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Macropolitical consensus and lateral autonomy in industrial policy: the nuclear sector in Brazil and Argentina

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Despite a similar tradition of state intervention in both Argentina and Brazil, in defining their nuclear industries, Argentina emphasized the role of its national private firms, while Brazil created state enterprises and imported foreign equipment at the expense of its national private firms. This contrasting division of labor among state, private, and foreign firms is particularly puzzling for several reasons. First, Argentina's history of state intervention and ownership was at least as extensive as Brazil's. Moreover, Argentina was less endowed than was Brazil in the capital goods sector relevant to nuclear power plant supplies. Furthermore, and perhaps consequently, industrial entrepreneurs in that sector were far more organized, cohesive, and politically stronger in Brazil than they were in Argentina.

In light of this contrast in industrial structures between the two countries, that Argentina emphasized private firms while Brazil emphasized state involvement would seem to be counterintuitive, since states generally are assumed to cooperate with, rather than displace, private firms where those firms are integrated and politically unified (as in Brazil). Conversely, direct state intervention (as an entrepreneur) is more likely where markets are more fragmented, divided, and unorganized.[1] Even so, Argentina promoted and protected national private firms in a relatively smaller, fragmented, and less sophisticated industrial sector. Such emphasis is even more intriguing if one considers the (relative) position of Brazil as an emerging economic giant in the 1970s. Its overall power—relative to a declining Argentina—and well-developed

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

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capital goods industry would have predicted greater domestic private participation, had state power and national endowments mattered.

Argentina and Brazil provide us with an almost perfect set for a most-similar-systems design.[2] Both are latecomer, middle-income, industrializing capitalist states with comparable levels of economic development; state intervention; technoscientific competence; per capita gross domestic product (GDP); sectoral contributions to GDP; reliance on external sources of technology, capital, and equipment; and proneness to authoritarian rule through military intervention. Moreover, the international context provided both countries with similar political, financial, and commercial constraints and opportunities. Nonetheless, their nuclear programs differed in their emphasis on national private industrial and technological participation.[3] Differences in levels of energy sufficiency per se do not explain their respective choices. Neither program followed a clear economic rationale given the availability of less expensive alternative sources of energy. The attempt here is therefore to analyze the choices of industrial structure and technology and not to address the question of why nuclear programs were sought in the first place.

Beyond the contrasts between Argentina and Brazil, efforts by any industrializing state to develop private entrepreneurship in the nuclear arena would seem, in themselves, anomalous. Extensive state intervention and ownership has been the norm throughout Latin America, particularly in energy markets and at the high-tech end of the sector. In fact, state entrepreneurship in nuclear industries has been common even in the industrial world because of (1) the long lead times between technological choice and plant completion, (2) the massive capital investments required, (3) the long-term realization of returns, (4) the high levels of commercial and technical risk, and (5) the perception of nuclear energy's centrality to industrial growth.[4] From this perspective, therefore, an industrializing state's support for private ownership in the nuclear sector is a least likely event—and one suitable for a critical case study.[5]

I find the reasons why certain sectoral arrangements and not others emerge

2. Adam Przeworski and Henry Teune, *The Logic of Comparative Social Inquiry* (Malabar, Fla.: Krieger, 1970).

3. For an elaboration on differences in domestic research and development (R&D) efforts, see Etel Solingen, "Bargaining in Technology," Department of Politics and Society, School of Social Sciences, University of California, Irvine, 1992.

4. Patterns range from active inducement of private firms in India, South Korea, Spain, and the United States, and market-conforming behavior in the United Kingdom and West Germany, to an arguably displacing role in Canada, France, and Italy. See Lawrence Scheinman, "Security and a Transnational System: The Case of Nuclear Energy," in Robert O. Keohane and Joseph S. Nye, eds., *Transnational Relations and World Politics* (Cambridge, Mass.: Harvard University Press, 1972), pp. 276–300; Herbert Kitschelt, "Structures and Sequences of Nuclear Energy Policy-making: Suggestions for a Comparative Perspective," *Political Power and Social Theory* 3 (1982), pp. 271–308; and John L. Campbell, *Collapse of an Industry: Nuclear Power and the Contradictions of U.S. Policy* (Ithaca, N.Y.: Cornell University Press, 1988).

5. On critical case studies, see Harry Eckstein, "Case Study and Theory in Political Science," in Fred Greenstein and Nelson Polsby, eds., *Handbook of Political Science,* vol. 7 (Reading, Mass.: Addison-Wesley, 1975), pp. 79–138.

to be rooted in domestic structural and institutional differences. In particular, I argue that varying degrees of macropolitical consensus on the one hand and of sectoral agency autonomy on the other can help explain differences in industrial policy. Thus, high levels of macropolitical consensus where the sectoral agency lacks autonomy lead to sectoral policies that resemble broad industrial patterns. In Brazil, the regime's more or less consensual hierarchy of goals and means together with a segmented decision-making mechanism constrained the range of options in such a way that nuclear policy followed the core parameters of Brazil's industrial "model": export-led rapid growth and macroeconomic stability. State entrepreneurship and foreign technology had increasingly become the means toward that end, leaving less room for national private industrial and technological resources.

Conversely, low levels of macropolitical consensus can turn a sectoral agency with significant autonomy into the most critical research arena for understanding industrial policy. Such was the case in Argentina, where the tripartite division of the state among the armed services strengthened the autonomy of each in its respective industrial sphere of influence, allowing the institutional preferences of the navy's atomic energy commission to prevail. These preferences led to the commission's special emphasis on domestic private entrepreneurial and technical resources.

The study presented here attempts to contribute to the literature in several ways. First, it seeks to examine the role of the state in industrial policy. In addition, the framework I suggest here has important implications for understanding technological development. Choices about industrial structure can define technological options as well. This relationship is evident from Brazil's selection of light water reactors fueled by enriched uranium and Argentina's preference for heavy water cycles fueled by natural uranium. Technology is at the heart of industrial development and has been regarded as a major bottleneck in the economic evolution of industrializing countries. Shedding light on how choices about technology come about, therefore, is particularly important, since it reverses the classical focus in economics on technological choice as an independent variable. The findings highlight ways in which domestic macropolitical consensus and sectoral autonomy may help explain bargaining positions and outcomes and in so doing are also relevant to a major debate in the international political economy literature on the nature of bargaining between technology recipients and multinational corporations: Is the international market inherently predatory, particularly in high-technology sectors, or does it provide a range of opportunities for newly industrializing countries (NICs) to play off competitors to their advantage? What determines the recipient's bargaining position, or "win-sets" (all possible international agreements that would be acceptable to the relevant domestic constituents)?[6]

6. Robert D. Putnam, "Diplomacy and Domestic Politics: The Logic of Two-level Games," *International Organization* 42 (Summer 1988), pp. 427–60.

The article advances the following propositions:

(1) Neither the level of private sector endowments nor the political strength of industrial entrepreneurs accounts for the different choices of nuclear sector structures.

(2) Although external constraints (international political, market, and financial factors) provide an important backdrop against which domestic choices are made, they do not necessarily determine those choices.

(3) Knowledge about levels of macropolitical consensus and sectoral autonomy helps anticipate the explanatory relevance of broad industrial models, sectoral institutions, or bureaucratic politics as critical research arenas.

(4) The degree of macropolitical consensus has important consequences for the operation of state bureaucracies and for industrial policy: high consensus tends to constrain the range of options under their consideration, whereas low consensus enables agencies to pursue their own "local rationality."

(5) Where both consensus and an agency's autonomy are low, explanations based on bureaucratic politics may be particularly useful.

(6) Where consensus is high and autonomy low, sectoral policy is more likely to resemble the "generic" industrial model.

(7) This will also be the case where both consensus and autonomy are high, provided there is a "happy convergence" between the model and the agency's preferences.

(8) Where consensus is low and autonomy high, an analysis of the sectoral agencies' institutional interests and trajectory will be most useful.

(9) A state with lower levels of macropolitical consensus over industrial policy may be able to extract greater concessions from foreign suppliers than one with a more coherent industrial strategy.

Nuclear choices: comparative responses

The argument I advance in this article is relevant to Brazil's large-scale 1974 agreement to acquire complete fuel cycle technology and eight pressurized water reactors from the West German firm Kraftwerk Union (KWU), a subsidiary of Siemens. Only the first two of these KWU reactors are under construction (Angra 2 and 3). Brazil had acquired its first plant (Angra 1) from Westinghouse in 1971 as a turnkey transfer and without setting up a nuclear industrial infrastructure. Argentina's efforts in that direction began in the early 1960s with fuel cycle activities. It acquired its first power plant (Atucha 1) in 1968 from Siemens. Atomic Energy of Canada supplied Argentina's second plant in 1973 (Embalse) and KWU, its third (Atucha 2) in 1979 (see Figure 1).

The role of private national firms in a given sector can be measured relative to the role of state and foreign firms in that sector. Figure 1 compares the respective participation shares of domestic private, of state, and of foreign firms in the first three power plants in Argentina and Brazil. Participation is

Type of Inputs	Plant 1						Plant 2						Plant 3					
	Brazil Angra 1			Argentina Atucha 1			Brazil Angra 2/3			Argentina Embalse			Brazil Iguape			Argentina Atucha 2		
	P	S	F	P	S	F	P	S	F	P	S	F	P	S	F	P	S	F
Electromechanical equipment	<2	—	98	13	—	87	27	—	73	40	—	60	28	20	52	50	—	50
Engineering supplies	<2	—	98	<2	—	98	10	30	60	35	10	55	30	30	40	30	60	10
National participation as a percentage of toal direct costs	8		92	38		62	47		60	60		40	60		40	70		30

FIGURE 1. *Share of supplies for the first three nuclear reactors in Brazil and Argentina by private, state, and foreign firms, in percentages*

Notes. P = private domestic firms; S = state firms; F = foreign firms. In Brazil's plant 1 a single firm accounted for more than 90 percent of total electromechanical equipment and engineering supplies.

Sources. Federal Senate of Brazil, *Relatório de Comissão Parlamentar de Inquérito do Senado Federal sobre o Acordo Nuclear do Brazil com a Republica Federal da Alemanha* (Transcript of the Parliamentary Investigating Committee of the Federal Senate Regarding the Nuclear Agreements Between Brazil and the Federal Republic of Germany, hereafter cited as *Relatório*), vol. 4 (Brasilia: Senado Federal, 1983), p. 81; Federal Senate of Brazil, *Relatório,* vol. 6, book 5 (Brasilia: Senado Federal, 1984), p. 324; Sara V. de Tanis and Jorge Kittl, *Twenty Years of Research and Development* (in Spanish) (Buenos Aires: National Atomic Energy Commission, 1976), p. 21; Sara V. de Tanis, *Development of Industrial Suppliers for Argentina's Nuclear Industry* (in Spanish) (Buenos Aires: National Atomic Energy Agency, 1985), pp. 15–16; Jorge Cosentino, "The 'Unbundling' Experience in the Argentine Nuclear Reactor and Power Plant Program" (in Spanish), presented at an international seminar on the unbundling of investment programs in the state sector in developing countries, Buenos Aires, November 1984; and *Clarin,* 15 April 1984, p. 14.

disaggregated into suppliers of electromechanical equipment and engineering services. These two categories account for about 70 and 8 percent, respectively, of the total cost of each power plant. For the first plant, there is a striking contrast between the contributions of Argentine private firms in electromechanical equipment (13 percent of total electromechanical supplies) and those of Brazil's (less than 2 percent). The pattern of greater participation by Argentine private producers in this area is maintained for the next two plants.

In the area of engineering services the respective contribution of private firms to the first plants was in each case barely perceptible. For the second plant, however, the contribution of Argentina's private engineering firms is

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TABLE 1. *Differences between Brazil's and Argentina's nuclear industries, 1964–86, by national private, state, and foreign participation in nuclear industrial activities*

Technology	*Brazil*			*Argentina*		
	Light water/enriched U[a]			*Heavy water/natural U*		
Nuclear industrial activity[b]	*Foreign*	*State*	*Private*	*Foreign*	*State*	*Private*
U exploration, mining, and yellowcake production	1) Joint venture: NUCLAM	1) Joint venture: NUCLAM 2) NUCLEBRÁS (NUCLEMON) 3) NUCLEBRÁS (Poços)	—	—	1) CNEA (Malargue)	1) Joint venture: Nuclear Mendoza[c] 2) Sanchez-Granel (Los Gigantes)
Conversion to UF_6 or UO_2	—	1) NUCLEBRÁS	—	—	1) CNEA	1) Nuclear Mendoza
U enrichment (Brazil) or heavy water production (Argentina)	1) Joint venture: NUCLEI–NUSTEP	1) Joint venture: NUCLEI–NUSTEP	—	—	1) CNEA (heavy water)	—
Fuel elements	—	1) NUCLEBRÁS (Resende)	—	—	1) Joint venture: CONUAR (fuel pellets) 2) Joint venture: FAE (Zircalloy tubes)	1) Joint venture: CONUAR (fuel pellets) 2) Joint venture: FAE (Zircalloy tubes)
Reactor engineering	1) Joint venture: NUCLEN	1) Joint venture: NUCLEN	—	1) Siemens 2) AEC 3) KWU	1) CNEA	1) Joint venture: INVAP
Heavy reactor components	1) Joint venture: NUCLEP	1) Joint venture: NUCLEP	—	1) Siemens 2) AEC 3) KWU	—	1) IMPSA

[a]Abbreviations and acronyms: AEC = Atomic Energy of Canada; CNEA = National Atomic Energy Commission; CONUAR = joint venture wherein the majority is owned by the private group Pérez Companc (PECOM) and the minority, by CNEA; IMPSA = Industrias Metalúrgicas Pescarmona; INVAP = Investigaciones Aplicadas—a joint venture with CNEA in the Rio Negro province; KWU = Kraftwerk Union; NUCLAM = NUCLEBRÁS Auxiliar de Mineração S.A.; NUCLEBRÁS = Empresas Nucleares Brasileiras S.A.; NUCLEI = NUCLEBRÁS Enriquecimento Isotópico S.A.; NUCLEMON = NUCLEBRÁS de Monazita e Associados; NUCLEN = NUCLEBRÁS Engenharia S.A.; NUCLEP = NUCLEBRÁS Equipamentos Pesados S.A.; NUSTEP = NUCLEBRÁS Steag Pesquisa; U = uranium; UF_6 = uranium hexafluoride; UO_2 = uranium dioxide.

[b]Does not include small-scale pilot plants.

[c]Nuclear Mendoza is a joint venture with CNEA in the Mendoza province.

over three times that of their Brazilian counterparts. In Brazil, the newly created state enterprise Empresas Nucleares Brasileiras S.A. (NUCLEBRÁS) provided the bulk of national engineering services. The contributions by private engineering firms to the third plant level off in each country. In the case of Brazil, the third plant project never went beyond the planning stage. In 1979, Argentina contracted for its third plant under changing political and institutional conditions (analyzed below; the changes explain, for instance, the creation of a joint state–foreign venture in reactor engineering).

Taking a more comprehensive look at the nuclear industry as a whole, Table 1 highlights Argentina's broad commitment to integrate national private firms into nuclear industrial activities. Private companies were engaged in uranium mining and yellowcake production and in the design and production of fuel elements and power plant equipment—including heavy reactor and instrumentation and control components.[7] There were no Brazilian private companies engaged in either fuel cycle activities or heavy components production. Instead, the state holding firm NUCLEBRÁS created joint ventures with foreign partners in most nuclear activities. The absence of domestic private sector participation can be easily detected in Table 1.

Our observations so far point to a consistently higher share of participation for Argentina's private firms when compared with Brazil's. The lower participation level of Brazil's private sector was offset by the expansion of state firms and the greater presence of foreign firms, as indicated in Figure 1. Looking at those differences in absolute terms, however, obscures a more profound contrast regarding the role of private national firms. A more valid measure of each country's commitment to maximize the role of private firms can be found by comparing the actual contribution shares (shown in Figure 1) with their respective available endowments—that is, against the capacity of private firms to supply components and services, regardless of cost considerations. We can thus gauge efforts to involve a maximum number of firms through the state's probing of extant capacity and its willingness to tolerate higher costs (relative to imported equivalents) and to absorb private investments in new machinery, training, and quality assurance. From this perspective, Argentina's commitment becomes even more pronounced.

Brazil's private electromechanical and engineering firms were far more internationally competitive in 1974 than were Argentina's in the early 1960s, when the latter's nuclear industry was designed. The custom-made capital goods sector supplying power equipment, in particular, enjoyed more modern production and research and development (R&D) facilities.[8] Between 1969

7. Most of these components are part of the nuclear system (as opposed to the conventional portions of a reactor) and require, therefore, more sophisticated capabilities.

8. See Instituto de Planejamento Economico e Social (IPEA), Engineering and Consulting in Brazil and in the Andean Group *Engenharia e Consultoria no Brasil e no Grupo Andino,* Serie Estudos para o Planejamento, no. 25 (Brasilia: IPEA 1984); Katherine Marton, *Multinationals, Technology, and Industrialization* (Lexington, Mass.: Lexington Books, 1986); Alain Rouquie, *The*

and 1975 Brazilian firms had invested substantially in training, new facilities, equipment, and quality control precisely to meet the potential demand from emerging sectors such as the nuclear program. By the early 1970s Brazil was the second largest producer of capital goods in the developing world (China was the largest) and by 1976 over ninety private Brazilian engineering firms were active internationally. A comprehensive probe of the sector found the industry mature enough to contribute about 54 percent of nuclear power plant inputs immediately and 70 percent soon after.[9] Private entrepreneurs claimed they could produce most components, except the primary circuit, and could meet about 90 percent of all the engineering needs.[10] Yet, despite the high potential for private sector participation, the firms were allocated only about 30 percent of electromechanical supply contracts and far lower percentages of engineering services. The nationalization of inputs for each consecutive nuclear plant was to be achieved mainly through the creation of state firms. NUCLEBRÁS Equipamentos Pesados S.A. (NUCLEP), which became the largest producer of heavy components for nuclear plants in the Third World and NUCLEBRÁS Engenharia S.A. (NUCLEN) were subsidiaries of NUCLEBRÁS, created in 1974. They were established as joint ventures with the foreign supplier KWU, displacing domestic private firms from markets NUCLEN and NUCLEP were able to service.

Argentina had a far more modest sectoral capacity (mostly of small and medium-sized firms).[11] Despite this, Argentina demanded its private firms contribute the greatest share of domestic inputs they could bear, and the state absorbed price differentials (relative to imported counterparts) as well as training and R&D costs. Domestic inputs were at times twice as expensive as

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Military and the State in Latin America (Berkeley: University of California Press, 1987), p. 291; Luiz Pinguelli Rosa, ed., *Technological and Economic Impacts of the Brazilian Nuclear Program* (Rio de Janeiro: COPPE/UFRJ [Coordenação dos Programas de Pos-Graduação de Engenharia da Universidade Federal do Rio de Janeiro], 1984); and Jorge M. Katz, "Domestic Technological Innovations and Dynamic Comparative Advantages: Further Reflections on a Comparative Case-Study Program," in Nathan Rosenberg and Claudio Frischtak, eds., *International Technology Transfer: Concepts, Measures, and Comparisons* (New York: Praeger, 1985), pp. 127–65.

9. The study was performed by Bechtel in 1973 for the Brazilian Nuclear Technology Corporation, a predecessor of NUCLEBRÁS. See Federal Senate of Brazil, *Relatório de Comissão Parlamentar de Inquérito do Senado Federal sobre o Acordo Nuclear do Brasil com a Republica Federal da Alemanha* (Transcript of the Parliamentary Investigating Committee of the Federal Senate Regarding the Nuclear Agreements Between Brazil and the Federal Republic of Germany, hereafter cited as *Relatório*), vol. 6, book 5 (Brasilia: Senado Federal, 1984), p. 210.

10. Only the steam generator, the reactor core, the reactor vessel, and the pressurizer could not have been produced by domestic private firms, according to a congressional deposition by industrialist Claudio Bardella in Federal Senate of Brazil, *Relatório,* vol. 6, book 5, p. 223. On capabilities in the engineering area see A. E. Muller, A. E. Gasparian, and H. J. Calvet Filho, "Aspects of Consolidation of Engineering Power Plants," manuscript, Montevideo, Uruguay, May 1980; and interview with a former director of NUCLEBRÁS Engineering (NUCLEN) in *O Estado de São Paulo,* 6/7/1985, and deposition by industrialist Ramon Villares in Federal Senate of Brazil, *Relatório,* vol. 6, book 5, p. 300.

11. Sara Tanis, *Desarrollo de Provedores para la Industria Nuclear Argentina* (Buenos Aires: Comisión Nacional de Energía Atómica, 1985).

their freight-on-board equivalents. Argentina's bid requests for power reactors required prospective suppliers to specify their projected level of "national content" as well as the sources and specifications of all reactor components. This disaggregated list was used to assess which components could be produced domestically. Several probes of three hundred to six hundred private industrial and engineering firms were conducted very early in the process specifically to evaluate their potential contributions to the nuclear program. Whereas Brazil expanded state entrepreneurship (NUCLEP and NUCLEN), Argentina worked to enable private firms to upgrade production facilities and design skills. Guided by the principle of "state subsidiarity," it intervened only when the private sector was unable to accomplish specific tasks. In fact, private firms were extremely reluctant to enter the nuclear market, and the National Atomic Energy Commission (CNEA) committed itself to reduce their "strategic uncertainty," i.e., it attempted to provide a more or less predictable environment in which firms could invest in new production lines.[12] These differences, however, should not obscure an overall strong state presence in both Argentine and Brazilian programs.

Differing choices of industrial structure involved differing technological paths as well. Brazil opted for light water/enriched uranium technology, which was readily available in the international market as the leading reactor type. Argentina, instead, adopted the less commercially and technically attractive heavy water/natural uranium technology. The argument developed in a later section of this article will explain the links between industrial strategy and technology choice.

Contending explanations

Why and when do states nurture and protect national private firms? Why and when do they displace them, either by stepping in directly as producers or by purchasing equipment from more competitive foreign firms? There are several competing interpretations of this variability in state intervention. It is clear from our introduction that "market failure" may explain state intervention in creating a nuclear industry as a whole but not differences in the extent, nature, or instruments of state entrepreneurship.[13]

A first possibility involves a simple microeconomic explanation, according to which the country with the more efficient set of private firms would display higher shares of participation by those firms. Conversely, the less competitive

12. On state subsidiarity in Latin America, see Alfred Stepan, *The State and Society: Peru in Comparative Perspective* (Princeton, N.J.: Princeton University Press, 1978); and Alain Rouquie, *Poder Militar y Sociedad Política en la Argentina—1943–1973* (Military Power and Political Society in Argentina—1943–1973) (Buenos Aires: Emece, 1982).

13. On market failure and public enterprises, see Harvey B. Feigenbaum, *The Politics of Public Enterprise: Oil and the French State* (Princeton, N.J.: Princeton University Press, 1985).

the private sector, the higher the likelihood that state or foreign firms would replace them. We know from the previous section that Brazilian firms were more competitive (and more actively seeking) to supply inputs for nuclear reactors than their Argentine counterparts. The independent probe by the Bechtel Corporation in 1973 confirmed the existence of a solid infrastructure in electromechanical equipment manufacturing and engineering services that would enable private firms to contribute up to 70 percent of inputs for the first (of the KWU) plants. Instead, Argentine firms were far less equipped, particularly ten years earlier, when the feasibility study for the first reactor was conducted. Despite a serious effort by the CNEA to engage private firms, the latter only were able to contribute about 13 percent of electromechanical supplies.[14] Clearly, the relative efficiency of the private sector in each country cannot account for the outcome. Efficiency would have predicted less state entrepreneurship and foreign supplies where national private firms were better endowed—that is, in Brazil. Instead, Brazil created public enterprises and the Argentine state played more of a subsidiary role.

International market considerations are often invoked in explaining state intervention and the resulting division of labor among state, foreign, and local private firms.[15] This second hypothesis—an extension of the previous one—traces distributional outcomes to the degree of vulnerability of national firms to international competitors. The lower the competitiveness of domestic firms, the higher the likelihood they will be displaced by their foreign counterparts. Thus, while domestic producers were arguably vulnerable to foreign competition in both countries, one would expect Argentina—the most vulnerable—to be saddled with a higher ratio of foreign supplies, an expectation challenged by the empirical outcomes examined earlier.

The external vulnerability of private local firms is also hypothesized to lead to the creation of public firms, either because the state cannot protect domestic producers or as a means to compete internationally or both. Accordingly, greater state entrepreneurship should have taken place in Argentina where, in fact, state subsidiarity in the nuclear sector was more common than in Brazil. This outcome questions the link between state ownership and external vulnerability. In fact, both Argentina and Brazil aimed to become major Third World exporters of nuclear technology and equipment, but Brazil relied at the outset primarily on newly created state–foreign joint ventures whereas Argentina promoted its private firms.[16]

14. CNEA approached the negotiations with foreign suppliers by providing a list of all local private firms capable of participating and insisted that each be included.

15. See Peter Evans, *Dependent Development: The Alliance of Multinational, State, and Local Capital in Brazil* (Princeton, N.J.: Princeton University Press, 1979); Samuels, *The Business of the Japanese State;* and Feigenbaum, *The Politics of Public Enterprise.*

16. On nuclear exports see Etel Solingen, "Technology, Countertrade, and Nuclear Exports," in W. C. Potter, ed., *International Nuclear Trade: The Challenge of the Emerging Suppliers* (Lexington, Mass.: Lexington Books, 1990), pp. 111–52.

A review of the international market for nuclear reactor technology and components challenges a more fundamental proposition about the predatory nature of international market forces and their threat to weaker producers in developing countries. In the late 1960s and early 1970s newcomers—particularly from Canada, France, and West Germany—began challenging U.S. firms, which had controlled 90 percent of the market a decade earlier. Excess capacity and the high financial stakes of each transaction in a globally shrinking market intensified competition among those firms.[17] Recipients, many of them NICs, were able to extract a maximum level of participation for their private domestic firms as a condition for granting contracts to foreign nuclear architect–engineering firms. In fact, recipients were even able to extort sweeteners in form of sensitive technologies (uranium enrichment and reprocessing) despite the attempt by supplier states to restrict their diffusion. Moreover, abundant foreign financing during those years offered recipient states an enhanced position to resist suppliers' credits, which often displaced local firms by tying financing to the purchase of equipment. In light of such permissive conditions from the point of view of the recipients, international market and financial forces—in themselves—fail to explain why Argentina exploited this latitude while Brazil did not. In fact, Brazil (a favorite of international financial institutions at the time) was less prone than Argentina to tie contracts to the participation of its private firms. Foreign financing did not have fixed effects and could have been used to expand either state entrepreneurship or private ownership. In other words, both countries responded differently to an array of similar international opportunities.

A third hypothesis to explain the variability in state intervention invokes the political strength of national private firms (measured by the thickness of access to policymakers and the ability to mobilize other political and economic forces) as likely to affect their share of supplies. Thus, the argument goes, the more politically robust the specific sector, the higher the probability that it will be protected from the expansion of state firms or foreign competitors. Robustness here is a function of how concentrated and organized, as opposed to diverging and divided, are the interests of the private firms. As Richard Samuels suggests, states are assumed to displace unorganized private firms more easily than a highly integrated sector.[18] Yet, the state holding company NUCLEBRÁS expanded in Brazil at the expense of a quite cohesive group of capital goods and engineering firms. Capital goods producers in Brazil were led by a small number of very large and tightly organized firms, which were highly dependent on state orders. Among the potential suppliers of the nuclear program were Brazil's largest industrial groups, such as Villares and Bardella. As major supporters of the military regime since its inception in 1964, the sector's

17. William Walker and M. Lonnroth, *Nuclear Power Struggles—Industrial Competition and Proliferation Control* (London: Allen & Unwin, 1983).

18. Samuels, *The Business of the Japanese State.*

political strength increased in tandem with its economic expansion, particularly since the early 1970s.[19] The association of custom-made equipment producers (ABDIB), which represented many of the firms with potential involvement in the nuclear program, was particularly strong. Conversely, in Argentina, the CNEA faced a much less unified and politically powerful group of firms. Those with potential links to the nuclear program were not very influential in the 1960s within the dominant, liberal-minded umbrella organization, the Union Industrial Argentina. The relative political strength of industrial firms, therefore, fails to explain why powerful Brazilian entrepreneurs got contracts for less than 50 percent of what they were able to supply while their feebler, at times nascent, Argentine counterparts were allocated the maximum possible share.

A fourth potential explanation for different distributions of state, national private, and foreign participation points to international power considerations. From that vantage point, an internationally more powerful state is arguably in a better position to protect its domestic interests. Structural power is often defined as an aggregate of political, military, and economic power, which determine a state's ability to influence others' policies.[20] Yet, had a state's international position been relevant, one would have expected Brazil to reflect higher levels of national content in its power reactors than Argentina. Had it chosen to do so, Brazil might have been in far better position to protect its private firms by virtue of their greater industrial strength and of the country's overall stronger bargaining position. The strength of Brazil's bargaining position can be deduced from three facts. First, the negotiations involved eight nuclear plants and related fuel cycle facilities. A "no agreement" outcome would have threatened the survival of the German supplier KWU because of the small, zero-sum market in the 1970s. Second, Brazil was West Germany's most important economic partner in the Third World. Third, Brazil had greater internal stability than Argentina.

Brazil was a rising economic power in the 1960s and 1970s, whereas Argentina's dramatic decline became the riddle of development theories. Brazil became the world's tenth largest industrial producer in the 1970s; its percentage of global gross national product (GNP) (1.6 percent) was more than double that of Argentina (0.6 percent), as was its share of regional (Latin

19. For an analysis of the sector's political power and access to state bureaucracies, see Evans, *Dependent Development;* and Fernando H. Cardoso, "On the Characterization of Authoritarian Regimes in Latin America," in David Collier, ed., *The New Authoritarianism in Latin America* (Princeton, N.J.: Princeton University Press, 1979), pp. 33–60.

20. If only the economic component is taken into account, state A is presumably more powerful than state B if A commands a greater share of global trade and credit than B and is less dependent than B on the global economy (as measured by the size of its external sector relative to gross national product). See Stephen D. Krasner, "State Power and the Structure of International Trade," *World Politics* 28 (April 1976), pp. 317–47. For an analysis of Brazil's and Argentina's structural power see David Mares, "Middle Powers Under Regional Hegemony: To Challenge or Acquiesce in Hegemonic Enforcement," *International Studies Quarterly* 32 (December 1988), pp. 453–72.

American) GNP (32 percent versus 26 percent).[21] Yet, as evident from Figure 1, the weaker of the two states secured higher levels of "indigenization" of inputs. Relative international power capabilities thus fail to predict overall levels of domestic participation and have little to say about the resulting mix of state and public entrepreneurship.

Finally, ideological considerations are at times advanced to explain different industrial choices despite similar international constraints and opportunities.[22] Argentina's choices, for instance, are traced often to a nationalist ideology that was geared to develop an autonomous nuclear capacity. Yet, Brazilian and Argentine "nucleocrats" fundamentally shared such an ideology but opted for different technical–industrial paths. Self-reliant nationalism was never the monopoly of Argentina's CNEA; it was deeply rooted among technocratic groups in other sectors, such as pharmaceuticals and aerospace. It was alive in Brazil's Nuclear Energy Commission as well. However, it did not lead to similar outcomes—distributions among foreign, national private, and state firms—across those sectors. Ideology in itself, therefore, can hardly explain differences between Argentina's and Brazil's nuclear industries or among Argentina's different industrial sectors, for that matter. As an explanation, ideology clearly is not sufficient and may not even be necessary.[23] Its fundamental weakness is that it can hardly predict outcomes by itself; at its best, it is always subsidiary to other explanations.[24]

21. Inter-American Development Bank, *"Economic and Social Progress in Latin America,"* (Washington, D.C.: Inter-American Development Bank, 1988). On the measurement of Argentine decline see William C. Smith, *Authoritarianism and the Crisis of the Argentine Political Economy* (Stanford, Calif.: Stanford University Press, 1989).

22. For two applications of this brand of theory to industrial policy in Argentina and Brazil see Emanuel Adler, *The Power of Ideology: The Quest for Technological Autonomy in Argentina and Brazil* (Berkeley: University of California Press, 1987); and Kathryn Sikkink, *Ideas and Institutions—Developmentalism in Brazil and Argentina* (Ithaca, N.Y.: Cornell University Press, 1991). Adler focuses mainly on informatics and traces outcomes (policy regarding foreign investment) to the ideology of self-reliance of technocrats. For a more moderate understanding of the independent power of ideas on political outcomes (studies that internalize the domestic and international context in which ideas can make a difference), see John S. Odell, *U.S. International Monetary Policy—Markets, Power, and Ideas as Sources of Change* (Princeton, N.J.: Princeton University Press, 1982); John Gerard Ruggie, "International Regimes, Transactions, and Change: Embedded Liberalism in the Postwar Economic Order," *International Organization* 36 (Spring 1982), pp. 379–415; Feigenbaum, *The Politics of Public Enterprise;* and Sikkink, *Ideas and Institutions.*

23. In his analysis of informatics in Brazil, Evans points out that the power of the technocrats—who shared a certain nationalistic ideology—should not be exaggerated, and that the governing agency's policies "were shaped by more than its personnel." See Peter B. Evans, "State, Capital, and the Transformation of Dependence: The Brazilian Computer Case," *World Development* 14 (1986), pp. 791–808.

24. On the utility and limitations of cognitive approaches, see Odell, *U.S. International Monetary Policy*; Peter A. Hall, ed., *The Political Power of Economic Ideas: Keynesianism Across Nations* (Princeton, N.J.: Princeton University Press, 1989); and, in particular, the following two chapters: Margaret Weir, "Ideas and Politics: The Acceptance of Keynesianism in Britain and the United States," pp. 53–86; and Peter A. Gourevitch, "Keynesian Politics: The Political Sources of Economic Policy," pp. 87–106.

The argument I develop in the next section thus focuses on variations in domestic structures and institutions. On the one hand, identifying the relevant structures, policy networks, or constellations of power is a necessary first cut.[25] On the other hand, an institutional outlook helps single out the locus and characteristics of the decision-making arena and its guiding preferences.[26] What structures of opportunity—given varying degrees of macropolitical consensus—may a sectoral agency seize in defining industrial policy? Why, when, and how does a sectoral institution become a central research arena, and what difference does it make?

Macropolitical consensus and lateral autonomy

In this section I argue that varying degrees of macropolitical consensus on the one hand, and of autonomy of the sectoral agency on the other, can explain industrial policy. Macropolitical goals are those at the apex of the state's hierarchy of goals and means.[27] They need to be defined more explicitly than simply the pursuit of economic growth or national security, which suggests that general means are often embedded in the definition of such goals. Thus, they may involve the pursuit of export-led growth, or of macroeconomic stability, or of a more egalitarian income distribution, or the strengthening of local private capital. Such goals can be deduced from an analysis of policy options most likely to lengthen the regime's longevity. They can also be identified through a review of declaratory policy and informal statements by the ruling coalition and its supportive networks. There are methodological trade-offs between those two independent measures; where they collude, our certainty about the nature of macropolitical objectives grows.

25. In that sense, this study comes close to Grieco's analysis of informatics in India and its emphasis on institutional interests, state autonomy, and state–private sector competition; to Haggard's comprehensive comparison of the politics of growth among NICs; and to Kitschelt's explanation of state intervention in nuclear industries in industrialized countries. See Joseph M. Grieco, *Between Dependency and Autonomy—India's Experience with the International Computer Industry* (Los Angeles: University of California Press, 1984); Stephan Haggard, *Pathways from the Periphery—The Politics of Growth in the Newly Industrializing Countries* (Ithaca, N.Y.: Cornell University Press, 1990); and Kitschelt, "Structures and Sequences of Nuclear Energy Policy-making."

26. Krasner highlights the influence of institutions and procedures on policy outcomes. Ikenberry, Lake, and Mastanduno emphasize the influence of organizational features of the state—which are relatively resilient against the idiosyncratic actions of groups and individuals—on state preferences. See Stephen D. Krasner, *Defending the National Interest: Raw Materials Investments and U.S. Foreign Policy* (Princeton, N.J.: Princeton University Press, 1978); and G. John Ikenberry, David A. Lake, and Michael Mastanduno, eds., *The State and American Foreign Economic Policy* (Ithaca, N.Y.: Cornell University Press, 1988).

27. See Michael Barzelay, *The Politicized Market Economy* (Berkeley: University of California Press, 1986); and Herbert A. Simon, *Administrative Behavior* (New York: Free Press, 1976). On the hierarchy and identification of goals and means (objectives and instruments), see Peter J. Katzenstein, "Conclusion: Domestic Structures and Strategies of Foreign Economic Policies," in Peter Katzenstein, ed., *Between Power and Plenty* (Madison: University of Wisconsin Press, 1978), pp. 295–336.

Macropolitical consensus is the expression of widely shared preferences over macropolitical goals among major political actors.[28] Such consensus grows when a dominant coalition with homogeneous converging interests monopolizes political power. The consensus may include private actors even when they are not central to the policy process. Levels of consensus can be assessed by identifying the most critical components of the coalition, i.e., those whose core macropolitical goals converge and without which no coalition would be possible. The likelihood of a stronger macropolitical consensus grows where all or most critical components—those with veto power—are "inside the tent."[29] This is the equivalent of a "historic bloc," which, by including all critical components, may be better able to formulate a more cohesive, stable, *raison d'état.*[30] It is possible but not inevitable that the sequential inclusion of additional coalition members may add up to a weakening consensus, particularly if the homogeneity regarding objectives is diluted; the larger the numbers, the higher the probability that new objectives and demands will be added. In other words, there may be a trade-off between the extensiveness and the intensity of the consensus.[31] Finally, the longevity of a coalition—the length of the expressed a priori willingness of members to support its policies—can be a measure of consensus. Very often, continuous shifts in membership in the coalition, resulting cabinet changes, and an unstable course are symptoms of a very fragile consensus. Longevity of commitment, however, is not always easy to identify and is neither a necessary nor a sufficient condition for a strong consensus to exist. Above all, consensus is always a matter of degree and can be best identified relative to other states or historical situations.[32]

Examples of high macropolitical consensus of varying contents include Germany and Japan, particularly in the first decades of the postwar era. The critical components of the Japanese coalition were (1) the industrial *keiretsu* barons represented in the Liberal Democratic party and (2) the state bureaucracy. The exclusion of portions of the small business community and organized labor strengthened the coalition's consensus. The content of that consensus was high rates of economic growth through the promotion of exports, state intervention, sectoral policy, and the regulation of imports. The South East Asian NICs revealed a similar basis of consensus until very recently.

28. "Preferences" articulate primarily material, but also ideal, interests. See Peter A. Gourevitch, "Keynesian Politics: The Political Sources of Economic Policy," in Hall, *The Political Power of Economic Ideas,* pp. 87–106.

29. I thank John Odell for clarifying my thinking on this point.

30. On "historic blocs," see Robert W. Cox, *Productions, Power, and World Order—Social Forces in the Making of History* (New York: Columbia University Press, 1987).

31. On extensiveness and intensity of political divisions, see Harry Eckstein, *Division and Cohesion in Democracy: A Study of Norway* (Princeton, N.J.: Princeton University Press, 1966).

32. See, for instance, Katzenstein's comparison among Britain, France, Japan, the United States, and West Germany in Katzenstein, "Conclusion." For an analysis of the coherence of macropolitical goals in France over time, see Helen Milner, "Resisting the Protectionist Temptation: Industry and the Making of Trade Policy in France and the United States During the 1970s," *International Organization* 41 (Autumn 1987), pp. 639–65.

There was also high consensus—albeit of a different nature—in both India and Israel following each's independence, which lasted until the late 1970s, and in Chile during the 1980s.[33]

Particularly low levels of consensus have characterized postwar Argentina (discussed in the following section), the pre–World War II Weimar Republic, and, perhaps, the United States in the post-Reagan era. The much discussed "decline of American hegemony" fueled a debate over the need, and the appropriate formula for, an industrial strategy.[34] The lack of programmatic consensus in the country contributed to the launching of Ross Perot's campaign for the U.S. presidency this past year. Another example of a state with low political consensus since the late 1970s and until very recently is Israel. There, the areas of contention have been industrial policy and territorial compromise in the West Bank and Gaza. Exploring the sources of macropolitical consensus goes beyond the objectives of this article, although the cases mentioned above suggest several possibilities. In different contexts, and occasionally in coexistence, external security threats, a benign form of hegemony-cum-protection, high levels of state autonomy, and the prospects for a relatively egalitarian income distribution all seem to strengthen consensus.[35]

The degree of macropolitical consensus has important consequences for the operation of state bureaucracies. On the one hand, where macropolitical goals are contradictory, interagency bargaining increases and bureaucracies become "balkanized."[36] Low consensus may lead to balkanization by straining the

33. On Japan, see Katzenstein, *Between Power and Plenty;* Michael Borrus and John Zysman, "Japan," in F. W. Rushing and C. G. Brown, eds., *National Policies for Developing High Technology Industries: International Comparisons* (Boulder, Colo.: Westview Press, 1986), pp. 111–42; Daniel I. Okimoto, *Between MITI and the Market: Japanese Industrial Policy for High Technology* (Stanford, Calif.: Stanford University Press, 1989); and Ellis S. Krauss, "Political Economy: Policymaking and Industrial Policy in Japan," *Political Science and Politics* 25 (March 1992), pp. 44–56. On the postwar consensus in Germany—low acceptance of inflation, tight money, fiscal frugality—see Raymond Vernon and Debora Spar, *Beyond Globalism—Remaking American Foreign Economic Policy* (New York: Free Press, 1989). On India's consensus and deviations from it, see Dennis Encarnation, *Dislodging Multinationals: India's Strategy in Comparative Perspective* (Ithaca, N.Y.: Cornell University Press, 1989).

34. A sample of this debate includes John Zysman and Laura Tyson, eds., *American Industry in International Competition* (Ithaca, N.Y.: Cornell University Press, 1983); Joseph S. Nye, Jr., *Bound to Lead: The Changing Nature of American Power* (New York: Basic Books, 1990); Richard Rosecrance, *America's Economic Resurgence—A Bold New Strategy* (New York: Harper and Row, 1990); and Henry R. Nau, *The Myth of America's Decline—Leading the World Economy into the 1990s* (New York: Oxford University Press, 1990).

35. Fishlow establishes connections among national security, state autonomy, and the coherent industrial project of East Asian countries. See Albert Fishlow, "Latin American Failure Against the Backdrop of Asian Success," *Annals of the American Academy of Political and Social Science* 505 (September 1989), pp. 117–28. Rueschemeyer and Evans argue that effective state intervention may initially grow out of coherent bureaucracies that are relatively autonomous from dominant social interests. See Peter Evans, "Transnational Linkages and the Economic Role of the State: An Analysis of Developing and Industrialized Nations in the Post–World War II Period," in Peter Evans, Dietrich Rueschemeyer, and Theda Skocpol, eds., *Bringing the State Back In* (Cambridge: Cambridge University Press, 1985).

36. On conflictive objectives and bureaucratic bargaining, see Barzelay, *The Politicized Market Economy;* and Jonathan Bendor and T. H. Hammond, "Rethinking Allison's Models," *American Political Science Review* 86 (Winter 1992), pp. 301–22.

internal "hegemony" of core institutions (such as a state's finance ministry) within the state apparatus. This hegemony acts as a "transmission belt" by projecting the content of consensus onto—and throughout—state agencies.[37] The strategic position of the British Treasury within the bureaucracy in the 1930s is an example of such hegemony as is the case of the Ministry of International Trade and Industry (MITI) in Japan and of the French Commissariat du Plan during the early postwar era.[38] In each case a decline in macropolitical consensus led to decreasing central influence and greater balkanization. In other words, low consensus may reduce the ability of central agencies to influence the parameters of sectoral decision making. Consequently, in light of weakened central guidelines, the latitude of sectoral agencies to pursue a wider range of policy options grows to include all logical possibilities—technical and economic—regarding foreign and domestic inputs, public and private procurement, subcontracting, R&D activities, and financing arrangements. In sum, ambiguity in macropolitical goals is likely to expand the range of permissible options in sectoral industrial policy.

On the other hand, where there are high levels of macropolitical consensus, such consensus is often expressed through a bureaucratic machinery with a more or less homogeneous outlook—an "embedded orientation" in Douglas Bennett and Kenneth Sharpe's terms—over industrial policy.[39] Bureaucratic guidelines thus tend to be more coherent, as in the early postwar years in Japan, and the range of options is more limited. This trimming of the edges in the repertoire of options may preclude an agency from embracing a policy it might have preferred in light of its own "local rationality."[40] If a nuclear agency's local rationality, for instance, compels it to strengthen a domestic constituency likely to support the program's continuity and expansion, it may pursue an indigenous technical capability and resist foreign equipment. Agencies will be more likely to bend their preferences and yield to central priorities when the latter are highly consensual, because the agencies' authority can be challenged more effectively under such conditions.[41] Coherence in bureaucratic guidelines does not imply absence of goal conflict, which is

37. The principle that "goal ambiguity" reduces central influence comes from organization theory. See R. M. Cyert and J. G. March, *A Behavioral Theory of the Firm* (Englewood Cliffs, N.J.: Prentice Hall, 1963); and Anthony Downs, *Inside Bureaucracy* (Boston: Little, Brown, 1967).

38. On how strong central agencies increase the coherence of sector-specific policies, also see Katzenstein, *Between Power and Plenty.* On the origins of hegemonic finance ministries as key loci of adjustment of domestic and international policy, see Robert Cox, "Social Forces, States, and World Orders," in Robert O. Keohane, ed., *Neorealism and Its Critics* (New York: Columbia University Press, 1986), pp. 204–54. On the British Treasury, see Margaret Weir, "Ideas and Politics," in Hall, *The Political Power of Economic Ideas,* pp. 53–86. On the limits of MITI's hegemony and the growing bureaucratic segmentation in Japan, see Kent Calder, "Japanese Foreign Economic Policy Formation: Explaining the Reactive State," *World Politics* 40 (July 1988), pp. 517–41.

39. Douglas C. Bennett and Kenneth E. Sharpe, "Agenda Setting and Bargaining Power: The Mexican State Versus Transnational Automobile Corporation," *World Politics* 32 (October 1979), pp. 57–88.

40. Graham T. Allison, *Essence of Decision—Explaining the Cuban Missile Crisis* (Boston: Little, Brown, 1971) p. 76.

41. Barzelay, *The Politicized Market Economy.*

inherent to any organization, including the state. Yet the presence of more or less consensual macropolitical goals may impose a series of overarching choice constraints on state agencies. A commitment to export-led growth may be just such a constraint and could preclude the inclusion of national private firms if the inclusion weakens such commitment. We can thus summarize the consequences of degrees of macropolitical consensus for the operation of state agencies by postulating that high consensus tends to constrain whereas low consensus enables.

The ability of a sectoral agency—such as Brazil's NUCLEBRÁS or Argentina's CNEA—to take advantage of a broadened repertoire of options depends on its degree of autonomy, both vertical and lateral. Bureaucratic autonomy has generally been defined as "relative undisputed jurisdiction" over a function or a service.[42] At the high end of the spectrum, such agencies are endowed with "quasi-sovereign" powers.[43] An agency with higher levels of *lateral autonomy* has greater capacity to define and carry out policy independent of the interference of other units. The more an agency can monopolize most aspects of a program—including planning, financing, technology transfer negotiations, training, fiscal incentives, and safety regulations—the higher its lateral autonomy. That is, autonomy grows as other agencies are effectively precluded—by formal procedure or by political arrangements—from influencing policy choice. Lateral autonomy can shield a unit from bureaucratic crosscutting pressures from other state agencies; it is thus a relational property of a state unit with respect to others and should not be confused with state autonomy as a whole.[44] The logical opposite of lateral autonomy is lateral segmentation, where a number of agencies, ministries, and state firms have overlapping jurisdictions over either the definition of a certain policy or its implementation.[45] The greater the number of agencies involved, the higher the segmentation.

Examples of agencies with lateral autonomy include the U.S. Federal Reserve Board, the German Bundesbank, the U.S. Energy Research and Development Administration (ERDA), and many but not all state atomic energy commissions. Dennis Encarnation and Louis Wells identify laterally autonomous agencies in Third World industries including oil exploration, petrochemicals, and computers.[46] Levels of lateral autonomy, of course, can

42. James Q. Wilson, *Bureaucracy—What Government Agencies Do and Why They Do It* (New York: Basic Books, 1989).

43. Gordon Tullock, *The Politics of Bureaucracy* (Washington, D.C.: Public Affairs Press, 1965).

44. Schwartzman's study of computers in Brazil, for instance, refers to "bureaucratic insulation" as autonomy from both state and outside clientelistic pressures. See Simon Schwartzman, "High Technology Versus Self-reliance: Brazil Enters the Computer Age," in Julian M. Chacel, P. S. Falk, and D. Fleischer, eds., *Brazil's Economic and Political Future* (Boulder, Colo.: Westview Press, 1988).

45. Barzelay, uses the term "segmentation" to identify a decision-making arena wherein authority over the same political product is diffused among numerous collegial state agencies (see Barzelay, *The Politicized Market Economy*). The literal opposite of autonomy is "heteronomy" (subordination); however, perhaps the best logical opposite of the term in this context would by "synonomy" (together with)—a nonexistent word. I forgo the temptation to use that term and adopt the less specific, but more widely used, concept of segmentation.

46. Dennis J. Encarnation and Louis T. Wells, Jr., "Sovereignty En Garde: Negotiating with Foreign Investors," *International Organization* 39 (Winter 1985), pp. 47–78.

vary over time. The origins of lateral autonomy may have something to do with how and whether autonomy is maintained. Budgetary independence can strengthen autonomy, as in the case of some U.S. agencies that rely on user fees or earmarked taxes, or programs over which Congress has less discretion over funding levels. The Federal Reserve Bank has an entirely independent funding source not subject to the standard congressional appropriation process. Budgetary independence also can be achieved outside of formal procedures, as when the U.S. National Security Council sought external funding for the agency's autonomous operations under the guidance of Lt. Colonel Oliver North. National security has been a well-known source of lateral autonomy in the postwar era in many countries.

More generally, the lateral autonomy of certain agencies can be traced to historical political compromises and is not always formally enshrined. For instance, certain Israeli ministries and agencies have gained lateral autonomy as a result of the country's electoral system. Proportional representation, and the fact that no single party in forty-four years has been able to get the required majority to govern on its own, has left small fringe (religious) parties with the power to extort such autonomy for the agencies they control. Attempts by the legislature (the Knesset) to obtain proper information regarding budgetary allocations and procedures relative to those agencies have not borne fruit. Other, quite peculiar historical political compromises explain the growing lateral autonomy of military industries and arms exports in China.[47] In Argentina, three highly antagonistic armed services have partitioned the state and its associated industrial sectors among themselves since 1955. In that process economic institutions controlled by the Argentine army, air force, and navy all gained high levels of lateral autonomy. The phenomenon of lateral autonomy is more widespread than one might suspect, and the conditions under which it makes a difference need to be specified.

The degree of an agency's *vertical autonomy* can be measured by the extent of its formal or informal accountability to the top executive. Where the executive has limited jurisdiction over or is expected to rubber-stamp the agency's preferences, the agency's vertical autonomy grows. Rubber-stamping is often a function of the technical complexity of the agency's portfolio or of a practical political compromise that precludes the executive from seriously challenging the agency's prerogatives. These limits on the agency's vertical accountability operate in many of the cases of lateral autonomy discussed above. It is possible that the conditions leading to lateral autonomy tend to tame effective control by the top executive.[48] The logical opposite of an agency's vertical autonomy is vertical centralization, where decision making is effectively concentrated at the

47. On China, see John W. Lewis, H. Di, and X. Litai, "Beijing's Defense Establishment: Solving the Arms-Export Enigma," *International Security* 15 (Spring 1991), pp. 87–109. On Israel, see *Ma'ariv*, 28 June 1992.

48. See William A. Niskanen, Jr., *Bureaucracy and Representative Government* (Chicago: Aldine-Atherton, 1971), p. 196, for a discussion of how U.S. agencies holding monopolies on the supply of certain public services have weakened executive control over those programs.

top executive level.[49] In sum, a highly autonomous agency enjoys horizontal control over policy and its implementation and is largely unencumbered by a superior authority. Such was the case with the Argentine nuclear agency CNEA, which was unhampered by the agendas of energy or economic bureaus and was formally accountable only to the nation's President. In practice, CNEA had ultimate power over most decisions and over implementation.[50] Contrarily, Brazil's nuclear decisions were taken and implemented in both a vertically centralized context by the top executive and a horizontally segmented one, in which the nuclear agency had little autonomy.

It is possible that low macropolitical consensus and a high incidence of lateral autonomy among state agencies are mutually reinforcing. However, low consensus does not always imply—although it sometimes enables—autonomous units; such units may also exist in arenas of highly consensual macropolitical goals. Similarly, when high consensus permeates state agencies it may be easier to relax vertical centralization. Yet agencies can maintain their vertical autonomy under low macropolitical consensus as well. In other words, macropolitical consensus is neither a necessary nor a sufficient condition for either lateral or vertical autonomy. Both autonomies can be rooted instead in enduring institutional characteristics of the state, which are not easily assailed by cycles of higher or lower macropolitical consensus.

An agency's lateral autonomy has particularly important implications for policy outcomes. Lateral autonomy neutralizes classical bureaucratic politics and allows the agency's idiosyncratic interests—such as preference for market solutions or state subsidiarity—to flourish. Segmentation, instead, imposes checks and balances and prevents the dominance of particularistic orientations; in other words, it thwarts preferences that may deviate from the accepted boundaries of industrial policy. High segmentation may be to industrial policy what "polycratic chaos" (rivaling ministries and incoherent allocation of resources) can be to the formulation of "grand strategy."[51]

We are now in a position to assess the research implications of different mixes of macropolitical consensus and lateral autonomy (see Figure 2,

49. See Katzenstein, *Between Power and Plenty;* John Zysman, "The French State in the International Economy," in Katzenstein, *Between Power and Plenty,* pp. 255–94; Samuels, *The Business of the Japanese State;* Campbell, *Collapse of an Industry;* and Ikenberry, Lake, and Mastanduno, *The State and American Foreign Economic Policy.*

50. On CNEA's control over the nuclear program and the inability of other agencies, including the Foreign Ministry, to influence nuclear policy, see *La Prensa,* 22 March 1984, p. 7.

51. Paul Kennedy, *The Rise and Fall of the Great Powers* (New York: Random House, 1987), p. 350. Calder, in "Japanese Foreign Economic Policy Foundation," discusses the impact of overlapping bureaucratic jurisdictions on Japan's foreign policy in high-tech areas, which he characterizes as erratic and reactive. On the centrifugal tendencies of state agencies, see Joel Migdal, *Strong Societies and Weak States* (Princeton, N.J.: Princeton University Press, 1988). The idiosyncratic characteristics of an agency relate to what Halperin labels "organizational essence"; see Morton Halperin, *Bureaucratic Politics and Foreign Policy* (Washington, D.C.: Brookings Institution, 1974). On the consequences of a highly segmented policy process in the French oil sector, see Feigenbaum, *The Politics of Public Enterprise.*

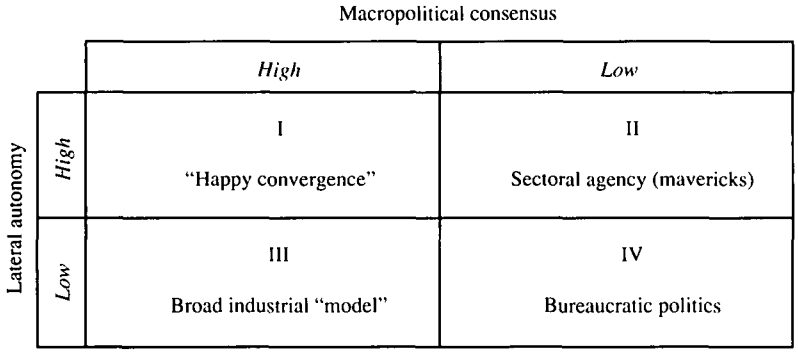

FIGURE 2. *The implications of macropolitical consensus and bureaucratic autonomy for explaining industrial policy*

clockwise). The impact of vertical autonomy on cell characteristics is more marginal. Beginning with the lower right-hand cell (cell IV), to the extent that consensus is low and sectoral agencies lack lateral autonomy, explanations based on bureaucratic politics—pulling and hauling among various agencies—may be particularly useful. The outcome in this situation is often an incoherent policy because it is formulated and implemented in the context of unstable or cyclical central priorities on the one hand and of clashing bureaucratic institutional preferences on the other. Inconsistency and immobilism can be exacerbated if there are powerful, antagonistic, private clienteles lobbying different agencies. Levels of vertical autonomy cannot alter the fundamentally contested nature of decision making in such cases, given low consensus and high segmentation.

Where macropolitical consensus is relatively high and lateral autonomy low (cell III), sectoral policy will resemble broader patterns, or the "generic model," more closely at whatever levels of vertical autonomy. In this case, industrial-technological goals at variance with such consensus are not likely to survive. Efforts at untangling sectoral decision making should be, therefore, directed at understanding the makeup of the dominant coalition and its preferences. This will also be the case where there are high levels of consensus and autonomy (cell I), provided there is a "happy convergence" between broad industrial patterns and the agency's preferences. It may be harder to predict the nature of sectoral policy in cases where the agency's preferences diverge from the policy set covered by the consensus.

Finally, when consensus is low but lateral autonomy is high (cell II), an analysis of the sectoral agencies' institutional objectives, interests, trajectories, and ideologies may provide a useful shortcut to our understanding of policy choice. This is often the case of a "maverick" agency shaping an industrial sector almost singlehandedly, particularly when its vertical autonomy is also high. Under these circumstances the counterintuitive consequence (at least

from a bureaucratic politics perspective) is that what may be the most powerful agency in the state—a Ministry of the Economy or a MITI, for example—will not necessarily prevail in policymaking. CNEA was not the most powerful agency within the Argentine state; it coexisted with other powerful agencies but enjoyed high lateral and vertical autonomy. Low bureaucratic autonomy can tame the agency's idiosyncratic characteristics *if* these depart from those of its bureaucratic sovereign.

Two final observations are in order. First, the degrees of macropolitical consensus and bureaucratic autonomy in themselves cannot predict policy outcome; however, they can foreshadow the explanatory strength of an agency's institutional peculiarities, or of bureaucratic politics, or of the overall industrial model. The specific outcome will be a function of the content of the consensus and of the agencies' preferences. Second, knowledge about the latter may help explain the content of certain choices but not why they prevailed. Hence, both the structural and institutional contexts in which the agency operates must be internal to the explanation of industrial policy.

What does this all tell us about nuclear choices in Brazil and Argentina?

Nuclear policy in Brazil and Argentina

The main argument of this section can be summarized as follows:

(1) In Brazil a more or less consensual hierarchy of goals and means and a segmented decision-making process constrained the range of options in such a way that nuclear policy followed the core parameters of Brazil's industrial model: rapid growth and macroeconomic stability. State entrepreneurship and foreign technology had increasingly become the means toward that end, leaving less room for national private industrial and technological resources. Brazil's case, therefore, falls within cell III of Figure 2 above.

(2) In Argentina, macropolitical consensus was low and the tripartite division of the state among the armed services strengthened the autonomy of each service within its respective industrial sphere of influence. This broadened the range of options, allowing the institutional preferences of the navy's atomic energy commission to prevail. These preferences led to the commission's special emphasis on domestic private entrepreneurial and technical resources. The Argentine case therefore fits cell II in Figure 2, the maverick agency.

Macropolitical consensus in Brazil in the late 1960s and early 1970s was strengthened by the considerable autonomy of state structures; that is, their ability to act independent of social class or interest group influence.[52] Most

52. State autonomy does not preclude a high convergence of interests among state and private interests. It is a highly contingent or historically specific phenomenon rather than an absolute condition and can vary across countries and periods. See Ziya Onis, "The Logic of the Developmental State," *Comparative Politics* 24 (October 1991), pp. 109–26. On state autonomy in

modern industrial sectors, national finance, and agribusiness backed the consensus, which was likely to benefit them more than the alternative of a strongly populist, heavy import-substitution industrialization. Rapid growth through exports (10 percent annually between 1967 and 1973) and macroeconomic stability were at the heart of that consensus and provided the military with the legitimating basis for its political control of the state.[53] The 1974 oil crisis endangered those core objectives; Brazil's dependence on external sources of energy for over 80 percent of its domestic consumption threatened its balance of payments and energy-intensive path to industrialization. Thus, the nuclear industry was designed to address that broader political objective: the continuation of the consensual model of economic development. State firms and readily available foreign technology, i.e., joint ventures such as NUCLEP (see Table 1) provided the instruments for that effort. State entrepreneurship had become, after all, the engine of growth and implied, in no few instances, the displacement of private capital.[54] In other words, among the many options made possible by its energy endowments, Brazil selected the agreements with West Germany and Siemens. The latter's scale, technical, and political-economic characteristics were compatible with the broader objectives and instruments of Brazil's industrial policy at that time. Major beneficiaries of expanded electrical generation capabilities were the (mostly public) metallurgic sector (the largest single industrial user of energy), chemical and petrochemical industries, paper manufacturers, and users of intermediate products, including many private producers of mechanical and electrical machinery.[55]

Brazil, see Philippe C. Schmitter, *Military Rule in Latin America: Function, Consequences, and Perspectives* (Beverly Hills, Calif.: Sage, 1973); and Alfred Stepan, "State Power and the Strength of Civil Society in the Southern Cone of Latin America," in Evans, Rueschemeyer, and Skocpol, *Bringing the State Back In,* pp. 317–46.

53. See Evans, *Dependent Development;* Robert R. Kaufman, "Industrial Change and Authoritarian Rule in Latin America: A Concrete Review of the Bureaucratic-Authoritarian Model," in Collier, *The New Authoritarianism in Latin America,* pp. 165–254; Haggard, *Pathways from the Periphery;* and Jeffry A. Frieden, *Debt, Development, and Democracy—Modern Political Economy and Latin America, 1965–1985* (Princeton, N.J.: Princeton University Press, 1991).

54. Barros supports the general claim that overall state-led economic growth took priority over strengthening the private sector. See Alexander S. C. Barros, "The Brazilian Military: Professional Socialization, Political Performance, and State Building," Ph.D. dissertation, The University of Chicago, 1978. The number of state enterprises increased from eighty-one in 1959 to 251 in 1980, particularly in high-technology infrastructural sectors such as electricity, gas, oil, telecommunications, iron ore, shipping, and steel. See Thomas J. Trebat, *Brazil's State-owned Enterprises—A Case Study of the State as Entrepreneur* (Cambridge: Cambridge University Press, 1983). The more specific contention that decision makers regarded fast implementation of a nuclear program as far more critical than maximizing private-sector supplies is clear from a letter by NUCLEBRÁS's director, Paulo N. Batista, to the firm Bardella, urging Bardella to make an immediate decision about their participation. See Federal Senate of Brazil, vol. 6, book 5, *Relatório* p. 246.

55. On the potential role of nuclear energy in the steel sector, see Guido Soares, "O Acordo de Cooperação Nuclear Brasil–Alemanha Federal" (The Brazilian–Federal Republic of Germany Agreement on Nuclear Cooperation), *Revista Forense* 253 (January, February, March 1976), pp. 207–32). On the country's energy balance, see Etel Solingen, "Domestic Adjustment and International Response," in Bennett Ramberg and R. Thomas, eds., *Energy and Security in the Industrializing World* (Lexington: University Press of Kentucky, 1990), pp. 123–52.

As argued above, macropolitical objectives are rarely a clear and coherent whole. Yet, relative to the Argentine case, and relative to other historical conjunctures (since the late 1970s, for instance), there was considerable consensus over core objectives in Brazil between the late 1960s and the mid-1970s. This consensus was enforced by the main economic bureaucracies; it permeated the internal operation of sectoral agencies like NUCLEBRÁS and the National Nuclear Energy Commission (CNEN) and constrained their options. (CNEN's autonomy withered away in 1967 with its transfer from direct subordination to the President to effective accountability to the Ministry of Mines and Energy; it thus played a marginal role in designing the nuclear sector.[56]) In other words, the guardians of the "model" and the "miracle" in Brazil defined the parameters of industrial policy in general and of the nuclear sector in particular.[57]

The architects of the nuclear industrial program of 1974 were Brazil's President Ernesto Geisel (former director of Petrobrás, the state's oil monopoly), General Golbery de Couto e Silva (military ideologue of Brazil's model of economic development), Paulo Nogueira Batista (director of the state firm NUCLEBRÁS and former chief of the Foreign Ministry's Economic Department), Foreign Minister Azeredo de Silveira (architect of the model's foreign policy), and Minister of Mines and Energy Shigeaki Ueki. Implementation was in the hands of NUCLEBRÁS; however, the utility Furnas (a subsidiary of Eletrobras) was the client, while partial financing was the responsibility of Banco Nacional de Desenvolvimento Econômico e Social (BNDES) and other agents, and licensing and effective R&D were more the domain of the CNEN than of NUCLEBRÁS's R&D center. This lateral segmentation did not exist in Argentina where all budgetary, research, international bargaining, licensing, and financing functions were the CNEA's responsibility. The dominance of central economic and energy agencies in Brazil was instrumental in curtailing radical departures from core macropolitical objectives. Brazilian decision makers regarded the possibility of slowing down the development of a nuclear industry—by fully integrating private Brazilian firms at the outset—as just such

56. See the inquiry by a parliamentary committee in Federal Senate of Brazil, *Relatório,* vol. 3, p. 103. On the bureaucratic segmentation of nuclear policy in Brazil, see Soares, "O Acordo de Cooperação Nuclear Brasil–Alemanha Federal."

57. On the hegemonic position of the Ministry of Finance within the bureaucracy between 1967 and 1974, with the ascendancy of Delfim Neto as Finance Minister, see Kaufman, "Industrial Change and Authoritarian Rule in Latin America." On the powerful Ministry of Planning and its responsibility to plan Brazil's economic affairs synoptically, see Barzelay, *The Politicized Market Economy.* On the constraining role of central economic agencies over sectoral programs during that period, see Sergio Abranches, "The Divided Leviathan: State and Economic Policy Formation in Authoritarian Brazil," Ph.D. diss.; Cornell University, 1978; and Ben Ross Schneider III, "Politics Within the State: Elite Bureaucrats and Industrial Policy in Authoritarian Brazil," Ph.D. diss., University of California, Berkeley, 1987. On the centralization of economic policymaking in Brazil between the late 1960s and the mid-1970s, see Schmitter, *Military Rule in Latin America;* Barros, *The Brazilian Military;* and Evans, *Dependent Development.*

a departure. Allowing privately held firms to provide a larger share of equipment involved risks of energy undersupply, delays, higher costs, and capital and technology shortages.[58] The policies of Finance Minister Delfim Netto had forced a tendency to search for foreign financing even when it implied higher ratios of suppliers' credits to regular loans. Suppliers' credits, in turn, often increased the shares of foreign equipment.

The choice of industrial structure involved the adoption of a particular reactor technology. Light water/enriched uranium cycles were better suited to Brazil's goals of creating a nuclear industry in a relatively short time period (which required leaping over certain development stages) and acquiring mastery over the complete fuel cycle under favorable financial conditions. As the leading technology in the global nuclear market, light water (pressurized) reactors ensured reliability, short delivery time, and, in the case of vendor KWU, a willingness to supply complete fuel cycle technology and financing.[59] In weighing the alternatives—one of which included a more costly and long-term program involving the extensive participation of Brazilian firms—decision makers opted for less expensive and more readily available foreign technology. The risks of light water reactor cycles included perpetuating external fuel dependency, particularly since the contracted enrichment procedure (jet-nozzle) had not been commercially proven. Uranium enrichment had been monopolized by the United States and the Soviet Union until the emergence of the European consortia EURENCO and EURODIF. Moreover, given its strategic importance (for the production of nuclear weapons), the commercialization of enriched uranium had been affected by severely restrictive conditions, contained in guidelines approved by the major suppliers through the so-called London Club.

There is widespread agreement among scholars that there had been a fundamental absence of macropolitical consensus over industrial policy in Argentina since 1955, although their explanations for so low a consensus have differed.[60] A leading argument, for instance, is that the autonomy of the Argentine state was consistently challenged by political and economic forces,

58. See the statement by Minister of Mines and Energy Shigeaki Ueki, in *Manchete,* 24 April 1976, pp. 75–97.

59. See the statement by former NUCLEBRÁS director Paulo Nogueira Batista in *O Estado de Sao Paulo,* 19 October 1983.

60. See Marcelo Cavarozzi, "Political Cycles in Argentina since 1955," in Guillermo O'Donnell, Philippe Schmitter, and Laurence Whitehead, eds., *Transitions from Authoritarian Rule—Latin America* (Baltimore, Md.: Johns Hopkins University Press, 1986), pp. 19–48. Carlos Waisman, *Reversal of Development in Argentina* (Princeton, N.J.: Princeton University Press, 1987); Alfred Stepan, *Rethinking Military Politics—Brazil and Southern Cone* (Princeton, N.J.: Princeton University Press, 1988); David Rock, "Political Movements in Argentina: A Sketch from Past and Present," in M. Peralta-Ramos and Carlos H. Waisman, eds., *From Military Rule to Liberal Democracy in Argentina* (Boulder, Colo.: Westview Press, 1987), pp. 3–20; Paul H. Lewis, *The Crisis of Argentine Capitalism* (Chapel Hill: The University of North Carolina Press, 1990); and Sikkink, *Ideas and Institutions.*

which precluded the state from consolidating a stable industrialization strategy.[61] Potential partners to a ruling coalition saw their interests better served by exercising veto power and by providing an erratic, selective support of policies than by effectively throwing their lot into a stable alliance. The military regimes of 1967 (the Argentine Revolution) and of 1976–81 (the New Order), in particular, attempted to launch new economic programs, which constituted major breaks with pasts of import substitution and which were likely to attract modern financial, large-scale industrial, and export-oriented sectors. Yet the positions of Argentine industrialists and Pampean producers were contradictory and as elusive as fireflies: now either or both were inside the tent; now they were not.[62] Their hesitancy is sometimes traced to their short-term views of profitability, their rejection of statism, and the deterring effect of a tight alliance with a conflict-ridden, ineffective military institution in control of the political process. This precluded the emergence of a strong consensus because it narrowed down the set of converging objectives. As a result, not only was the Argentine coalition a highly unstable one but its shifting boundaries were much harder to identify than was the case for Brazil in the decade following 1964. The exclusion of certain political forces with divergent interests (small-scale producers of standardized products, labor, political parties) from the coalition was designed to strengthen the basis of consensus. These forces, however, proved to be too powerful to be discounted altogether, as the intermittent assaults by the Confederación General Económica and the "Cordobazo" popular uprising of 1969 revealed. The attempt to genuflect to nonmembers or occasional members of the coalition in exchange for political support weakened the consensus even further.

Argentina's shifts between attempts at macroeconomic balance and inward-looking policies and their reversal for most of the post-1955 era were symptoms of the feeble consensus. That feeble consensus may also explain why a succession of economic "czars" (Economy Ministers Krieger Vasena and Martinez de Hoz) failed to imbue state agencies with a coherent program. Challenges by the National Development Council and an array of state enterprises, for instance, frequently undermined orthodox policies. The ambiguity in macropolitical objectives, in other words, expanded the range of

61. See Guillermo O'Donnell, *Estado y Alianzas en la Argentina, 1956–76* (State and Alliances in Argentina, 1956–76), Estudios Centro de Estudios de Estado y Sociedad (CEDES), no. 5 (Buenos Aires: CEDES, 1976); Jorge F. Sabato and Jorge Schvarzer, *Funcionamento de la Economía y Poder Político en la Argentina: Trabas para la Democracia* (The Economy and Political Power in Argentina: Barriers to Democracy) (Buenos Aires: Centro de Investigaciones Sociales sobre el Estado y la Administración, 1983); Rouquie, *The Military and the State in Latin America;* Smith, *Authoritarianism and the Crisis of the Argentine Political Economy;* and Frieden, *Debt, Development, and Democracy.*

62. These contradictions are evident from statements, open letters, and annual reports by the agroexporter association Sociedad Rural, the Unión Industrial Argentina, and the Argentina Chamber of Commerce. See Smith, *Authoritarianism and the Crisis of the Argentine Political Economy,* pp. 84–90.

options that sectoral agencies could pursue.[63] In this permissive context, agencies with high levels of lateral autonomy could maximize their ability to define and implement their own policy preferences and to expand their jurisdiction. The CNEA did just that when it became the sponsor of industrial and engineering firms and of a large elite segment of the scientific-technical community.

The origins of such lateral autonomy in Argentina lay in the de facto tripartite division of the state among the three armed forces since 1955. In that year the military ousted President Juan D. Perón, marking the beginning of a cycle of military juntas and brief constitutional interludes. Each service secured centralizing authority over certain industrial sectors on an exclusive basis. This arrangement reflected a delicate balance of power among the forces. Any decree-laws required consultations with the Military Council, composed of all three services. The power formula allocated the presidency to the army, the vice-presidency to the navy, and the three remaining junta positions to the Argentine army, navy, and air force, respectively. In practice, the President had no effective control over agencies and programs under the jurisdiction of the service branches.[64] The army controlled the General Directory of Military Production (DGFM), which coalesced an array of state enterprises in steel, timber, petrochemicals, and electronics. The air force's niche included manufacturers of automobiles, aluminum, and agricultural machinery; the National Directorate of State Industries (DINFIA), which superseded the Military Aircraft Industry; and the National Mechanical and Metallurgical Industries (IAME). The navy controlled budgetary allocations and major appointments and policy decisions at the CNEA and at the National Shipbuilding and Naval Factories (AFNE). Such autonomy allowed an impressive continuity of leadership at the CNEA and made possible the functional vertical integration of the nuclear sector under its aegis.

This principal–agent relationship enabled the Argentine navy to shape a nuclear industry more compatible with its own institutional interests than with energy requirements as a whole and to maintain throughout thirty years of political upheaval and low macropolitical consensus the fundamental industrial-technical characteristics of the program. Among these characteristics was the choice of heavy water/natural uranium reactors. The navy's presumption that such reactors would allow greater domestic entrepreneurial and technical participation was based on several assumptions. First, the production of heavy water was assumed to be less complex than uranium enrichment. Thus,

63. On failed efforts by Minister of the Economy Martínez de Hoz to control sectoral deviances, see Jorge Schvarzer, *Martínez de Hoz: La Lógica Política de la Política Económica* (Martínez de Hoz: The Political Logic of Economic Policy) (Buenos Aires: Centro de Investigacions Sociales sobre el Estado y la Administración, 1983). On balkanization of the state apparatus, see Smith, *Authoritarianism and the Crisis of the Argentine Political Economy*, p. 176.

64. Robert Potash, *The Army and Politics in Argentina 1945–1962: Peron to Frondizi* (Stanford, Calif.: Stanford University Press, 1980).

domestic firms could conceivably carry out every stage in the fabrication of fuel elements. Moreover, natural uranium was abundant in Argentina (as it was in Brazil), and heavy water was commercially sold by several countries. These conditions would tend to maximize fuel independence and allow time for a national technology to mature. Paradoxically, both Argentina and Brazil mastered uranium enrichment technology in the 1980s, while heavy water production in Argentina continues to be problematic. The presumed opportunities offered by heavy water reactors were offset by greater costs, a longer lead time, and more technical risks than originally expected.[65]

Maximizing national inputs was a symbol of technical competence, efficiency, and achievement that the navy used in its rivalry with the other two services. The latter had continuously challenged the navy's institutional power—through fratricidal interservice combat in 1962—and increasingly eroded the position the navy enjoyed at its heyday in 1955. The possibility of a greater role for national firms and technical resources enabled CNEA to create legitimating constituencies and clientelistic networks among industrial entrepreneurs and scientific-technical elites. This strategy fit naturally with the navy's traditional penchant for technical excellence, often held as an advantage over the army. CNEA's institutional characteristics (meritocratic recruitment, stability, and corporate identity) aided in maintaining technical excellence. These characteristics lay in contrast to the army's short-lived control of the nuclear program. In 1951 Perón announced to the world, prematurely, that Argentina had mastered nuclear fusion before verifying the fraudulent claim of the exiled Austrian physicist Ronald Richter. The program was then under the authority of army colonel Enrique Gonzalez. The navy helped uncover the sham and took control over the nuclear commission in 1952.

The strategy of engaging private entrepreneurs was also highly compatible with the navy's classical liberal support for business and for state subsidiarity. The navy was influenced by the British and American political, economic, and military models, while the army embraced a Prussian and statist tradition. Secular groups and political parties linked to the wealthy liberal Anglophile oligarchy supported the navy and provided its core recruitment pool.[66] In sum, technical achievement and inclusionary strategies increased the navy's political capital and its ability to preempt attempted army intrusions into the definition of industrial-technical priorities and the budgetary allocation process. This interpenetration of military and economic power was not peculiar to Argentina, but its extent was unique in Latin America. The military's control of productive sectors was deeply rooted in Argentina before it gained any significance in Brazil (in the late 1970s). Neither did interservice rivalry in Brazil ever reach the extremes of the Argentine case. For the most part,

65. Luiz P. Rosa, ed., *Energia, Tecnologia e Desenvolvimento: A Questão Nuclear* (Energy, Technology, and Development: The Nuclear Question) (Rio de Janeiro: Vozes, 1978).

66. Gary W. Wynia, *Argentina: Illusions and Realities* (New York: Holmes and Meier, 1986).

Brazil's National Information Service, a centralized intelligence apparatus, maintained a standardized outlook among the armed services and submerged disagreements into unifying compromises.[67]

How applicable is the argument I advance in this section to other historical periods? Can different structural and institutional conditions explain alternative policy outcomes during the early 1960s or late 1970s? There was dramatically little macropolitical consensus in Brazil in the early 1960s during the presidencies of Jânio Quadros and João Goulart. The old populist alliance collapsed and the severe macroeconomic crisis made it impossible to govern without alienating one segment or another of the ruling coalition.[68] This was the volatile crisis preceding the April 1964 military coup that overthrew President Goulart. At the time, the CNEN was a federal *autarquia* with administrative and financial autonomy. CNEN took steps to involve Brazilian firms and the national scientific-technical community in the emerging nuclear energy program; it also adopted natural uranium reactors. The similarities to the Argentine case described above are striking. The Brazilian policy, however, was completely reversed following the 1964 coup; the new macropolitical conditions and institutional arrangements led to the very different program analyzed earlier.

Changes in consensus and lateral autonomy by the late 1970s allow one other test of the usefulness of this framework for explaining policy over time. At this historical juncture the declining performance of the model and the rising political power of industrial entrepreneurs eroded the old consensus. The economic crisis of the mid-1970s sharpened the contradictions between maintaining macroeconomic stability and strengthening the position of local private capitalists.[69] In a much publicized 1978 statement, the "Manifesto of the Eight," major industrial leaders formerly supportive of the ruling coalition made their dissatisfaction with the regime—and with expanding state entrepreneurship—evident.[70] Yet, their continuing support was essential for a military regime with little popular legitimacy. At the very time macropolitical consensus was waning, the Brazilian navy strengthened its control over the CNEN, reinvigorating the latter's autonomy. Partnerships with private firms and technological networks revived technical options compatible with those interests. By 1988, NUCLEBRÁS itself was dissolved and the state firm NUCLEP, privatized.

A dynamic analysis of the Argentine case is possible only if we address the postauthoritarian period in the latter part of the 1980s. Until then, low

67. See Rouquie, *Poder Military y Sociedad Política en la Argentina;* Lewis, *The Crisis of Argentine Capitalism;* and Barros, *The Brazilian Military,* pp. 43–48.

68. See Stepan, *The State and Society;* and Frieden, *Debt, Development, and Democracy.*

69. On the external sources of erosion of consensus see Stepan, "State Power and the Strength of Civil Society in the Southern Cone of Latin America"; Barzelay, *The Politicized Market Economy;* and Evans, *Dependent Development.*

70. "Primeiro Documento dos Empresários" (First Document of the Industrialists), Forum da *Gazeta Mercantil,* July 1978.

macropolitical consensus and CNEA's high lateral autonomy were a constant and allowed CNEA to pursue a remarkably consistent policy for almost thirty years. Without such autonomy the program probably would have been more influenced by other bureaucratic forces. The economic ministries and the electrical utilities would have pushed for a more "rational" (i.e., less expensive) program with lower levels of national participation, a maximum level of imported equipment, and, most probably, light water reactors.[71] The army might have injected its preferences for statist alternatives, as it did with the industrial complex comprising DGFM. In short, in the absence of macropolitical consensus, conflicting bureaucratic pressures would have increased the range of possible options and, most likely, the program's incoherence.[72]

Macropolitical consensus remained fragile until 1990 when President Carlos S. Menem introduced an orthodox stabilization program backed by a broad spectrum of industrial interests and even fractions of labor. Expressing the new consensus, the Planning Secretariat engineered the reorganization and privatization of CNEA in 1991. By then CNEA's autonomy had been curtailed in tandem with the old tripartite arrangement among the armed forces. The old policy and partnerships gave way to a new—leaner—program. The possibility of turning over control of plant 3 (Atucha 2) from the state to the manufacturer (Siemens) for completion as a turnkey plant began to be explored, representing quite a new beginning for the Argentine nuclear industry.

Implications for bargaining with technology suppliers

Levels of bureaucratic autonomy and macropolitical consensus can influence the process of bargaining with technology suppliers through their impact on the size of what Robert Putnam calls domestic win-sets, on the risks of involuntary defection, and on the credibility of commitments and reduction of uncertainty.[73] For example, low consensus and high levels of autonomy may narrow the size of the win-set to the institutional preferences of the sectoral agency. A small domestic win-set, in turn, can be a bargaining advantage and can increase the negotiators' leverage over the distribution of benefits from the international bargain. High levels of lateral autonomy in the midst of low consensus cancel out the risk of involuntary defection, the small size of the win-set notwithstanding.

For over thirty years Argentina's domestic win-set in nuclear negotiations was restricted to the rigid set of choices of the CNEA. The need for the CNEA's (i.e., the navy's) singlehanded endorsement of any nuclear agreement was transparently clear to suppliers. CNEA's autonomy to make decisions and

71. These deductions are based on attempted challenges to CNEA along those lines. See Daniel Poneman, *Nuclear Power in the Developing World* (London: Allen and Unwin, 1982).

72. This scenario falls within cell IV in Figure 2.

73. See Putnam, "Diplomacy and Domestic Politics."

implement them, which was unencumbered by political or bureaucratic interference, strengthened the credibility of its commitment. Its monopolistic control over the nuclear industry was far from a state secret; it was often used by the navy for domestic purposes and was openly wielded in negotiations with technology suppliers. Such control enabled the CNEA to bargain forcefully and effectively for maximum local content and national control of the technology transfer process. The CNEA was able, for instance, to stave off suppliers' attempts to maximize foreign inputs through suppliers' credits. It was also able to resist attempts by suppliers to apply restrictive clauses, including export restrictions, appropriation of improvements, and control over quality assurance. Foreign control over quality assurance confers to suppliers the ability to act as gatekeeper and, hence, to exclude local firms on technical grounds. The CNEA even compelled suppliers to extend the quality guarantees accompanying their own equipment to those of Argentine origin.

Bargaining advantages may dissipate when both consensus and autonomy are low. Both can increase uncertainty as to the contours of the win-set, may raise the risk of involuntary defection, and can weaken the credibility of commitment. Under such conditions, unstable demands create a supplier's nightmare, forcing a continual reassessment of the interplay among political and bureaucratic forces within the recipient state.[74] As Putnam suggests, at a certain level of uncertainty the unpredictability of the boundaries of the domestic win-set can lead suppliers to require additional assurances (side-payments) that ratification will take place. (These conditions may explain Mexico's weakened bargaining position in negotiating agreements with the automobile and pharmaceutical industries.[75])

The independent effects of high consensus seem to be mixed. On the one hand, high consensus within a ruling coalition may dissipate fears of involuntary defection in the opponent. There is greater certainty that the coalition "can deliver," and this strengthens its bargaining position.[76] On the other hand, because high consensus improves the chances of easy ratification, negotiators are less able to use domestic pressures as a bargaining chip to obtain concessions. The effects of high consensus may be better gauged in conjunction with levels of bureaucratic autonomy. Low bureaucratic autonomy, for instance, may increase the risks of involuntary defection, make the environment less predictable, and weaken the advantages of high consensus. Despite a fairly consensual development strategy, for example, India's bargaining with foreign

74. On foreign investors' primary concern with the political and administrative stability and the predictability of the host country, see Encarnation and Wells, "Sovereignty En Garde."

75. See Douglas C. Bennett and Kenneth E. Sharpe, *Transnational Corporations Versus the State: The Political Economy of the Mexican Auto Industry* (Princeton, N.J.: Princeton University Press, 1985); and Gary Gereffi, *The Pharmaceutical Industry and Dependency in the Third World* (Princeton, N.J.: Princeton University Press, 1983).

76. Stepan argues that a stronger, cohesive state elite—capable of providing a predictable environment for foreign capital—enjoys a better bargaining position. See Stepan, "State Power and the Strength of Civil Society in the Southern Cone of Latin America."

suppliers in the computer sector initially was hampered by segmented institutional decision making.[77]

Brazil's more or less consensual industrial strategy in the late 1960s and early 1970s arguably strengthened its credibility vis-à-vis foreign suppliers. This is the background against which Brazil negotiated the so-called deal of the century, then estimated at $20 billion, with KWU and its associated financial and industrial agents. At the same time, foreign negotiators appeared to have discounted the possibility of domestic opposition to ratification. In particular, they assumed (on the basis of exploratory contacts with state officials) that the boundaries of Brazil's win-set were quite flexible.[78] Indeed, these boundaries were flexible, given the costs of a no-agreement outcome for the coalition that designed the nuclear industry. Nevertheless, extensive concessions in the area of German supplies, the creation of foreign-controlled state–foreign ventures, and the acceptance of restrictive technology-transfer clauses placed the agreement outside the bounds of what private Brazilian firms could embrace. By 1975 Brazil's consensus was clearly cracking, yet Brazilian negotiators failed to use domestic pressures to exact concessions that would have satisfied national industrialists and scientific-technical groups.[79] Efforts by some NUCLEBRÁS officials to heed those groups' demands were suppressed by the highly segmented decision-making context, which echoed the general directives of central state agencies.

As Putnam suggests, negotiators are often badly informed about the complexities of domestic games on the other side.[80] High consensus may make it easier for foreign negotiators to assess the domestic win-set and avoid negative reverberations but does not preclude miscalculations. For example, on the one hand, both Brazilian officials and German negotiators failed to anticipate how a loosening consensus was changing Brazil's win-set. On the other, both understood that any agreement would require the complete transfer of nuclear fuel-cycle technology. This was what Putnam calls a "synergistic issue linkage."[81] It was designed to satisfy Brazil's military establishment, but also compelled suppliers to broaden their own win-set. A military regime was, after all, orchestrating Brazil's consensus, although the negotiations on all industrial programs were primarily in the hands of high-level civilian technocrats. Not only did KWU agree to transfer fuel-cycle technology to Brazil but it also gained West German support for that sensitive

77. Grieco, *Between Dependency and Autonomy.*

78. Declarations by KWU officials at the time confirm that they regarded the 30-percent share of supplies by private Brazilian firms and the technological control of joint ventures by German firms as squarely within the domestic win-set; see *Nucleonics Week,* 31 October 1985, p. 6.

79. On the position of Brazilian negotiators, see declarations in *Manchete,* 4 April, 1976; *Journal do Brasil* (7 November 1976); *O Estado de São Paulo* (19 March 1977); Federal Senate of Brazil, *Relatório,* vol. 6, book 5, p. 302; and *O Globo,* 20 June 1975.

80. Negotiators can also be misinformed about levels of bureaucratic autonomy or segmentation. See Encarnation and Wells, "Sovereignty En Garde."

81. Putnam, "Diplomacy and Domestic Politics," p. 447.

transaction, which challenged U.S. nuclear export policy. This transfer may well be considered one of (now united) Germany's early steps in the direction of growing political assertiveness in world politics.

Conclusions

This article has sought to explain state intervention in nuclear industries as an outcome of the state's structural and institutional characteristics. It links the analysis of sectoral and broader industrial policy by focusing on levels of macropolitical consensus on the one hand and sectoral agency autonomy on the other. Knowledge about levels of consensus and autonomy help anticipate the explanatory relevance of macropolitical models, sectoral institutions, and bureaucratic politics as critical research arenas. My conclusions are fourfold:

(1) High levels of consensus and overlapping jurisdictions over a sector's policy (segmented decision making) thwart the agency's ability to impose its own institutional agenda. Under these conditions, sectoral policy will resemble more closely the generic industrial pattern defined by the content of the consensus. Efforts at untangling sectoral decision making in this case, therefore, should be directed at understanding the makeup of the dominant coalition and its preferences.

(2) This will also be the case where there are high levels of consensus and autonomy and where broad industrial patterns converge with the agency's preferences. Where agency preferences diverge from the policy set covered by the consensus, it may be harder to predict the nature of sectoral policy.

(3) When consensus is low (i.e., when there is a widened repertoire of macropolitical options) and the agency's autonomy is high, understanding policy choice will require an analysis of the sectoral agencies' institutional objectives, interests, trajectories, and ideology. Such maverick agencies can shape an industrial sector almost singlehandedly.

(4) Low consensus and low lateral autonomy lead to pulling and hauling among various agencies, which suggests that explanations based on bureaucratic politics may be particularly useful in those cases. The framework thus helps resolve a perennial question left unanswered by Graham Allison's model: when does interbureaucratic bargaining matter?[82]

There are several implications to the above findings. In the first place, they point out that industrial policy choices are not always determined by international market opportunities, relevant domestic endowments, or the political strength of industrial entrepreneurs. Second, an understanding of the structural conditions shaping macropolitical consensus—the nature of ruling policy networks, for instance—is necessary to explain constraints but insufficient to

82. For a sample of this debate, see Allison, *Essence of Decision;* Bendor and Hammond, "Rethinking Allison's Models"; and Stephen D. Krasner, "Are Bureaucracies Important? (Or Allison in Wonderland)," *Foreign Policy* 7 (Summer 1972), pp. 159–79.

describe choices and outcomes. The breadth and stability of a ruling coalition in itself, for instance, may not necessarily lead to greater displacement of private firms. It was Brazil's broader and more stable coalition that chartered state entrepreneurship in the nuclear sector. The independent role of sectoral state institutions helps explain that counterintuitive outcome. Third, the need to specify the structural context within which such agencies operate limits explanations based on pure institutional drive. Rather than positing only that institutions can be important, I have suggested the conditions under which they may be more or less relevant. Under conditions of low macropolitical consensus, expectations that an autonomous agency's previous policy will predict future policy are more robust than they would be under conditions of higher macropolitical consensus.[83]

Macropolitical consensus and lateral autonomy can explain why state intervention is not always consistent across sectors or over time. States can displace private firms in some sectors but not in others, and at certain points in time but not at others. How helpful is this framework in improving our general understanding of sectors in Brazil and Argentina? Under conditions of low consensus and high lateral autonomy—as with Argentina's atomic energy commission—we expect sectoral agencies almost singlehandedly to guide a sector's industrial strategy. Such expectations seem to be confirmed by the development patterns of the oil, steel, petrochemical, and arms industries in Argentina and by the informatics, aircraft, aerospace, and arms industries in Brazil. The four Argentine sectors were part of its army's industrial fiefdom, which often displaced private firms from those markets. These industries bore the statist imprint of the army and its consistent preference for foreign equipment and technology.[84] The four Brazilian sectors were consolidated during the late 1970s and early 1980s. At that time private industry challenged the economic model, eroding the macropolitical consensus of 1967–74. The lateral autonomy of certain agencies—like the air force's Centro Tecnico Aerospacial and the navy's Secretaria Especial de Informatica (Special Secretariat for Informatics [SEI])—increased. The SEI was created in 1979 directly under the authority of the National Security Council and came to control and coordinate all activities in the informatics area. There was a growing private capital interest in domestic production and purchase of microcomputers, and SEI's lateral autonomy allowed it to reduce strategic uncertainty in the sector through stable support for those firms.[85] The agencies'

83. On the hypothesis that policy outputs are better predicted by previous outputs than by dominant coalitions, see Aaron Wildawsky, *The Politics of the Budgetary Process* (Boston: Little, Brown, 1964); Richard E. Neustadt, *Alliance Politics* (New York: Columbia University Press, 1970); and Robert Axelrod, "Bureaucratic Decisionmaking in the Military Assistance Program: Some Empirical Findings," in Morton H. Halperin and A. Kanter, eds., *Reading in American Foreign Policy—A Bureaucratic Perspective* (Boston: Little, Brown, 1973), pp. 154–71.

84. R. D. Mallon and J. V. Sorrouille, *Economic Policymaking in a Conflict Society: The Argentine Case* (Cambridge, Mass.: Harvard University Press, 1975).

85. Evans, "State, Capital, and the Transformation of Dependence."

preferences for a more market-conforming strategy in these four sectors in Brazil can explain the policy outcomes, which resembled the partnerships of Argentina's CNEA.

In Brazil, high macropolitical consensus and low lateral autonomy (1967–74) led to a nuclear industry most compatible with the overall model, that is, one relying on state entrepreneurship, joint ventures with foreign suppliers, and imported equipment.[86] The primacy of the model was also evident in two other situations: (1) those in which development was mapped by central economic agencies, such as steel (Companhia Siderurgica Nacional) and electricity (Eletrobrás) and (2) those in which sectoral agencies had significant lateral autonomy but had preferences that were compatible with the guiding policy set, such as the oil exploration and refining (Petrobrás) and petrochemical (Petroquisa) industries. These cases, therefore, were often characterized by displacement of private Brazilian producers. Policy in sectors that evolved under conditions of low macropolitical consensus and low lateral autonomy was often mired in bureaucratic entanglements, as with Proálcool, the program designed to produce a renewable fuel.

A second set of implications relates to the consequences of domestic processes for bargaining with foreign suppliers. How do bureaucratic autonomy and macropolitical consensus influence the external bargain? Low consensus and high levels of autonomy may narrow the win-set to the institutional preferences of the sectoral agency. This small win-set, in turn, becomes a bargaining advantage for the host country (no other outcome will be acceptable). An agency's monopoly over ratification and implementation also decreases the risk of involuntary defection. When there are higher levels of consensus, however, a coalition may be more effective in the attempt to undermine the power of autonomous agencies, particularly if the mavericks' choices impose high political costs.[87]

Bargaining advantages tend to wane where both consensus and autonomy are low. Under such conditions, the uncertainty over the contours of the win-set and over the credibility of commitment grows, as does the risk of involuntary defection. Foreign investors are more likely to require additional assurances (side-payments). The independent effects of high consensus seem to be mixed: it may dissipate fears of involuntary defection in the opponent on the one hand, but the expectation of easy ratification may also prevent that side from deploying domestic pressures as an instrument to exact concessions. The effects of high consensus may be better gauged in conjunction with levels of bureaucratic autonomy. Segmented decision making increases the risk of involuntary defection, makes the environment less predictable, and may thus weaken whatever advantages high consensus might have created.

86. In *Dislodging Multinationals,* Encarnation analyzes how widespread that model was in Brazil.

87. On how a more coherent development strategy can moderate the negotiating leverage of an autonomous agency, see Encarnation and Wells, "Sovereignty En Garde."

The present findings regarding bargaining outcomes thus reaffirm the contention that the objectives of a technology recipient are not necessarily compromised by international market or political forces. The external context did not force the choice of reactor technology or a given distribution of costs and benefits among state, private, and foreign actors. In both cases recipients were able to extract certain concessions from suppliers. Joseph Grieco's and Dennis Encarnation's emphasis on the recipient's ability to take advantage of competitive pressures among technology suppliers proves accurate even for products as highly sophisticated as nuclear reactors.[88]

Finally, the validity of this framework is not limited to industrializing recipients. Advanced industrial and developing states alike are characterized by different degrees of macropolitical consensus at different times. Neither are institutions with high levels of autonomy or highly segmented decision-making contexts peculiar to industrializing countries. The dilemma of producing a viable post–cold war economy in the United States has bred several proposals within those contexts. One blueprint for dismantling the cold war economy proposed the creation of an autonomous Office of Economic Conversion, which would be able to break through the political impasse (low consensus) over that process.[89] Another recent proposal advocated the creation of a "super Department of International Trade and Industry" to overcome excessive bureaucratic segmentation. The growing literature on the U.S. Federal Reserve attests to increased interest in, and recognition of, the impact of bureaucratic autonomy on the articulation of domestic and international policy.[90] Applying the framework comparatively to the analysis of sectoral industrial policy can also shed light on how domestic structures and institutions set the terms around which bargaining in technology takes place.

88. See Grieco, *Between Dependency and Autonomy;* and Encarnation, *Dislodging Multinationals.*
89. *New York Times,* 18 May 1982.
90. See, for instance, Ellen Kennedy, *The Bundesbank—Germany's Central Bank in the International Monetary System* (New York: Council on Foreign Relations Press, 1991).