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THE NATIONAL SCIENCE AGENDA AS A RITUAL OF MODERN NATION-STATEHOOD: THE CONSEQUENCES OF NATIONAL "SCIENCE FOR NATIONAL DEVELOPMENT" PROJECTS

A DISSERTATION
SUBMITTED TO THE DEPARTMENT OF SOCIOLOGY
AND THE COMMITTEE ON GRADUATE STUDIES
OF STANFORD UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGRESS OF
DOCTOR OF PHILOSOPHY

Gili S. Drori

June 1997

I certify that I have read this dissertation and that in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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ABSTRACT

This study is a comparative investigation of the ways by which the globalization of modern science affects the characteristics of different nation-states. Whereas much research and policy discussion focuses on science as an instrumental, or technical, system with immediate consequences for national conditions, such as economic development, science should also be regarded as a general cultural framework, which is highly institutionalized at the global level. As such, the institutionalization of science at both the global and national levels affects a wide variety of national properties. Following this line of reasoning, this dissertation study employs cross-national and longitudinal data and multiple-indicator methods to show national-level consequences of scientific expansion on the processes of rationalization and modernization of social and political life. It appears that the cross-national expansion of science practice results in, or is associated with, a variety of measures of (a) the standardization of civil and governmental procedures and (b) the expansion of the political rights and political engagement. I conclude from these empirical findings that scientization encourages (a) greater general societal rationalization and (b) expanded notions of social actorhood and agency. This evidence demonstrates how the globalization of science alters local conditions, both civil and political, by supporting the institutionalization of bureaucratic practices and participatory politics. Thus, the expansion of science -- clearly affected by global processes -- carries a general secularized faith in a rationalized world and in human agency. In this sense, the practice of science is a national ritual, whose social role is as a legitimacy-providing institution, rather then a technically functional institution. On a broader level, the study emphasizes the relations between globalization processes and the sovereignty of the nation-state. I conclude that science carries modernist and global notions of rational governance, identity politics, self-determination, and democratization. Science globalization processes, therefore, encourage the worldwide institutionalization of the liberal mode of governmentality.

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Last on this list yet always first in my mind is my family. Dania, Assa, and I joke frequently about how it is impossible to ask our mother a simple question without having to research it through several encyclopedias, or how our father had us rehearse every presentation – even to our 6th grade classmates – until he was satisfied that we could answer all his probing questions. Undoubtedly, it is this upbringing which lead me to embark on the path for, and challenge of, acquiring a Ph.D. I thank my Aba and Ima and also Naya and Assinka. My daughters, Ellie and Neta, bring joy and purpose to my life. And, last, my deepest appreciation goes to my husband and best friend, Jerry Sanders. I could not have done any of this without him; I love him for it...and for a million other reasons.

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INTRODUCTION

1980 was declared by the UN's General Assembly as the Year of Science for Development. In numerous ceremonies, conferences, workshops, and documents, statesmen and scientists celebrated the role of science in economic growth. Science was explicitly and formally hailed as a chief factor in establishing a developed economy, meaning knowledge-based, technology-based, and an industrialized economy. 1980 was the culmination of a long period, which started in the 1960s and during which the discourse of "science for national development" became solidly established. This discourse, by defining the social role of science as dependent on developmentalism, diffuses the notion that science is a means to an end in a utilitarian scheme, or that science is a means to achieve national economic prosperity in national plans. It, therefore, instrumentalizes science; it approaches science from a purely technical perspective. Moreover, by doing so it confines our outlook on the nature of science and on the consequences of its globalization.

In this work I draw attention to the cultural dimension of science. I argue that science is a global cultural institution and that its cultural qualities are central to understanding its social role and the impact of its globalization. I argue further that science embodies a secular faith in rational order and in human agency, and that in this capacity it alters nation-statehood. In other words, science offers a particular world-view – one of order, rationality, and human agency – and it is the globalization of this world-view, rather then of science practices alone, that alters nation-states worldwide. Nation-states that incorporate science practices under the instrumentalist expectation that science institutionalization will result in economic development are subject to scientization, meaning the permeation of the scientific world-view into local society. Scientization, in turn, re-shapes national practices and visions in accordance with the modernist concepts that science carries. Overall, the most crucial outcome of science globalization is the changes to local society through scientization. In this sense, the much instrumentalized process of science globalization has direct cultural implications to local societies.

While my study focuses on the globalization of one domain, namely science, my arguments may be generalized to other arenas. First, I argue that global domains re-shape national contexts in accordance with the dominant themes of the global polity. Therefore, while national "styles" are persistent, the overall consequence of globalization processes is the trans-national convergence of forms. In this sense, my findings relate to the general issue of the effects that globalization processes bear on local environments. Second, I relate my conclusions to the nature of the impact of globalization processes on national forms. I argue that seemingly value-neutral global domains carry great cultural implications for national contexts. In this sense, the form and the meaning are mixed together; or, the globalization of practices is mixed with the globalization of the discursive regime that these practices embody.

I begin this work by reviewing the main characteristics of the worldwide diffusion of science. In Chapter 1, which is mainly descriptive, I illustrate the main features of science globalization: isomorphism (which shows how similar organizational formats are diffused worldwide) and loose-coupling (which demonstrates that such organizational formats have weak organizational ties among them). I, then, describe the discursive regimes that dominate national and international discussions of science. I argue that the main discursive regime, namely the model of "science for national development," encourages the exponential rates of science globalization. In conclusion, I point to the instrumentalist approach that dominates any policy discussion and academic investigation of science globalization.

Chapter 2 argues that such discursive tendencies to instrumentalize, rationalize, and localize science result in the dismissal of the cultural origins and nature of modern science. In contradiction with the attitude which regards science as a technical means for a social and predominantly national end, I argue that science is a global cultural framework which embodies a secularized faith in rational order. Science offers a particular world-view of order, rationality, and human agency or action. By carrying this cultural "core," science is a pivotal part of the spread of modernity and is a central feature

of the global polity. Nation-states that incorporate scientific institutions permit (probably in an unplanned manner) this world-view to permeate their societies.

In this Chapter, I also describe the general model for the effects of science globalization on nation-statehood: science globalization results in scientization, and scientization results in changes to national practices in accordance with the modernist concepts that scientization carries. Then I proceed to provide two examples for such relationships. First, I specify how the scientific concepts of order and rationality are incorporated as part of the scientization process, and how this process leads to the rationalization and standardization of practices and images of nation-states worldwide. Second, I discuss how the science-embedded concept of human agency results in the alteration of local polities to become participatory polities. These theoretical assertions are empirically tested in Chapters 4 and 5.

Chapter 3 sets the base for cross-national empirical investigation, by operationalizing the general models, describing the data, and specifying the statistical models. Applying these data and model specifications, Chapter 4 focuses on the effects of scientization on the standardization of national practices. In numerous empirical models, it shows that science practice is central to the standardization of various dimensions of governance. Specifically, it demonstrates that intense science practice results in the institutionalization of an active and expanded national information sector, in greater cross-national standardization of management practices, and in the cross-national standardization of images of governance. In general, these tests show that science practice enhances the signals of administrative competence and is related to the development and globalization of rational bureaucracies. I conclude that scientization encourages standardized, rationalized, and bureaucratized nation-statehood through the introduction of modernist concepts of rational order.

Chapter 5 adds to this conclusion by focusing on the effects of scientization on nation-statehood through the modernist concept of actorhood and agency. Again, in numerous

empirical models, I shows that science practice encourages (a) the construction of various political actors and (b) the empowerment of social actors to engage politically. This evidence demonstrates how science practice alters local political culture, by supporting the institutionalization of participatory politics. Science carries modernist and global notions of identity politics, self-determination, and democratization, and its incorporation alters national concepts of governmentality.

In Chapter 6, I summarize the evidence as for the effects of scientization on nation-statehood: scientization is associated with rational bureaucratization and with participatory politics, both of which indicate the liberal form of governmentality. I, then, discuss how science and its ethos are integrally linked with the ideology and the practice of nation-statehood. These linkages are established historically in modernity and are strengthened further by the current world polity. Moreover, in this Chapter, I reflect on science as a national ritual, by pointing to its social role as a legitimacy-providing institution, rather then a technically functional institution. To support this assertion, I review the involvement of non-rational elements in the process of science globalization. Overall, the discussion of scientization and liberal forms of governmentality broadens into the general discussion of the interrelations between globalization processes and nation-statehood. Whereas globalization and nation-statehood are co-constitutive, meaning they each reinforce each other's practices and discursive themes, my discussion draws attention to the impact of cultural globalization processes. I emphasize that global norms are powerful for the constitution of nation-statehood, its identity, and its practice.

CHAPTER 1

THE GLOBALIZATION OF SCIENCE

Science is one of the social spheres most influenced by, and subject to, the processes of globalization[1]. The global expansion of the institution of science, its practices, organizations, and world-view[2] -- or science globalization, is one of the most rapid expansion processes in recent times. This process is fueled not merely by general globalization pressures, such as the increasing global nature of trade and labor, but also by the scientific ethos. Science, unlike other social institutions[3], defines its domain as universal and its inquiry as boundary-less (see, Merton 1973). As such, science globalizes at an exponential rate: by the 1990s all nation-states published at least 10 papers in scientific journals, 95% are linked with the Internet, about 80% have at least one science organization (such as a professional association or a policy agency), and 35% have a governmental ministry for science affairs. This accelerated globalization of science results in both (a) the institutionalization of an international field of science and its construction as a source of legitimacy and (b) in the diffusion of science institutions and culture to all nation-states. These trends – on both global and national levels – have both organizational and discursive features. In other words, the organizational and discursive features of science are being globalized both by institutionalizing a global field of science and by the diffusion of this institution to all nation-states.

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[1] Following Robertson (1992), my use of the term "globalization" stands for (a) an empirical acceleration in the trans-national interdependence of activity in a particular field and the diffusion of these organizational formats to an increasing number of nation-states, and (b) a simultaneous consolidation of a consciousness to that field. For further discussion of the intellectual history of the concept of "globalization" and its different definitions, see Robertson 1990, 1992.

[2] In my work, science is defined as a set of institutionalized activities for (a) collecting information by observing nature and society and (b) analysis of such information, both of which are executed through a defined set of methods and by a credentialled professional group. This definition includes what is commonly referred to as Western science; it does not include "esoteric," "traditional," or "local" science.

[3] Art, for example, defines its activity as individualistic, thus cultural embeddedness is assumed. Once culture-specific features are of essence to the institution, it is difficult to raise claims in support of globalization and its cross-national and cross-cultural nature.

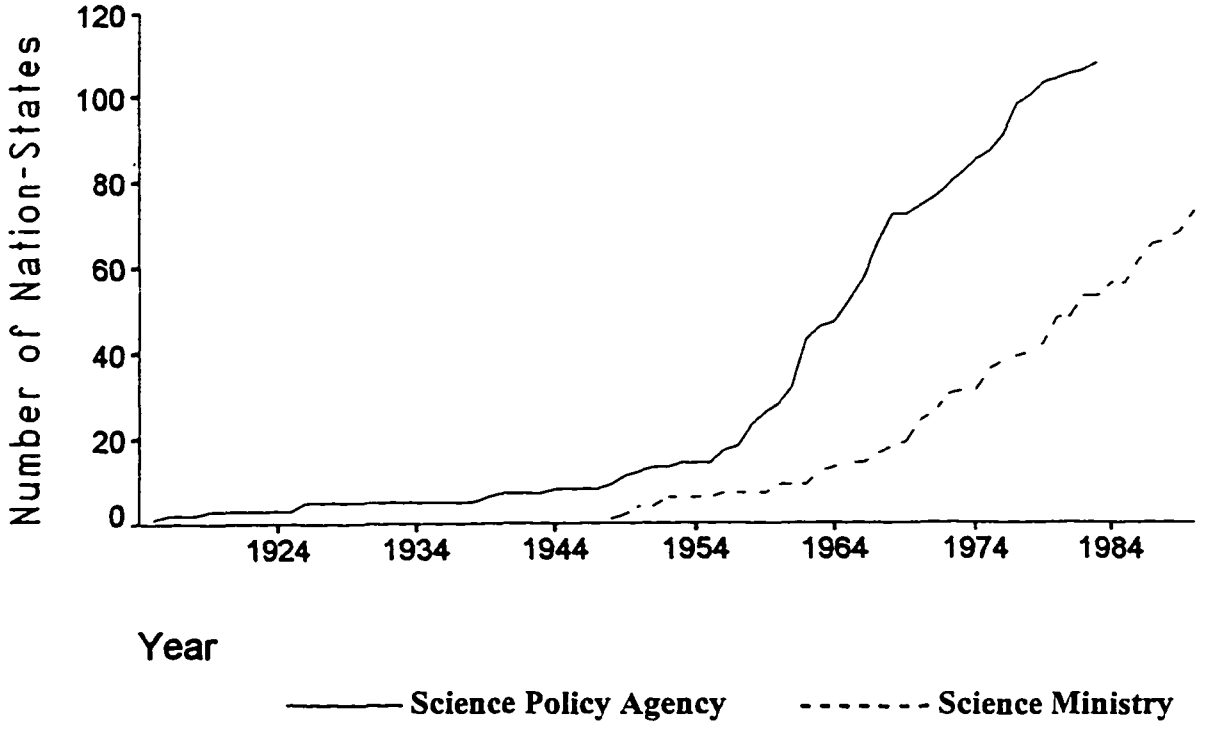
This Chapter describes these features of the science globalization process. In Section 1.1 I describe the main organizational features of science globalization: isomorphism (which shows how similar organizational formats are diffused worldwide) and loose-coupling (which demonstrates that such organizational formats have weak organizational ties among them). In Section 1.2, I describe the nature of the discourses that support the accelerated process of science globalization. I show that there are two main models of approaching and envisioning the social role of science. The "science for national development" policy model regards science as a means for delivering economic progress (Section 1.2.1). It is the most dominant approach to science in international and national fora. Yet, a less emphasized approach towards science considers science globalization in regards to the protection of human rights (Section 1.2.2). It focuses on the infringement of such rights by scientific advancements. I show how both discursive regimes are propagated by international organizations and how their concepts are expressed in policy texts. To conclude, in Section 1.3, I reflect on these policies and academic investigations of science globalization. I argue that all such studies and their conclusions are governed by an instrumental perspective on the social role of science. This dominant attitude in science policy views science as a technical means for a social (predominantly national) end. Most importantly, the instrumental reduction, institutionalized in a universal manner, produces additional effects that are different in nature from the expected effects. Overall, this tendency to instrumentalize science results in the dismissal of the cultural origins and nature of modern science. Hence, it is this instrumental perspective that I transcend in my dissertation work.

1.1 The Global Expansion Of Science Practice: Organizational Features

In addition to the intense differentiation and specialization of the sciences (Barnes 1985) and to the exponential growth in the volume of scientific activity (Gilbert & Woolgar 1974), science expands globally. The expansion of science transcends developmental barriers and regional divisions, regardless of what science indicators are examined or what time period is investigated. Most noticeably, the trends of science globalization

greatly intensified after World War II. Overall, science in its different forms, expands at varying rates in both developed and developing countries, in all regions of the world and continuously during modern times.

Figure 1.1.1
The Institutionalization of National Science: Cumulative Establishment Dates of Science Ministries and National Agencies for Science Policy



1. Sources: Finnemore 1991; Jang 1995.
2. Similar trends, although not as dramatic, are evident when considering the proportional number of nation-states, i.e., the number of states with a science agency or ministry per the number of independent nation-states at any time point.

Such increased rates of science activity are monitored both on a global level and on a national level. Globally, there is a dramatic increase in the number of international science organizations, both professionally and socially-oriented (Schofer forthcoming).

While professional science organizations[4] pioneered the field of non-governmental international organizations, the rise in the sector of socially-oriented science organizations[5] is predominantly a post World War II phenomenon. Parallel trends are monitored for the membership in such organizations (both on a governmental and non-governmental basis), in participation in international science events (such as international conferences), and in the networking among scientists (Schott 1988, 1991). These unifying world trends, especially those following World War II, mark a dramatic change in the consolidation and expansion of the global field of science.[6]

Similar trends of expansion are monitored on a national level. In the field of science education, nation-states increase enrollments in higher education science and engineering programs (Ramirez & Lee 1995) and the relative share of instruction time devoted to science and mathematics in primary and secondary schools rises (Kamens & Benavot 1991; Benavot 1992:156). There is an increase in the scientifically trained labor force, as the number of scientists, engineers, and technicians rises. There is also a dramatic rise in the production of science, as measured by paper publication, citation counts of scientific papers, book titles in the sciences, registered technical patents, etc. There is an intensive growth in the participation of nation-states in scientific exchange, as measured, for example, by the rates of national participation in scientific conferences and national memberships in scientific organizations. Finally, there is an expansion in the field of national science organization: an increasing number of nation-states have a ministry of science (Jang 1995) and a national body for science policy (Finnemore 1991, 1993).

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[4] Such as, the International Sociological Association, the International Union of Geological Science, and the International Union of Biological Science.

[5] Such as, the International Network of Engineers and Scientists for Global Responsibility and the International Organization of Chemical Sciences in Development.

[6] While science consolidated into a coherent organizational field with a unifying ethos and a web of inter-locking relations, world affairs somewhat affected its unity. For example, the Cold War encouraged the construction of somewhat differentiated scientific communities in the West and the East blocks; within these political blocks, scientific connections were denser then they were across the blocks. There is also some evidence that the scientific practice in each group of nations developed in unique tracks; science in Communist countries centered in the 1970s around engineering, space, and basic natural sciences, whereas Western science focused more on the medical and biological sciences (see, Frame, Narin, & Carpenter 1977). Nevertheless, the Western and communist science practices did not reveal distinct definitions of science, as Schott's (1992a) analysis of Soviet science shows.

Figure 1 and Table 1 provide examples for the rapid expansion of national science in the post World War II era. In summary, these different measures of growth in national scientific activity indicate the establishment of a national-level field of science. By the early 1990s an overwhelming number of nation-states incorporated science into their practices and established agencies to further devise plans for science growth.

Table 1.1.1
The Expansion of National Science: Selected Measures

Variable Name N=	**Year**	**Mean** (Std. Dev.)	**Coef. of Variance**
Enrollments in Tertiary Education - Ratio to Relevant Age Group N=106	1950 1955 1960 1965 1970 1975 1980 1985	1.94 (2.82) 2.50 (3.52) 3.50 (4.72) 5.66 (7.31) 6.96 (8.47) 10.06 (10.55) 11.85 (11.50) 13.79 (13.13)	1.45 1.41 1.35 1.29 1.22 1.05 0.97 0.95
Memberships in ICSU Organizations N=203	1954 1959 1964 1969 1974 1979 1984 1989	1.71 (3.44) 2.31 (4.33) 2.84 (4.91) 3.59 (5.80) 3.89 (6.23) 4.47 (6.23) 5.38 (7.53) 5.60 (7.57)	2.01 1.87 1.73 1.62 1.60 1.48 1.40 1.35
Paper Publications in Scientific Journals ("Hard" Sciences) Per 100K Citizens N=134	1973 1978 1982	.07 (.17) .34 (3.14) .43 (4.29)	4.722 4.949 4.879
Scientists & Engineers in R&D Per Million Citizens N=37	1960 1970 1980	682.16 (828.24) 1098.30 (1278.86) 1549.16 (2022.95)	1.21 1.16 1.31

Isomorphism. The process of science globalization demonstrates increasing homogeneity of forms, or much institutional isomorphism (see, Shenhav & Kamens 1991). Different nation-states, regardless of their nation-specific characteristics, structure national science in a similar set of organizational formats. For example, most nation-states practice a similar range of scientific specialties, incorporate programs for science education in schools (Kamens & Benavot 1991), establish universities as the basic organizational form for academic life (Riddle 1989), form a national agency for science policy (Finnemore 1991, 1993), and include science as a ministerial duty (Jang 1995). Moreover, countries differentiated by developmental conditions or political alliances emphasize similar research problems for their national scientific communities (e.g., Schott 1992a regarding Soviet science). Hence, while the overall magnitude of scientific activity is still concentrated in the hands of a few countries (mainly core countries), and while national scientific communities are embedded in multiple environments[7], the variance between nation-states in the patterns of scientific activity is declining.[8] The consistent decline in the coefficient of variance of various indicators of science practice over time, as presented in Table 1.1.1, provides some evidence for growing worldwide convergence of forms.

Institutionalization and Consequent Loose-Coupling. While the practices of science are being diffused worldwide and incorporated into various nation-states, these practices are not incorporated in a coherent manner. Therefore, as a result of the global institutionalization of science, within each nation-state one scientific practice is only loosely-coupled[9] with another scientific practice. This assessment is supported by a few studies of science in less developed countries (LDCs): in these countries science is

[7] Schott (1992b) describes Swedish research as simultaneously embedded in, and oriented towards, the American center and the Nordic and European environments.

[8] The isomorphic nature of science globalization extends also to texts. Policy texts, for example, not only reflect an identical attitude towards science and its social role, but also make use of similar phrases. This is demonstrated in Section 1.2.

[9] Loose-coupling is defined as an organizational structural condition where organizational subsets are weakly coordinated or independently developed and operated (see, Scott 1987a:262). It describes the

compartmentalized into different functions, different organizational settings, or different social networks. For example, Rossum & Hicks (1997) show that during the 1990s there exists little interaction among scientists in sub-Saharan Africa. Hence, while science thrives on social interaction among scientists and, while all sub-Saharan scientists are involved in a scientific network in the North, there exist merely weak South-South relations in the domain of social and economic sciences. Similar results are presented by Velho (1976) in regards to Latin American scientists. He shows that only 2% of the citations in scientific papers written by scientists from LDCs are of scientific literature written by their colleagues from LDCs. Ramirez & Drori (1992) investigate this phenomenon with different indicators and different methodology, yet we reach similar results. Based on a structural equation model for 126 less developed countries circa 1985, we calculated that the correlation between science practice and science policy is weak and non-significant (r^2=.20). This demonstrates that in less developed countries there exists a gap between policy and practice in science.[10] Overall, loose-coupling is an outcome of general institutionalization processes, which exert pressures towards the incorporation of scientific practices.

To summarize this Section, these different measures of science practice indicate a rise in various dimensions of scientific activity. Moreover, these examples reveal a dramatic expansion of world-level science: science is currently based within a dense global web of organizations and science is institutionalized in all nation-states in a somewhat similar form. Why does the field of science experience such rapid rates of globalization? Why do nation-states, which differ greatly in their needs and cultures, incorporate a similar form of scientific activities into their practices? The globalization of science is greatly supported by the image of science. Therefore, due to the perception of science (that is, the social role assigned to science) nation-states incorporate science into their structures and practices. Section 1.2 describes this image of science.

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connections among organizational units or fields and "may vary in strength along a continuum from very loose or decoupled to tight" (Beekum & Ginn 1993:1296).

[10] This evidence does not apply to developed countries, where the factors of science policy and science practice were empirically undifferentiated.

1.2 The Discourse Of Global Science

The image of science is crystalized in numerous texts about science. Such policy texts and academic investigations explicate the discourse of global science, or the dominant perspective about science. This discourse has two variants[11]: the first describes science as defined through development, while the second variant describes science through its impact on human rights. While both are enthusiastically advocated by international organizations, their influence is unequal: the discourse of science and development is overwhelmingly dominant, while the discourse of science and human rights is marginalized. This Section describes both variants of this discourse, their unique definition of the social role of science, the texts that embody this definition, and the agencies that promote each discursive variant. While it may seem as if the two variants of the discourse are antithetical to each other, I find great discursive similarities among them (Section 1.3).

1.2.1 The "Science For National Development" Policy Model

Science is highly praised as a requirement for any modern, civilized, economically vibrant nation-state. Like education and technology, science paves several paths towards national development. While some researchers and policy-makers take a normative approach towards national progress[12], most discussions rest on a structural,

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[11] I employ the term "variant" to emphasize my point that there exists only one global discourse about science, namely a utilitarian, econo-centric discourse, as summarized in Section 1.3. Yet, under this discursive "umbrella" exist two versions of it, each exhibiting science's utility in reference to a unique dimension of econo-centricity, namely human rights or national development.

[12] The normative approach to national progress argues that development relies not on structural factors, but rather on the gradual change in the nature of the people who together compose nation-states. Accordingly, social change is caused by the change in the normative orientation of the members of society; it is values, motivations, and psychological forces that bring societal changes about. While this approach draws extensively from Weber's canonized work *The Protestant Ethic and the Spirit of Capitalism* (published 1904), it also furthered the study of (a) normative effects on social change to consider the characteristics of the "modern man" (e.g., Inkeles & Smith 1974) and (b) the components of the "mental virus" and the processes by which it "transmits" modernity (e.g., McClelland 1961, 1969). Regarding the role of science in national development, the effects of science -- positive or negative -- are mediated by the normative position that is carried by science. Science is the carrier of a rational, cause-and-effect world-view, which is based on Western logic -- what is called "the scientific mind." Thus, it is the normative changes in the

instrumentalist perspective. According to the structural-instrumentalist approach, science is a major factor in the deliverance of progress.

The Model. The "science for national development" (SND) model describes national economic growth as dependent on the scientific and technical capabilities of the labor force. Such capabilities rely on the level of advanced scientific and technical training. Such advanced training relies on the foundations of science education in primary and secondary schools. In general, the effects of science on national development are mediated by the skillfulness of the labor force and, hence, resting on a foundation created for the use of sophisticated technology and advanced manufacturing practices. In this scheme the role of science is two-fold. First, science is used as an education mechanism to (a) shape positive attitudes towards modernization, and (b) train candidates in science and technology, in this way, preparing them for higher education and more sophisticated production roles. Second, science is used to create a knowledge base for technology, either transferred from Core economies or locally produced. I summarize this conceptualization of the social role of science into the model of "science for national development." Figure 1.2.1 is a graphic illustration of the principles of the SND conceptual model.

The SND model establishes a causal link among science schooling, advanced or "applied" science, and the economic conditions of the nation-state. It regards science as a means, or a mechanism, for achieving the objective of national progress. This model elaborates on the notion that science and economic progress are mediated by technology, by specifying that it is the technical capabilities of local personnel, and the technological products created by such skilled laborers, that stand for what was previously generalized as "technology."[13] Furthermore, implied in this conceptual model is that specific

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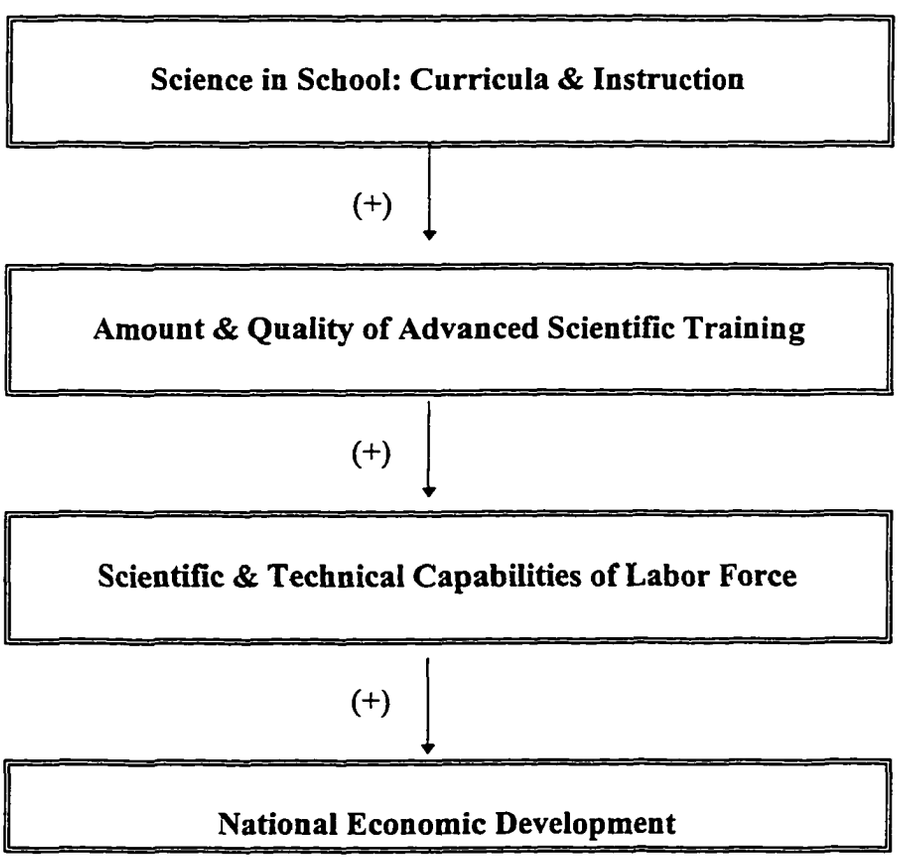
indigenous people, who are now science educated, that lead to national development. As Kelly (1990:53) states, albeit in a somewhat different context: "the idea is not merely to provide education in science, but education through science."

[13] For explanations, empirical testing, and a critical assessment of the hierarchical model among science, technology, and the economy, see Drori 1993.

scientific disciplines are expected to contribute to the advancement of their relevant economic sector. For example, medical sciences affect health conditions, physics leads to the development of atomic energy sources, engineering and geo-physics contribute to solving problems of water resources, etc.[14] Finally, a national emphasis on selected scientific disciplines may also provide a competitive edge to the local economy. For example, African countries can emphasize zoology and botany, thus relying on a rare and unique local resource and providing an opportunity for increased tourism and related revenue.

Figure 1.2.1
The Image of Science I: The "Science for National Development" Policy Model



[14] Nayar's (1976) study of India is an example of a discipline-specific approach to national development.

The SND model has four main assumptions. First, the model regards science as a national project, i.e., a scheme which is aimed at providing benefits for the nation as a whole and which relies on national financial support and societal legitimacy. Second, it envisions a particular plan, or systemic program, for the achievement of national development. Unlike national policies for the support of, for example, the arts, the SND plan is very explicit in its vision of the path which leads from science to national economic development: science education leads to a scientifically and technologically skilled labor force, and such skilled personnel enables industrialization and economic progress. Third, it considers science to be a "real" social institution, rather than a socially constructed phenomenon. And, last, the model allows for the discursive regime of "national development" to dominate any discussion of science and its social role.[15] In this sense, "development" is the master narrative for any discussion of science issues.[16] This trend parallels an increase in development-related arguments in other social spheres; for example, education policy and educational aims during the 1950-1970 period are also deeply immersed in developmentalism (Fiala & Gordon-Lanford 1987). Moreover, the vision of national development is reduced to economic development, i.e., the type of national development that is easiest to quantify and easiest to monitor.[17] In summary, the SND conceptual model promotes a vision of science as (a) national, (b) systemically planned, (c) realist, and (d) development-oriented, economic-centered, and utilitarian.

This conceptual model rests on the theoretical foundations of the structuralist-functionalist modernization theory, which is essentially a liberal socio-evolutionist perspective. Like other expressions of the Western models of rational utlitarianism,

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[15] For analyses of the international discourse of developmentalism, see Escobar 1983, 1995 and Ferguson 1990. Ferguson (1990) also offers an example of how this reductionist discourse forces countries such as Lesotho into the uni-dimensional category of LDCs.

[16] While here I emphasize the subordination of the science discourse to developmentalism, these discursive regimes, in fact, are mutually supportive. The faith in science and technology is one of the main factors shaping developmentalism and its policy plans (Escobar 1995:32, 35-36). See also Escobar 1983.

[17] Even the normative approach to national development (which, as mentioned earlier, regards science as promoting values and motivations of modernity) or the "new model of development" (which identifies the objective of national development as both economic and cultural in essence; Mayor 1982) are focused, at the last instance, on economic results. In other words, although these approaches identify seemingly

(especially in policy circles) the SND model is taken for granted as a neutral and context-free paradigm. Whether viewing social development as a unidirectional progression (along the lines of, for example, Toennies' studies of community and Durkheim's studies of organic and mechanic social solidarity) or whether viewing it as a continuous process (along the lines of Parsons' definition of pattern variables), all advocates of modernization theory envision an "ideal type" of society. When applied to the study of nations, modernization theory conceptualizes the process of national development as divided into stages. Hence, the condition of the developed countries is regarded as a higher state, or an advanced level, of achievement for nation-states, and the condition of Third World countries is merely a lower, more backward stage. It further supposes that situations and events may be replicated from one nation to another. It suggests LDCs follow in the footsteps of developed countries (DCs), in order for LDCs to achieve the desired economic prosperity and social liberties. In this scheme, science is envisioned as a mechanism that proved effective in the progress of DCs, and, thus, is expected to reap similar benefits for LDCs. Furthermore, the SND policy model is rooted in the related political notions of the nation-state as a goal-oriented, rational, authoritative, inter-linked yet autonomous actor. This is, in effect, an expression of the dislocation of the authority of governance away from the world polity -- its discursive regimes and organizational carriers. This discursive dislocation is, however, misleading, as demonstrated in the following sub-section, since the SND model was formalized, and is propagated, mostly by international organizations.

The Role of International Organizations in Propagating the SND Model. While science and technology have been agenda items for the UN and UNESCO since their formation, more concentrated and organized efforts to promote SND started in the late 1950s. Since then, all development and science-oriented UN agencies convey similar messages that present science as a means for national economic development. During this period, there is an increase in the number of policy declarations by UN agencies that

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unique factors -- values of modernity or a combination of cultural and economic elements -- as mediating between science and national progress, their focus is still on economic development.

promote the issue of SND and there is a parallel increase in the attention given to this issue (for example, in the number of reports about SND and the number of pages devoted to SND matters in summary volumes). Moreover, during each Development Decade science and technology were highlighted as focal concerns for progress-seeking nation-states. The first Development Decade brought the 1963 Conference on the Application of Science and Technology for the Benefit of the Less Developed Countries, held in Geneva. 1963 was also the first year UN publications formally organized and presented the topic of SND as a separate category or chapter (while earlier publications devoted relatively small and separate sections to science and technology-related topics). The 1965-1970 preparatory work of the Committee on the Application of Science and Technology to Development shaped the resolutions for the Second Development Decade, adopted by the General Assembly (24 October 1970). And, finally, the peak of UN efforts to promote SND are (a) the 1979 Vienna Conference on Science and Technology for Development and the "Vienna Program" (the program of action to conclude the Conference), and (b) the declaration of 1980 as the International Year of Science and Technology for Development.[18]

The efforts of UN agencies to promote SND reached far beyond the assembly of periodic international conferences. In addition, UN agencies organized regional conferences and conferences directed at target countries, such as the Rehovot, Israel 1960 conference which was aimed at newly formed states (see, Gruber 1961). UN agencies also sponsored and widely distributed a multitude of publications on SND, ranging from proceedings of expert conferences to case-specific studies on the effects of scientific projects on development or the effects of science in certain countries and regions (e.g., Clarke 1985; Ajeyalemi 1990; Eisemon & Davis 1991). Since the issue of SND is of concern for several UN agencies[19], coordinating organizations for SND were created. Such organizations are, for example, the Intergovernmental Committee on Science and

[18] These 1979 events are viewed as water-shed points in the UN promotion of SND (see, Rittberger 1982).
[19] Such as, United Nations Conference on Trade and Development (UNCTAD), United Nations Industrial Development Organization (UNIDO), and United Nations Education, Scientific, and Cultural Organization (UNESCO).

Technology for Development (established 1971) and the UN Center for Science and Technology for Development (established 1980). This organizational basis for SND was altered several times to accommodate both parallel structural changes in UN organizations and concerns for efficiency. Today all SND matters are concentrated in the hands of the UN Commission on Science and Technology for Development (under the auspices of ECOSOC), which is a 53-member body set on a governmental basis. Finally, UN agencies promote SND by funding SND-related projects. Such financial sponsoring covers both (a) the establishment of science projects in specific countries (as in UNDP-sponsored projects, which range from building weather predicting stations to providing schools with equipment for science laboratories) and (b) the funding of expert evaluation as to the effectiveness of current projects and providing recommendations for future work.[20]

In addition to the organization of the SND field by UN agencies, these agencies also imprint texts of national science policy with the imagery of science. Figures of speech, which are used to covey the social role of science as the basis for national progress, are found first in policy statements of UN agencies and later in national policy texts. The following policy declarations are but samples of the most explicitly argued policy statements:

> "The General Assembly, [c]onvinced that science and technology can make an outstanding contribution to economic and social progress"
> United Nations - General Assembly Resolution 2318(XXII), 15 December 1967.

> "The General Assembly, [n]oting that scientific and technological progress has become one of the most important factors in the development of human society"
> United Nations - General Assembly Resolution 3384(XXX), 10 November 1975.

[20] Like SND's administration, the funding channels of SND also went through organizational changes. For example, the Interim Fund on Science and Technology for Development (established in 1980) was re-organized in 1982 into the UN Financing System for Science and Technology for Development, and re-organized yet again in 1986 into the UN Fund for Science and Technology for Development.

> "We, the participants in the Project 2000+ Forum...[b]elieving that scientific literacy and technological literacy are essential for achieving responsible and sustainable development"
> UNESCO - Project 2000+, Paris Declaration, 5-10 July 1993.

Other examples of statements by UN agencies are stylized as directives and, thus, are more explicit. For example:

> "Governments that are interested in laying the groundwork for a more technical oriented economy...should place heavy emphasis on general mathematics and science...These subjects are relatively inexpensive to teach and are likely to promote economic growth more efficiently than can in-school vocational education"
> The World Bank, *Education in Sub-Saharan Africa*, 1988:62.

Similar statements are echoed in declarations of national policy organizations. For example:

> "The Government sees higher education and the institutions of higher learning as the major means for scientific, technological, and cultural progress, as an important support for the economic and social prosperity of the State"
> Basic Principles for Government Policy, Government of the State of Israel headed by Mr. Yitzhak Rabin, 1992, section 9.11.

> "The Council believes that it is of national importance that all Canadians receive a quality education in science and technology. For Canada to cope with social changes rooted in highly specialized technologies, its citizens need the best general education possible - an education comprising not only of the traditional basics of language and mathematics, but also the *new* basics of our contemporary culture: science and technology"
> Science Council of Canada, *Science for Every Student* (Report 36), 1984:9.

UN agencies[21], and other international organizations, are instrumental in the diffusion of these policy texts worldwide, and, hence, encourage the isomorphism of policy texts (see, McNeely 1995). Most importantly, these organizations serve as sites for the expression

and articulation of the dominant SND discourse. It is in their texts that the discourse is most explicitly demonstrated. In this way, they play a pivotal role in shaping the discourse on SND – in the organization of the field of SND and in their worldwide promotion – while simultaneously being constructed by this discourse.

Additional contributions to the globalization of science imagery is provided by international non-governmental organizations (INGOs). International scientific associations, both professionally and socially-oriented, carry the scientific ethos of universalism and the notions that science is useful for growth-seeking nation-states. Aimed at gaining legitimacy for their groups, professionally-oriented science organizations use a specialized jargon to convey the usefulness of their professional disciplines. Socially-oriented scientific associations, which -- by definition -- promote social responsibility of scientists and scientific disciplines, establish a strong link between the vocation of science and the setting of national and global goals, among which development is a central concern. Both these types of science organizations carry the imagery of science as a means for national development. Of course, the texts of socially-oriented science INGOs are more explicit then the texts of professionally-oriented science INGOs in their definition of their goals as having a social import. Also, general science organizations have a stronger ability to affect development issues then do disciplinary scientific associations. Following are several excerpts from the definition of aims by various science INGOs[22]:

> "...Strengthen the earth sciences and their effective application in the progress of developing countries"
> (International Commission on the Lithosphere[23])

> "...Promote establishment and use of chemical information systems to solve specific problems, particularly those related to national

[21] For a review of the efforts of UN agencies to promote SND, as summarized by the UN, see UN 1968:214-220, 1979:82-84, 1986:208-213.

[22] The information about the following international science organizations (aims and characteristics) are collected from Yearbook of International Organizations 1993/4, Volume 1 (Union of International Associations 1993).

[23] Established 1980; Headquartered in Ottawa, Canada; Membership: individuals from 66 countries.

development,..."
(International Chemical Information Network[24])

"...Reaffirm the role of culture and of scientific and technical research in solving the complex problems posed by development..."
(Community of Mediterranean Universities[25])

"Promote and foster the growth of scientific community in Africa, and stimulate and nurture the spirit of scientific discovery and technical innovation as to serve socio-economic development and regional integration and world peace and security..."
(African Academy of Sciences[26])

"...Endeavour to harness the chemical sciences to work towards solutions of socio-economic problems...Identify the needs, problems and opportunities and assist in the determination of priorities for development in respect to the chemical sciences in less-developed countries; Focus attention, effort and resources from developed countries onto the needs and problems of developing countries by enlisting the help of selected specialists and institutions to assist in specific development programs..."
(International Organization for Chemical Sciences in Development[27])

In summary, both governmental and non-governmental international organizations promote the SND model, and, hence, the imagery of science which it carries. Their contribution to the institutionalization of this discourse and to its organizational base is tremendous: they set the agenda, formalize the discourse, organize the field, and, most importantly, are responsible for the diffusion of scientific imagery into all nation-states. Moreover, the inter-connections among all science organizations, and between them and development-oriented and commercial organizations, establish a dense web of institutional ties, all of which are immersed in, and simultaneously promote, the imagery of science as a vehicle for national economic development.

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[24] Established 1988; Headquartered in Paris, France; Membership: institutions, commercial organizations, and individuals from 27 countries.
[25] Established 1983; Headquartered in Bari, Italy; Membership: 128 universities in 19 states in the region.
[26] Established 1985; Headquartered in Nairobi, Kenya; Membership: individual fellows from 23 African nations and 5 foreign fellows.
[27] Established 1981; Headquartered in Mexico City, Mexico; Membership: individuals, scientific organizations, and research groups from 31 countries.

1.2.2 Science and Human Rights

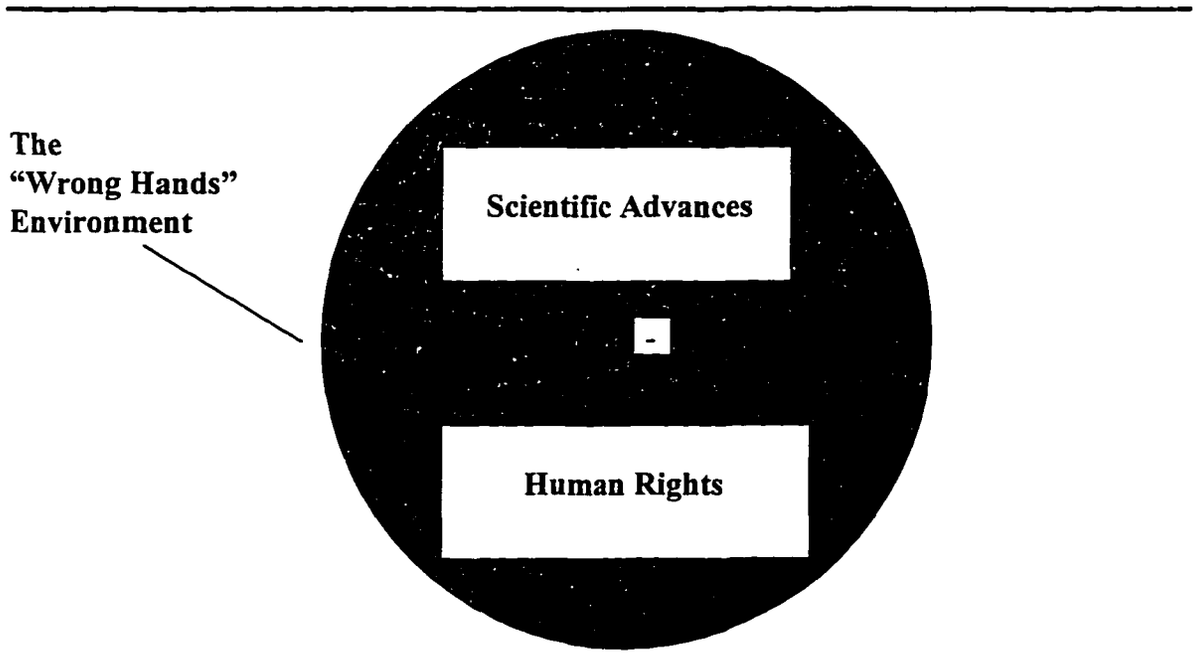
The international discourse of science, while reigned by the SND model, offers another, however marginal, vision of science's social role. This vision is formulated in, what I call, the model of "science for human rights" (SHR). This model, which connects scientific practices and human rights, is evident in numerous international declarations and policy texts and is presented as the alternative to SND. Based on this premise, the models seemingly diverge on a number of dimensions. While the SND model carries a meliorist perspective on science, the SHR model regards science as a source of infringement on human rights. In other words, while in SHR texts science is mentioned in relation to world peace, security, freedom, and independence, these texts reflect a concern with the infringement of such ideals through scientific means and a call for securing scientific advances so they will not be used for ill aims. For example, the 1975 UN "Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and for the Benefit of Mankind" boldly states that nation-states should:

> "...[R]efrain from any acts involving the use of scientific and technological achievements for the purposes of violating the sovereignty and territorial integrity of other states, interfering in their internal affairs, waging aggressive wars, suppressing national liberation movements or pursuing a policy of racial discrimination"
> UN General Assembly Resolution 3384 (XXX), 1975 [underline added].

In this sense, the SHR model describes science as affecting human rights negatively: scientific advances provide the technical tools to inflict harm on human populations. Technical advances in recording devices (e.g., computerized data banks), for example, infringe on one's right of privacy; psychiatric advances are employed for political torture; and, advances in the bio-medical sciences, which enable artificial insemination and genetic engineering, go against current notions of human development.

Overall, science is seen as a source capable of violating a variety of rights, namely legal, political, medical, economic, and cultural rights. Few and far between are the mentions of the positive effects of scientific and technological advances on human rights. Such texts mention, for example, the contribution of science to sustaining and extending life through eradication of illnesses and control of plagues, the improvement of human relations through the development of communications technology, the securing of life through the technology of weather and natural disaster prediction, or the enabling of popular elections through computerized national data management. None of these positive effects are, however, codified into international formal programs of action. Again, the positive benefits of science in securing human rights are over-shadowed by the attention given to the hazards to human rights by the ill uses of scientific advances.

Figure 1.2.2
The Image of Science II: The "Science for Human Rights" Conceptual Model



The SHR model envisions the relationship between science and human rights as direct. In contradiction with the SND model, where science-development relations are mediated by the skillfulness of the labor force and by technology, science has direct effects on

human rights. It is merely the implementation of scientific advances by "the wrong people" or "for the wrong purposes" that results in the infringement of rights. Thus, there are no mediating elements between science and human rights but rather an environmental factor that shapes this relationship. In this sense, whereas the SND model assumes that the science-development relationship is stable in all times and locations, the SHR model identified the conditions for the relationship between science and human rights. Figure 1.2.2 graphically describes the tenets of the SHR model.

While the SHR model addresses one of the main concerns in modern times – fear of science and technology's evil uses – this issue was marginalized in international discourse and policy. Overall, the SHR model is over-shadowed by the SND model. Moreover, SHR never consolidated as a policy model. In other words, unlike SND which was translated into policy action, SHR does not serve as the guiding principle for a program of action by international organizations or nation-states. Rather, SHR is used as an additional parameter in the general evaluation of human rights' matters. A few factors contributed to this marginalization of SHR and its dismissal as a policy guideline. First, the discourse of development is much more dominant in international affairs than the discourse of human rights. Moreover, developmentalism subsumed the rights' discourse by employing a reductionist perspective onto the definition of rights. For example, the latest "wave" of UN-sponsored studies of science that focus on the effects of science on human rights, share this reductionist perspective by referring to "third generation rights" (Weeramantry 1990, 1993). Their definition of human rights is "peace, development, and healthy environment," their focus is on the rights to work, to proper health care, and to minimal standards of living, and therefore, they also consider progress within a somewhat confined economic framework. This corresponds with the implicit link between economic rights and human rights in other UN texts: namely, the Declaration on the Use of Technological Progress in the Interests of Peace for the Benefit of Mankind (formalized as UN General Assembly Resolution 3384 (XXX) 1975) and the two human rights covenants --- International Covenant on Civil and Political Rights (ICCPR, signed in December 1966) and International Covenant on Economic, Social and Cultural Rights

(ICESCR, signed in December 1966). The peak of such reductionist efforts is the 1981 initiative to institutionalize a "right to development" (see, Ogata 1990:5). This initiative called for the study of this right by a UN sub-commission and for an amendment to the 1975 Declaration to include this newly-fashioned human right. All these texts reflect the dominant attitude that human rights are secured, or at least greatly promoted, by the deliverance of economic prosperity.

Second (and related to the definition of human rights), the broad definition of such rights served as an obstacle for the creation of a supportive international lobby. The expanded definition -- which ranges from the right to privacy, right to work, right to vote, and right for life – resulted in the lack of international consensus on this matter and inhibited international governmental cooperation. Such differences between countries in their definition of human rights resulted in, for example, the abstention of different blocs of nation-states from voting on international action to secure such rights.[28] Therefore, fewer action on the SHR was initiated by IGOs and a smaller organizational basis was created to address this matter.[29] The UN delayed the establishment of the UN Center for Human Rights, located in Geneva, until 1990 and created the post of High Commissioner for Human Rights only in 1994. In general, the issue of human rights was left as the domain of INGOs and in their reports they address the specific matter of scientific and technological effects on rights. For example, INGOs, such as Amnesty International and Human Rights Watch, routinely mention the use of scientific methods in tortures in such places as Israel, South Africa, and Latin American countries. Yet, these organizations lack the "teeth" to stop such violations of international formal norms.[30]

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[28] Western countries consistently abstained from voting on UN resolutions in support of the 1975 Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and the Benefit of Mankind. This Declaration, as well as most of the action towards greater UN human rights work, was initiated by socialist bloc countries.

[29] For a review of UN efforts in the matter of SHR, see Ogata 1990; see also The Economist 1997a.

[30] Another reason why SHR is left to the domain of INGOs while SND is mainly the concern of IGOs is the different reference points in defining science. SND, by focusing on national development, defines science in national terms and therefore appeals to governmental formats (as in IGOs). SHR, on the other hand,

1.3 Summary: On the Instrumentalization Of Science

The globalization of science practices, clearly an accelerated process, is supported by the discourse of science. That is, nation-states incorporate scientific practices and international science organizations are proliferating because of the understanding that science is a useful, or beneficial, enterprise.[31] The international discourse regarding science, whether reflecting the SND or the SHR models, presents science as a strategic resource. Science is viewed as an instrument in furthering social goals, such as economic development, or as an instrument for infringing on human rights, for example, through politically motivated torture. In this sense, the general approach to modern science, from either perspective, is teleological[32]. Hence, both SND and SHR models are products of the same discursive mold, namely utilitarianism. The sole difference between the utilitarian mode of either SND or SHR models is the positive/negative approach to science.

As mentioned earlier, SND is the overwhelmingly dominant model in the international discourse of science affairs. Moreover, SND, unlike SHR, was translated into worldwide policy and action. Hence, it is SND's utilitarianism that most clearly reflects the discourse of, and about, science.[33] This discourse creates an inextricable link between science and economic development by defining science as conceptually dependent on national progress.[34] Since developmentalism is a technical, problem-solving perspective

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appeals to INGOs because it refers to science in trans-national (not national or state specific) terms, namely trans-national values, such as human rights.

[31] While governments do rely on the prospect of benefits when making the conscious decision to incorporate science into national practices, such national action also reflects an enactment of the development "script" by nation-states. The definition of science globalization as a ritualistic act of participation in the discourse of national identity is explored further in Chapter 6.

[32] Alternatively labeled as consequencialist or utilitarian. By either label I mean justifying all (whether an action, a situation, or a meaning) by, and through, their purpose.

[33] In any event, the SHR model does not offer a conceptual alternative to this utilitarian mode. On the contrary, SHR offers another instance of the instrumentalization of science by defining its goals and social role in reference to (the violation of) human rights.

[34] Moreover, in an earlier paper I argue that science is engaged in a retrospective re-definition of its seventeenth century origins to prove that instrumentalism is a natural trait of modern science. In this move science historians over-emphasize the utilitarian dimension of science in seventeenth century writings. For example, Francis Bacon's *New Atlantis* (published 1627) is depicted as an epic description of the uses of,

(Escobar 1995:44), SND's approach instrumentalizes science: it reduces science to its uses, and conceptualizes it as a tool or a technical solution for a social problem.[35] In doing so, it also confines the investigation of the social role of science to merely its "material" dimension and dismisses all cultural accounts of this role.

Moreover, this instrumentalization of science relies on a narrow definition of social goals. It over-emphasizes the goal of economic progress and margnalizes other social goals, such as social equality.[36] Consequently, social research on the effectiveness of science measures scientific success solely by these standards of economic growth. Again, such research dismisses the cultural consequences of the institutionalization and globalization of science.[37]

In addition, the dominant discourse of science is a-historical. It assumes that the consequences of scientific advances are stable over time and in various locations. While this assumption greatly encourages the diffusion of science worldwide, it also corrupts the assessment of such science policies.

Finally, the current discourse of science adds value judgments to the social goals that are served by scientific advances. It juxtaposes the discourses of SND and SHR with the "good science/bad science" debate: SND propagates the "good" consequences of

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and benefits from, scientific advances: improved orchards, improved breeds of animals, and improved medications. Such retrospective reconstruction of the origins and nature of modern science is initiated by the scientific profession in light of the nineteenth century ideals of national development. For further discussion see, Drori 1994.

[35] By "instrumentalism" I mean applying a purely technical approach and assuming a cause-effect relationship. I do not mean "instrumentation," which refers to the focus of scientists on the device aspect, or the apparatus, of their activity (see Knorr-Cetina 1981; Woolgar 1988:88).

[36] As mentioned in regards to the marginalization of SHR in relation to SND, the goal of economic development over-shadows and co-opts even the matter of human rights.

[37] This reductionist and instrumentalist turn in regards to science is a part of a general neo-realist approach. Such approach assume that "stability and change are the result of unanalyzed actors pursuing primordial interests" (Boli & Thomas 1997:171). In academic discussions, and in particularly in sociology, "state-competition...and world-system theories...follow suit, reducing transnational structures to military or economic processes dominated by major world powers" (1997:171-172). It is a part of a general tendency of theories of politics since the 1950s to exhibit instrumentalism, reductionism, utilitarianism, and functionalism (March & Olson 1989:1-19).

scientific advances by focusing on economic growth, while SHR emphasize the "bad" consequences of science by focusing on the violations of human rights. The "good/bad" axis offers a critique of, and seemingly poses the alternative to, each discourse: the critique of SND is the dependency theory's arguments on the enslavement to the Western production mode and logic (Sagasti 1973; Nandy 1988; Alvares 1992), while the SHR's critique is the description of the benefits of scientific advances, such as those mentioned earlier. Hence, the criticism of the current discourse of science is itself instrumental in nature. In this sense, while offering criticism, it does not offer an alternative perspective: the criticism is confined to the instrumentalist approach and merely transposes the perspective on the consequences – harmful versus beneficial. Such criticism does not transcend teleological instrumentalism. In my dissertation work I aim to offer such a transcending approach. I propose to consider the general socio-cultural context of science as the proper perspective on its social role, its consequences, and the process of its globalization.

Following this reasoning, Chapter 2 describes science as essentially a cultural institution, which has general and cultural effects on the societies that incorporate its practices into their structures. Science is not merely a mechanism of connectivity -- to either social institutions (such as, development or rights) or to social networks (such as, the international community). Rather, science is a substantive cultural framework, or – to paraphrase Clifford Geertz[38] -- a web of significance.

[38] In advocating cultural analysis, Geertz (1973:5) writes: "Man is an animal suspended in webs of significance he himself spun. I take culture to be those webs, and the analysis of it is not experimental science in search of a law but an interpretive one in search of meaning."

CHAPTER 2
SCIENCE IN CONTEXT

By the 1990s most nation-states have incorporated at least a few scientific practices: the establishment of national agencies for science policy, routine allocation of national funds for R&D, and the incorporation of science education programs into school curriculums, to name a few. As described in Chapter 1, various nation-states – differentiated by numerous characteristics – adopt these scientific practices with the expectation that scientific progress will result in economic progress. With such instrumentalist expectations for achieving national development, science practices are incorporated into societies worldwide.

These instrumentalist expectations of science are rooted in a confined definition of its social role. This definition, as mentioned in Chapter 1, positions science in relation to national economic development. It, therefore, confines the possible consequences of science to national and economic outcomes. Moreover, it excludes any regard to science as a general and cultural framework and further confines the possible consequences to specific and technical (i.e., limited, rather then far-reaching, and non-cultural) effects. In this work I depart from the instrumentalist discourse on the social role of science. I also describe how science globalization is essentially a cultural process and how science is essentially a cultural institution. I show this by exploring the broad cultural effects that science and its globalization have on various societies.

These arguments set the theoretical ground for my work: how science globalization results in the cultural transformation of nation-states by scientization – the adoption of a scientific world-view (Section 2.1). I then elaborate on how scientization alters the practices and images of local societies (Section 2.2). To provide examples for this general argument I focus on two particular cases of scientization-rooted alterations to nation-statehood. First, in Section 2.3, I discuss how the scientific notions of rationality and order lead to the standardization of practices and images of nation-states worldwide. Second, in Section 2.4, I discuss how the science-embedded notion of human agency (or action) results in the alteration of local polities to become actor-based forms of government. In conclusion, Section 2.5 suggests that these theoretical arguments lend themselves to empirical testing and paves the path towards an empirical assessment of the cultural effects of science globalization on nation-statehood.

2.1 Science as Culture

The cultural perspective is not new to the social studies of science. Previous researchers described research procedures (Galison, Hacking), scientists' interactions (Mulkay, Knorr-Cetina, Latour & Woolgar, Lynch), and scientific techniques and instruments (MacKenzie, Lenoir) as socially constructed and negotiated. This rich tradition is, however, limited to mostly ethnographic or historical work and it excludes comparative studies. Currently, these restrictive views in the cultural study of science limit the understanding of the science globalization process. Hence, in this work I set out to combine a cultural perspective to the social role of science with a comparative investigation into the process of science globalization. Yet when employing this global perspective, I shy away from the instrumentalist arguments of the dependency theorists (Wallerstein 1980) – even when specifically applicable to science (Aronowitz 1988; Sagasti 1973) – since such arguments ignore the complexity and variety of modes in international relations. With this in mind, my study falls within the theoretical framework of world polity theory (Meyer et al. 1987, forthcoming). I highlight the centrality of world polity when investigating national traits and processes, while focusing on their organizational dimensions and describing their roles in providing legitimacy to the nation-state.

In studying science from this cultural and organizational perspective, I argue that science has two main features. First, it is a broad cultural institution that commands great authority and serves as a source of social legitimacy. Second, science is a global institution which is organized at the world level and is further diffused to all nation-states. Moreover, in describing the process of science globalization and its consequences, I argue that these two features are pivotal to the type of effects that science has on its social environment. In other words, it is the qualities of science as a cultural and a global institution that produce particular relations between science and its social environment. The definition of the social role of science should refer to these two qualities as central and break away from an instrumentalist and realist perspective.

Considering that the definition of the social role of science directs the research into the consequences of science, I also attribute broad cultural elements to such consequences. I argue that science is an authoritative and legitimating cultural institution that has general effects on the culture of the societies which adopt its practices. Such cultural effects are felt not only through the specific actions of scientists but on the general model of nation-

statehood. Furthermore, since science is also a global institution, its existence as a part of a nation-state helps link that particular society with the world polity. The aim of my work is to discuss and empirically demonstrate the general effects of science on the cultures of various nation-states.

2.2 Science Globalization and Scientization

Science globalization is not merely the diffusion of science practices worldwide; it is not merely the existence of science ministries in most nation-states (Jang 1995), the institutionalization of science policy agencies (Finnemore 1993), nor is it the submission of scientific journal articles from all countries. Rather, science globalization results in the scientization of the societies that incorporate these practices into their structures. In this view, science globalization has direct cultural implications. Nation-states that incorporate science practices permit science-like, or science-based, modes to permeate society. Adoption of such modes alters the local ways of doing things. Figure 2.2.1 graphically displays this relation between science globalization and scientization.

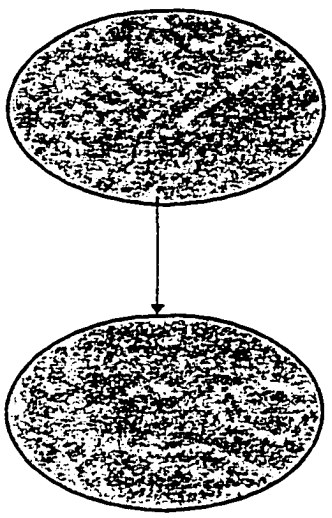
Before further describing the relationship between science globalization and scientization, I would like to elaborate on the nature of scientization. Scientization has three main types of effects. First, science serves as the main source of expertise in a society, as scientific evidence and arguments are valued as the main source of knowledge. Second, science-like practices are incorporated into the routines of various sectors of society, resulting in science serving as the main source of images. Thirdly, scientization results in the incorporation of the scientific world-view, which serves as the main source of concepts and values. Following is an in-depth discussion of each of these points.

Science serves as a source of expertise. Nation-states that incorporate science practices and institutions have higher numbers of experts in various fields, and put a high value on expertise as a source of clout. For example, in scientized societies evidence and judgment are often given by "expert witnesses" whose "expert opinion" is called for in the courts, in infomercials, or in policy discussions. In this sense, the incorporation of science-embedded practices re-organizes the status order of occupations by allowing the occupation of science to take responsibility over social insight and judgment.

Scientization results in a common and casual use of science-like practices. Highly scientized societies are more accustomed to the daily use of scientific "tools." For

example, the daily newspapers in highly scientized societies commonly offer statistical analyses, graphs and charts, whether these analyze election results or trends of global warming. Hence, their audience becomes accustomed to the display of scientific techniques (whose details and complexities are probably beyond the understanding of most readers). Also, in highly scientized societies people regularly refer to statistical evidence or use scientific terms when expressing opinions on various daily issues. In this sense, science-based practices influence the style of daily discourse.

Figure 2.2.1
Science Globalization and Scientization



Science Globalization
- Construction of a global field of science
- Diffusion of science practices to nation-states

Scientization
- Science expertise as valued opinion
- Science-like practices permeate everyday discourse
- Scientific world-view alters national institutions

Scientization results in the permeation of the scientific world-view into various spheres of social life. The scientific world-view perceives the world as ordered, action as rational and social entities (such as humans or organizations) as agentic[1] actors. These themes are not unique to science, rather they are core elements of modernity[2]. As Escobar eloquently states: "Science and technology had been the markers of civilization par excellence since the nineteenth century, when machines became the index of civilization, the 'measures of man'... This modern trait was rekindled with the advent of the development age" (1995:36). Science is, thus, pivotal to modernity, and the scientific world-view is the core of the modernist episteme. Science is immersed in, and loaded with, the themes of

[1] "Agency" refers to the notion of control over one's environment, or the concept of exercising assertiveness over one's destiny. This term is further explained in Section 2.4.
[2] Many are the definitions of "modernity." I rely on Ben-David's general perspective, which defines modernity as the loosely inter-related phenomena of (a) private economic enterprise, (b) liberal democracy, and (c) religious tolerance (1990:389). I add to Ben-David's emphasis on social practices a discursive

Western culture and of Judeo-Christian tradition. In this sense, science serves as the "spear-head" in the globalization of modernity.

Specifically to my argument, the globalization of science, which results in the scientization of various nation-states, leads to the incorporation of this scientific world-view into these societies. Hence, scientized societies share in the belief that the world is rationally ordered and that humans play an active role in the control of their destiny. This shared belief serves as a prism for the evaluation of all other social spheres. In this sense, scientization alters social attitudes, processes, and actions – in social spheres that parallel science. Corporate practices, state procedures, and political culture are all altered by the adoption of the scientific world-view. Nation-states are more accustomed to science-like data involved in their everyday life and national institutions appear more rational and ordered.

The final point in this Section concerns the effects of actions versus general effects. Some researchers stress that scientization changes to a nation-state are dependent on the actions of scientists. For example, scientists serve as advisors to political heads-of-state, so their opinions assist in shaping governance procedures; or, political action is mobilized around scientific evidence and expertise, so scientific research is used to alter public opinions. I wish to expand on this notion, by arguing that it is not merely the actions of scientists that fuel national changes, but also the incorporation of the culture of science. By acknowledging that scientific expertise has a role in social judgment and decision-making, we also acknowledge that science's assumptions (or the scientific world-view) are legitimate. This assertion opens the door to the study of the ways in which science globalization alters local cultures through scientization.

2.3 Scientization and Changes to Local Cultures

Scholars and lay-people banter around phrases like "global economy" and "global village" in describing the currently-dominant social process – globalization. Globalization is also fashioned as a focal concern of social scientists – economists, political scientists, and scholars of culture studies. All agree that national and international entities are deeply integrated into a globalized field and acknowledge that globalization processes exert great pressures on local, namely national, contexts. Yet, the

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dimension, thus considering the knowledge/power perspective on the institution of modernity (see, Foucault 1980).

form and extent of such pressures is still disputed. In addition, the consequences of globalization pressures on the re-shaping of local societies is under discussion.[3] Overall, this tradition investigates the tensions created due to of the exertion of globalization pressures onto local, or intra-national, environments. In the following Section, I discuss such globalization pressures in the domain of science. I then elaborate on the consequences that science globalization bears on local environments through scientization.

The incorporation of scientific practices and institutions (namely, science globalization) leads also to the adoption of the scientific world-view (namely, scientization). Scientization is, therefore, the infiltration of the scientific world-view into society. The scientific world-view, which is immersed in modernity and is loaded with modernist concepts, offers an interpretive perspective on reality. Hence, while nation-states are incorporating science institutions, they are also (probably in an unplanned manner) incorporating modernist notions that are embedded in these science institutions.[4] These notions are central to the modernist episteme, yet they are most prominent in the scientific world-view.

What are some of these modernist concepts? Two examples, which are at the center of my work, are actorhood and rational order. In the context of the scientific world-view these modernist concepts mean that individuals and institutions are attributed agency, social processes are ascribed rationality, and the existence of a natural and social order is assumed. These concepts shape the institution of science by supporting, for example, experimentalism and taxonomy. They are also extended and attributed to the reality that is the object of scientific inquiry. In this way, we can see that the scientific world-view carries modernist concepts of reality – natural and social. The natural sciences, for example, search for laws of action in the natural world, thus assuming the existence of a natural order. In addition, social science research that employs survey methodology constructs the individual as a social actor by regarding individuals as relevant social

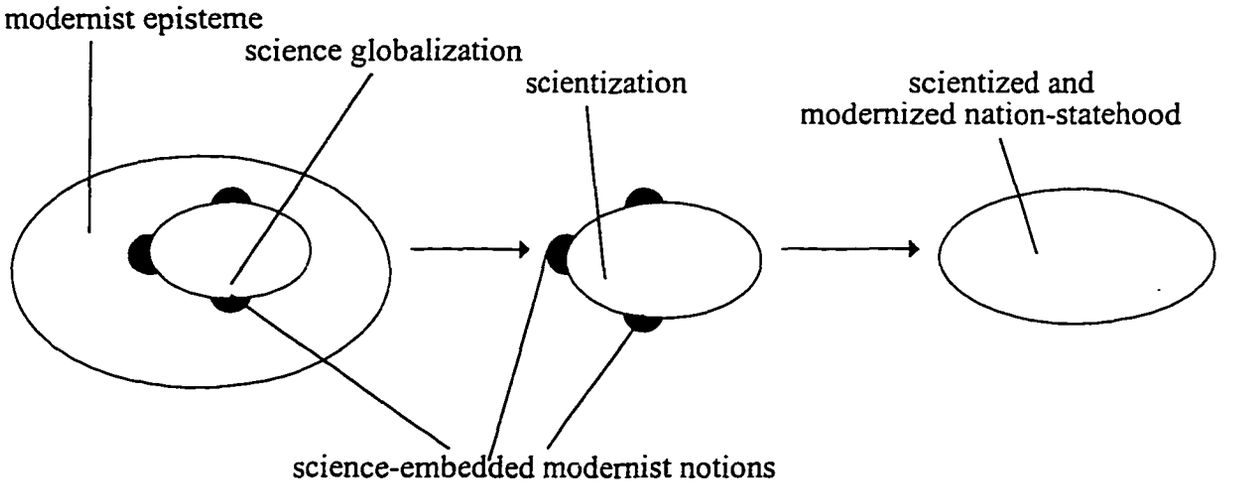
[3] Neo-realists and neo-liberals conclude that domestic factors alone account for the form of local actions and institutions, thus undermining the importance of international factors. Others (e.g., Featherstone 1990; Meyer et al. 1987, forthcoming), on the other hand, regard factors that are exogenous to the local context as crucial in determining local forms.

[4] The incorporation of science into national practices, while being a conscious act of national policy, has an unplanned facet: the incorporation of cultural elements that are a part of the institution of science. In this sense, the incorporation of such cultural elements is not a strategy for rewards (such as, countries that have a more modernized appearance receive more foreign investment), but rather an enactment of the development "script." This issue is developed further in Chapter 6.

entities and attributing meaning to their opinions. Science embodies these modernist notions and scientific practices put these notions into everyday action.

I argue that causal relations exist between science globalization, scientization, and a particular form of nation-statehood. Science globalization, as I have shown, results in scientization. Scientization results in changes to the nation-state. Such changes are in accordance with the modernist definition of nation-statehood in the world polity, and, therefore, also in accordance with the modernist concepts that are carried by science. In a world polity that emphasizes rational order and actorhood, and in which science is infused with these modernist themes, a nation-statehood will consist of a rationalized bureaucracy and a participatory polity. Figure 2.3.1 portrays the relationships among science globalization, scientization, and the current format of nation-statehood.

Figure 2.3.1
Science Globalization, Scientization, and the Modernist Format of Nation-Statehood



The aim of my work is to trace the consequences of scientization and the link between science practices and civil, political, and cultural features in various nation-states. I argue that the scientific world-view of "the natural" (which is, according to science's ethos, the domain of science) translates into a world-view of "the social." Science globalization results in a modification of societies worldwide in accordance with the liberal modern world-view. In this sense, scientization is not limited to the study of "the natural," but rather affects the perception of social order, procedures, and *desiderata*.

What are the science-embedded modernist notions that are being globalized? What are the science practices that are re-shaping societies worldwide? What are the social characteristics that are being re-shaped by processes of scientization? The globalization of science carries with it a few central traits of modern society. Most dramatically, science carries a faith in a rationalized world and in human agency. Scientization results in the incorporation of these modernist themes and, in this sense, science sets the cultural stage for modern social life. By attributing rationality to society, and through the empowerment of social actors, it also shapes modern nation-statehood.

These modernist notions are imprinted into societies which incorporate science and unintentionally, incorporate its world-view. Nation-states adopt the practices of science under the assumption that science will result in greater economic development. Due to the non-rational elements of science globalization, the various consequences of science practice are de-coupled from each other: the national focus becomes the economic and instrumentalist results of science expansion which over-shadows the additional effects of scientization on civil and political practices.

In summary, science is an encompassing social institution which enjoys broad legitimacy and commands great authority. As such, it has effect on its social environment – not only through the specific activities of scientists, but mainly on the general model of society. In addition, science is a global institution, thus scientization links particular societies with the world polity. In this way, scientization exposes local cultures to the worldwide model of society and of nation-statehood. Science, being the spear-head of modernity is pivotal to the diffusion of such global models of nation-statehood.

In the following sections, I discuss the particular effects of the scientific world-view on nation-statehood. I demonstrate several effects of scientization, by pointing to a few possible social spheres that are altered due to their conformity with the scientific world-view and its related modernist notions. I elaborate on the causal model of Figure 2.3.1 by specifying (a) what the particular science-embedded modernist concept is that creates the change in nation-statehood and (b) what the sphere of nation-statehood is that is altered by this science-embedded modernist concept.

In Section 2.4 I discuss how the science-embedded notion of rational order translates into the rationalization of nation-statehood. I also review the social spheres that are altered by the science-embedded prism of rationality – namely, the standardization of various

practices of governance. In Section 2.5, I discuss how the science-embedded notion of actorhood results in changes to the local political culture by (a) the extension of actorhood to various political actors and (b) the empowerment of such constructed actors to take political action. This further demonstrates how scientization alters nation-states worldwide.

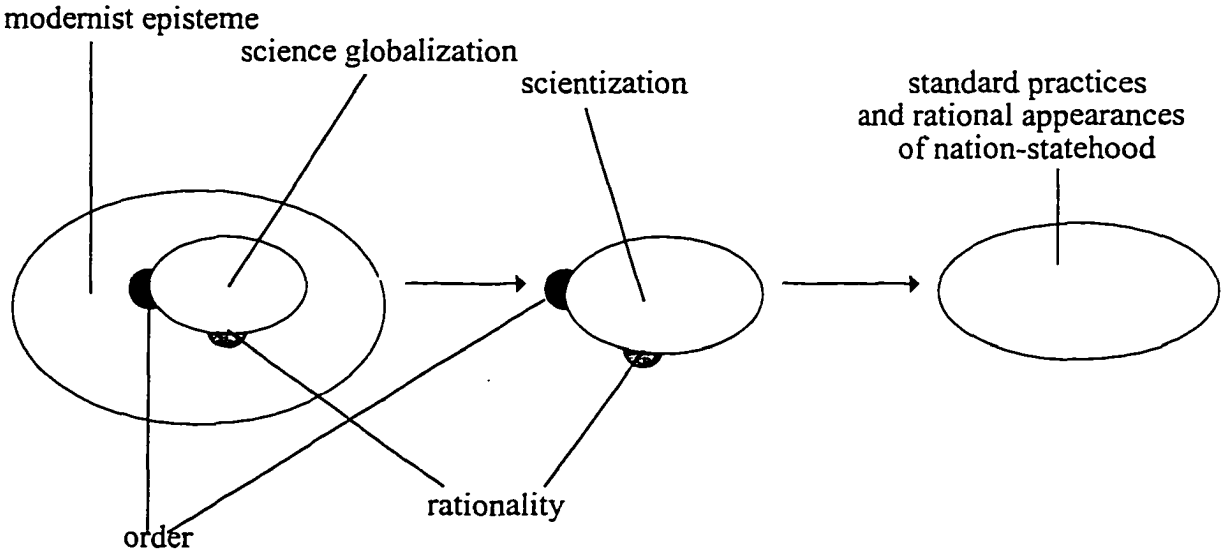
2.4 Science, Rational Order, and Standardization

In the following section, I focus on the incorporation of the modernist concepts of rationality and order and the effects that these concepts have on the alteration of nation-statehood, resulting in a rationalized bureaucracy. I argue that scientization carries the notion of the existence of a rational order, and that scientization results in the attribution of rational order to other social spheres, including nation-statehood. Scientized societies are, therefore, also emphasizing rational action and a notion of order. Rational action is exemplified in a greater tendency towards standardized action. Standardization, in this sense, refers to the acceptance of modes of practice that are (a) generally recognized as excellent and authoritative and are (b) regular and routine. Standardization is the ultimate exercise of technical and rational principles and leads to the elimination of arbitrary rule-making or fatalistic notions. In scientized societies standardization is prevalent, and, therefore, the polity takes a rational and ordered form. Figure 2.4.1 graphically presents the adaptation of Figure 2.2.1 to the relations between scientization and standardization.

First, let me elaborate on the science-embedded modernist concept of rational order. The notion of the existence of rational order – natural and social – is at the heart of the scientific quest for identifying patterns. Identifying patterns relies on the codification, labeling, classification, and organization of knowledge. This scientific attitude is most obvious in the categorization of social and natural realities: the scientific taxonomy of animals into mammals and reptiles; the classification of plants into trees and vines; the labeling of space objects as planets, suns, and galaxies; or the grouping of humans into social classes and racial groups. In all these taxonomies, the scientific labor involves the identification of similarities and differences across the "units," the labeling of such categories, and the sorting of "units" into these categories. In this sense, science's dominant realist episteme encourages the objectification of reality through standardization and officialization.

"One of the quintessential aspects of modernity...(is) the need to compose the world as a picture" (Escobar, 1995:56). Modernity implies that the modeling of reality is at the core of scientism, and that standardization is a core processes in modeling. Modeling requires both abstraction and information. First, information gathering, or knowledge acquisition, is necessary for one to be familiar with the situation of concern. Second, abstraction, or compartmentalization of such knowledge, reconstructs such reality into generalized "sets." The processes of modeling breaks reality into categories, or model components, and then re-assembles them into a relational configuration.

Figure 2.4.1
Scientization and Standardization of National Practices



Furthermore, scientization supports greater conformity with international standards, whether in regards to practices or to presentation. In this sense, scientization encourages greater worldwide standardization - that is, not just within nation-states but also across various nation-states. This is due to the ethos of science, which claims that knowledge and scientific laws are universal. Hence, if knowledge is accepted as universal and scientific laws are regarded as boundary-less, then knowledge categories are transferable from one social context to another. Therefore if, and once, patterns are identified and models are constructed, then modes of operation are transferable from one context to another. Most often the transfer of knowledge-categories (and models) is from the core countries to the peripheral ones.

In summary, scientization involves the infusion of the social logic of ordered rationality into all nation-states, as these notions are rooted within the scientific world-view and are embodied in globalized scientific practices. Therefore, scientized societies are more amalgamated with these modernist notions of rationality and order. Since these notions are embodied in standardization, scientized societies are more apt to engage in standard practices and to employ standard images. Moreover, scientized societies are more likely to engage in international standards.

2.5 Science, the Social Actor, and Political Culture

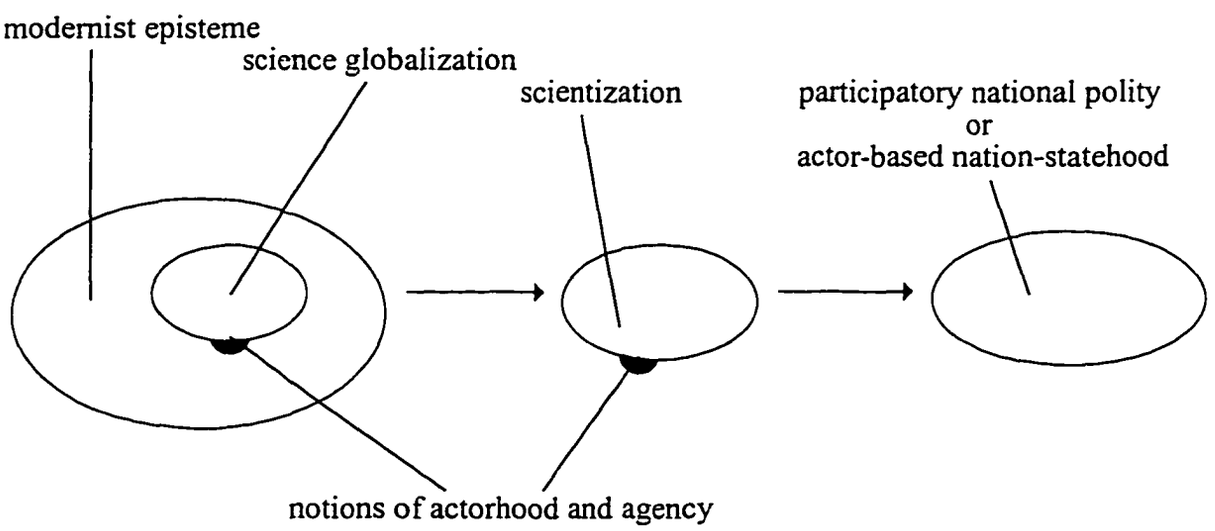
Following the logic that scientization alters local cultures (Section 2.3), in this section I focus on the consequences of the modernist concept of actorhood. I argue that scientization carries the modernist concept of actorhood, and that this concept alters the local polity and the definition of nation-statehood. Actorhood refers to constructed social entities (e.g., humans, organizations) and attributes agency to them. Scientization, by carrying and diffusing actorhood, encourages greater political mobilization and an expansion of the discourse of political actorhood. It seems, therefore, that the incorporation of science into various national societies promotes changes in these societies towards this liberal, Western model of nation-statehood. Figure 2.5.1 graphically presents the adaptation of Figure 2.3.1 to the relations between scientization, actorhood, and the nature of the national polity.

The changes that scientization brings to local political culture are mediated by the modernist notion of actorhood. This modernist notion conceptualizes "the actor" as an agentic social entity (an individual, a social group, or a non-human category) and defines its role in the shaping of social destiny. Hence, the modernist understanding of an actor (a) constructs, or defines, the category and (b) empowers it for action by attributing agency to it. This notion is a central element in the discourse of science. Scientization constructs social entities and, hence, defines the participants in the polity. Through the attribution of agency to these constructed entities, scientization encourages various forms of political engagement. In this sense, scientization is central to the shaping of the polities in various nation-states.

First, how is scientization – through its notion of actorhood – contributing to the construction of political actors? The taxonomic nature of science (which, as described

earlier, constructs and standardizes knowledge categories) translates into the construction of other categories, such as categories of political actors. Scientization, by making the social craft of creating knowledge categories thinkable, makes the crafting of other categories thinkable too. Moreover, the thinkable is practicable: constructed entities, once defined, become real entities. Hence, groupings of objects constructs both the object and the group. For example, the definition of women as political actors both (a) defines women as a distinct social and political category, and (b) labels each member of the group as a woman enabling them to make political claims based on this "label." Furthermore, scientization, through the process of taxonomy, constructs differences and similarities among these objects or across these groups. For example, zoological taxonomies differentiate insects from arachnids and group house cats, tigers, and leopards as the cat family. Similarly, eugenics differentiates among human racial categories, while anthropology links ethnic and racial categories by describing patterns of early human migration across continents. This scientific taxonomic attitude is employed both on the natural and the social world. In their search for legitimacy, the social sciences drew on the prestigious realist attitude of the natural sciences, and hastened to employ this constructivist turn on human subjects.

Figure 2.5.1
Scientization and the Participatory Polity



The construction of social entities relies greatly on scientific reasoning and scientific evidence. The scientific discourse provides the language "tools" and the "evidence" with

which one category is differentiated from another. For example, gay and lesbian activists often cite genetic evidence from the Human Genome Project (which points to the existence of genetic markers of one's sexual orientation, among other things) to define themselves as a distinct social group. By drawing on such scientific evidence they legitimize their definition as social actors. In a similar move, consumer groups rely on theories of the economic market to define their social actorhood. The social category of "the consumer" – defined in contrast with "producers" or the "government" – is constructed from a scientific theory on economic relations. Overall, social groups enjoy greater legitimacy for their claims of distinctiveness, to the degree that they rely on scientific evidence to justify their claims.

Second, how does scientization, through the concept of actorhood, empower political actors to actively participate in the polity? The role of scientization in the institutionalization of actorhood does not end with the construction of social entities. Rather, scientization also empowers these social entities through the conceptualization of their actorhood as agentic. Agency is defined in terms of commanding assertiveness over destiny. This modernist conceptualization of actorhood is immersed in the Judeo-Christian religious notion of one's control over one's destiny. In science, this attitude is secularized to take the obvious meaning of human control over nature. In other words, "doing" science means to observe, sort, categorize, and analyze, and in the end, control nature. As Meyer and Jepperson (1996) state, in their description of contemporary analysis: "Nature is stable, rationalized, lawful, and inert: it can be comprehended and used by empowered human actors. Spiritual forces in the environment are exhausted, and are located in human, organizational, and political actors." The approach of modern science, which distinguishes it from pre-modern science, is that nature is passive and humans are its manipulators.

These activist, or agentic, notions over one's natural environment translate into, among other things[5], actor-based norms over one's political environment. The scientization process encourages popular mobilization for political action and supports a political culture of participation. Science-embedded notions of actorhood establish a normative basis for the institutionalization of participatory politics. Scientized societies, which are

[5] Such as, the attitude in the social sciences to regards actors, whether human or organizational entities, as analytic focal points.

therefore more infused with this notion of actorhood, have institutionalized more participatory forms of politics.[6]

2.6 Towards an Empirical Research of the Consequences of Scientization

Section 2.3 offers a model of the relationship between scientization and nation-statehood. It argues for the effects that scientization has on nation-statehood, through the introduction of science-embedded modernist notions. Sections 2.4 and 2.5 offer examples for such relationships. First, I argue that scientization encourages a rationalized and standardized form of nation-statehood, namely a rational bureaucracy, through the introduction of the notions of order and rationality. Second, I argue that scientization encourages a participatory form of nation-statehood, through the introduction of the notion of actorhood. The modeling of such relations between scientization and nation-statehood lends itself to empirical testing. Specifically, one may test the causal relationships between scientization and each of the dimensions of nation-statehood – (a) scientization and standardized nation-statehood and (b) scientization and participatory nation-statehood. In this section I hypothesize on such direct effects of scientization on both venues of nation-statehood, namely rationalized and participatory nation-statehood.

As argued earlier, scientization results in greater standardization and rationalization of various national procedures. *The greater the level of scientization of a nation-state, the greater the level of standardization of its practices and images* (H1). Standardization is evident in a variety of social practices. First, and most obvious, scientization results in the standardization of all information-based activities. For example, scientization encourages the national efforts to gather standardized information. Hence, *the greater the level of scientization of a nation-state, the greater the level of standardization of information-based practices* (H1.1). Scientization also encourages the institutionalization of a local information sector. Hence, *the greater the level of scientization of a nation-state, the more institutionalized its local information sector* (H1.2). Scientization also

[6] Sections 2.4 and 2.5 offer two examples of modernist notions that are embedded in science and are being diffused worldwide. Similar discussions can be developed about additional science-embedded modernist notions. For example, science is also infused with the modernist notions of competitiveness. Competitiveness serves as a central theme in science's normative structure (see, Merton 1973). For example, science's reward system is organized around this meritocratic norm, assuming that prestige and other rewards are awarded to the highly talented and productive members of the scientific community (Cole & Cole 1973). Science-based competitiveness, like the notions of rationality and actorhood, re-shapes the societies which incorporate science into their institutions. Having its roots in liberal pluralism, science-based competitiveness is closely linked with liberal notions of market and prices. Therefore, one would expect a close empirical relationship between scientization and indicators of various liberal

encourages other forms of cross-national standardization. First, scientization encourages the incorporation of international standard practices. Hence, *the greater the level of scientization of the nation-state, the more international standard practices are incorporated locally* (H1.3).

Yet, scientization and its standardization effects does not solely impact the information sector. Other social spheres are also subject to such standardization pressures. Therefore, *the greater the level of scientization of the nation-state, the more social spheres are subject to standardization* (H1.4). In these additional social spheres, scientization also encourages the incorporation of international standard images. Hence, *the greater the level of scientization of the nation-state, the more international standard images are incorporated locally* (H1.5). Overall, such hypotheses suggest that scientization enhances greater rationalization and standardization of a variety of social procedures and institutions: most obviously scientization affects the information sector, yet the rationalizing and standardizing effects of scientization extend beyond the field of knowledge and information to affect such domains as management and governance. Scientization, therefore, enhances the perception of standardized, legitimate governance.

Second, scientization bears great consequences for the political dimension of nation-statehood. Hence, *the greater the level of scientization of the nation-state, the greater the local polity is infused with notions of the agentic actor* (H2). As Section 2.4 suggests, scientization contributes to the construction of social entities. Hence, more scientized societies are more apt to construct and accept claims for distinctiveness, especially if such claims are backed by scientific evidence. The discourse of rights reflects the process by which social groups make political claims for their distinctiveness. This discourse locates privileges as derived solely from one's existence as a defined entity, and is an extension of Locke's theory of natural rights. This notion of rights is immersed in the modernist concept of actorhood: the affiliation with a social group, which sets the basis for the claim of rights, depends on the definition of this social group as legitimate, or valid. So, the discourse of women's rights, as mentioned earlier, is based on the definition of women as legitimate social entities; and, in defining women as social entities, womanhood is empowered as a legitimate source for political claims. Scientization, being both a source of actorhood and a modernist source of providing legitimacy to distinctiveness, supports the expansion of the discourse of rights. Hence, *the greater the level of scientization of*

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economic practices (e.g., governmental control over the financial market, size of the public sector, and privatization initiatives).

the nation-state, the more enhanced is the discourse of rights (H2.1). Furthermore, scientization encourages the empowerment of such political actors to engage in the political process. Hence, *the greater the level of scientization of the nation-state, the more actors become politically active* (H2.2). Overall, scientization, through the notion of actorhood, enhances the construction of political actors as agents and supports greater political mobilization.

These hypotheses are at the heart of my empirical investigation. The following chapters of my dissertation work provide the numerous empirical tests to further evaluate the relations between scientization and nation-statehood.

CHAPTER 3

RESEARCH MODEL AND DATA

The effects that global scientization processes bear on societies worldwide are the focus of my dissertation work. As detailed in Chapter 2, my interest is in showing that such outcomes extend beyond the technical and the economic, to include the general cultural and political effects. Both scientization and its consequences are empirical phenomena: they can be observed and estimated, as are the processes that relate scientization with such consequences. This Chapter establishes an empirical model and an estimation basis for an empirical investigation of such phenomena and relationships. After establishing the logic of comparative studies, Section 3.1 operationalizes the main concepts: (a) scientization, (b) standardization and rationalization, (c) political participation, and also describes the indicators and factors. Section 3.2 operationalizes the relationships among these concepts by specifying the causal model. This "ground work" enables the empirical testing of the hypotheses (Section 2.6) as follows in Chapters 4 and 5.

3.1 Operationalizing the Consequences of Global Scientization Processes

Scientization, being an outcome of the global expansion of science, lends itself to cross-national research. Cross-national research is an established research tradition, especially by advocates of world polity theory (Meyer & Hannan 1979; Thomas et al. 1987; to name only the edited volumes). It regards each nation-state as an empirical unit of analysis, it estimates each unit's "qualities" from comparative and mostly secondary data, and, most importantly, it investigates global trends by identifying cross-national differences and similarities. Having the added rationale for using nation-level data as indicators of global trends (since my general interest is the changes in the nature of nation-statehood), my study directly follows this research tradition.

In Chapter 2, I described two facets of nation-statehood that are altered by scientization processes: (a) rationalized national practices and (b) actor-based national polity. The

following Section describes in detail the operationalization of these two types of consequences and of the scientization process. I list each concept, its operational definition, and its indicators.

Before proceeding to operationalize the main concepts, I should note three general issues. First, I rely on multiple indicators for representing each concept, and, as described in Section 3.2, I employ a multiple-indicator methodology. Using a multitude of indicators permits me to generalize beyond the obvious limits that any single cross-national indicator carries. By relying on multiple-indicator methodology, the various indicators are combined into substantive latent variables, or latent dimensions[1]. An alternative way of utilizing the availability of multiple indicators for a single concept is by repeating an identical model for multiple indicators of each concept. While these methodological details and their benefits are explored in length in Section 3.2, here I list the various indicators for each concept.

Second, to further clarify the notion of latent dimensions and to specify the indicators used to demonstrate each concept, Table 3.1.1 describes the various indicators for each concept.[2] In addition, while the various indicators and the latent dimensions are mentioned in this Chapter, they are fully detailed[3] in the presentation of the results in Chapters 4 and 5. The specifications for the latent dimensions[4] are presented in each figure or table of results.[5]

Finally, unless the source of the data is specifically mentioned in the indicators' description in Chapters 4 and 5, they were gathered from Nation-3 data file, which is a compilation of cross-national data, most of which is from UN and UNESCO statistical

[1] A latent dimension depicts a theoretical construct, or concept, which is based on empirical measurements, or indicators.
[2] Appendix A provides descriptive information for each indicator.
[3] In terms of the indicators' source, basic descriptive statistics, and, most importantly, their relevance as empirical reflections of the concept, or latent dimension.
[4] Such as, the indicators combined in the latent dimension and Eigenvalue.

yearbooks, the Penn Tables (see, Summers & Heston 1991), and Arthur Banks' data (Banks 1976).

Table 3.1.1
Operationalizing the Model: Concepts and Indicators

The Model	The Indicators
Science Practice	Publications in the sciences (natural and social) Citations of scientific papers Membership in international science organizations Institutionalization of national science institutions Existence of an effective national science base
Standardization	Information Sector: • Institutionalization • Activity • New technologies • Complexity Management Procedures: • Accounting • ISO-9000 Appearances: • Corruption in government
Construction of the Political Actor	Expansion of Rights: • Women's rights • Human rights • Consumers' rights • Gays and lesbians' rights • Environmental rights
Political Mobilization	Popular Action: • Popular mobilization (demonstrations, strikes, and riots) • Voting Political resources: • Freedom of association • Access to news media Liberties: • Civil liberties • Political liberties • Democracy

[5] Specifications are offered only for latent dimensions that are not initiated through SEM, thus created by SPSS's factor analysis procedure.

At this time, let me proceed with the operationalization of the main concepts. First, rationalization processes are operationalized as the standardization of national practices and appearance. As elaborated in Section 2.4, rationalization is embodied in the use of standard, or legitimate and uniform, national practices and images, which are, most often, internationally legitimated standards. I chose to focus on three national arenas in which standardization processes are evident: the national information sector, management practices, and the image of the country. Each of these arenas is explored through several indicators. The information sector exhibits four facets of activity, each indicated by several measures: (a) the level of activity is indicated by the number of incidents of unreported data in UN statistical yearbooks in the years 1980 and 1990, (b) the institutionalization of the field is indicated by the dates of execution of the first national census and of the publication of the first national statistical yearbook, (c) the incorporation of new information technologies (specifically, two measures of the incorporation of Internet technology) is indicated by the duration since initial linkage with Internet and the rate of growth of Internet use, and (d) the complexity of information gathering procedures is indicated by the number of deviations in national data reports from UN standards of statistical reporting in 1980 and 1990.

The second arena of national standardization is that of management procedures, specifically accounting and managerial control. Accordingly, its indicators are (a) an index (1-8) for the adherence to international standards of accounting in 1979, and (b) the number of certificates awarded to national companies by the International Standards Organization by March 1995 on the basis of compliance with standards of managerial control (ISO-9000 standards; standardized by population size). Finally, standardization of the national image is indicated by a cross-national measure of the perception of the state as corrupt in 1980-5 and 1996 (index 1-10).

The second consequence of scientization processes is the incorporation of participatory politics. I regard participatory politics as having two main components: (a) the construction of political actors and (b) the empowerment of such actors into political

engagement. Accordingly, each component is indicated by several cross-national measures. First, I focus on the construction of political actors as is evident in the establishment of rights' discourses. I do so by referring to five categories of political actors, namely, women, human, consumers, gays and lesbians, and environmental rights. As evidence for the establishment of the discourse of women's rights I rely on three indicators: an index of women's status in 1985, an index of women's equality in 1985, and an index of gender development in 1992. The establishment of a national human rights' discourse is indicated by four cross-national variables: a factor score for adherence with international standards of human rights, Charles Humana's human rights' index for 1986, the UNDP's human development index for 1992, and Ruth Sirvad's human repression index for 1986. The national discourse on consumers' rights is indicated by two variables: a latent dimension for an early, versus later, establishment of national consumers' organizations, and the number of national consumer-related organizations in 1992. National promotion of gays and lesbians' rights is indicated by latent dimensions for such rights in 1984 and 1994, as indexes for these rights' were developed from the narratives of The Pink Book's editions of these years. Last, the national attention to environmental rights is indicated by the number of international environmental treaties ratified by each nation-state in the years 1980 and 1990.

The empowerment of such political actors is indicated by their political engagement. Political engagement has three main components: popular mobilization for action, access to resources for political organizing, and liberties. Popular mobilization is expressed through two main media: (a) a latent dimension for defiant mobilization for political action in 1980 and 1985 (which combines data on riots, strikes, and demonstrations), and (b) the number of registered voters in 1980 (standardized by population size). For investigating the availability of political resources I focus on two types of resources: (a) freedom of association index in 1985 and (b) a latent dimension score for access to the news media in 1980 and 1984 (which combines data on access to print and broadcast media). The last facet of political engagement is liberties. Liberties are indicated by (a) an index (1-7) of civil liberties in 1973 and 1989, (b) an index (1-7) of political rights in

1980, 1988 and 1993, and (c) an index (1-10) of institutional democracy in 1980 and 1985.

Finally, I operationalize the concept of scientization as the level of scientific practice: the more science is practiced within a nation-state, the greater the permeation of the scientific world-view, and, hence, the more extensive the scientization of society. Science practice is indicated by four variables, each representing another facet of scientific activity: institutionalization of an organizational basis, production (or output), prestige, and linkages with world science. Accordingly, I rely on the following indicators: (a) the establishment date of a national science policy agency, (b) the number of science publications (in either the natural or social sciences) per capita and over several years during the 1970s and 1980s (standardized by population size), (c) the number of citations of scientific papers written by authors from the nation-state in 1973 and 1982 (standardized by population size), and (d) membership ratio in the associations of the International Consortium of Scientific Unions (ICSU) in 1969 and 1979.[6] For some simple demonstrations of the distribution of scientific activity[7] I also employ an ordinal variable (scale 1-4) for the existence, or lack, of a national scientific base in 1985.

In summary, the three main concepts for investigating the consequences of global scientization processes are scientization, rationalization, and participatory politics. They are operationalized, accordingly, as (a) science practice, (b) standardization, and (c) the expansion of the discourses on rights and the level of political engagement. Finally, because of the complexity and multi-faceted nature of each of these concepts, each is indicated by multiple cross-national indicators.

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[6] Changes in the composition of the latent dimension of science practice are made to increase the number of cases in each analysis. Such changes do not alter the substantive interpretation of the results.
[7] Such as Table 5.2.2.

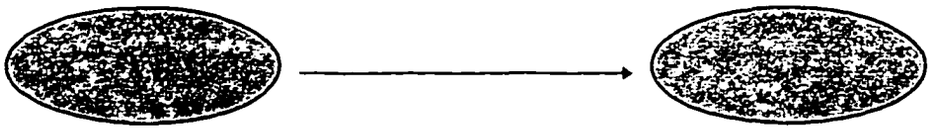
3.2 Modeling the Relationships between Scientization and its Consequences

Now that the three main concepts are operationalized and their indicators are specified, I will operationalize the relationships among these concepts. As described in Chapter 2, I regard scientization processes as forming the basis for the intensification of national tendencies towards (a) greater rationalization and (b) expanded participatory politics. In other words, scientization is the independent element while rationalization and participatory politics are its dependent elements. These causal relationships and the concepts' operationalization are described in Figures 3.2.1 and 3.2.2.

Figure 3.2.1
The Effects of Scientization on Standardization: Operationalizing the Model

The General Model:

Scientization	Standardized and Rationalized Nation-Statehood



The Operational Model:

Science Practice	Standardization of Practices and Appearances

Time Period:

in 1970s and 1980s	in late 1980s and 1990s

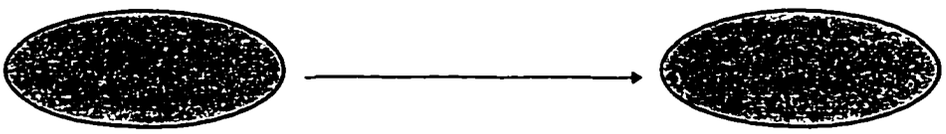
Here I wish to emphasize a few matters relating to the model. First, to clarify and simplify such causal relationship between science practice and its consequences, I employ a panel design.[8] Second, for considerations of data availability and reliability, the investigated time period begins in the 1970s.

[8] Due to problems of either colinearity or of data availability (that is, that either the time-lagged dependent variable is too highly correlated with the dependent variable or that the dependent indicator is not available for an earlier time point), I occasionally rely on a cross-sectional design.

Figure 3.2.2
The Effects of Scientization on the Local Polity: Operationalizing the Model

The General Model:

Scientization	Actor-Based National Polity



The Operational Model:

Science Practice	(a) Construction of the Political Actor (b) Mobilization for Political Engagement

Time Period:

in 1970s and 1980s	in late 1980s and 1990s

Last, I add a control element to the empirical investigation of science practice and its consequences, namely a latent dimension of national development. This is because the level of national development is associated with, if not determinant of, most national-level social conditions, including the standardization of national practices and participatory politics. In line with my decision to adopt a multiple indicator approach, I shy away from the over-simplified categories of commonly used indexes of national development (e.g., Snyder & Kick 1979; Time Magazine 1975) and establish a latent dimension.[9] This latent dimension combines two main indicators: (a) energy consumption per capita[10] for the years 1970 or 1980 and (b) the rate of secondary education in these years. In some models I add a dummy variable for non-core countries[11] to emphasize the effects of adverse developmental conditions on the relationship between science practice and its consequences. Together these indicators compose a multi-faceted description of national conditions of progress. Most

[9] Still, the Pearson correlation between the dimension of national development in 1970 and Snyder & Kick's 3-category classification is .61 and with Time Magazine's "five worlds" classification is .82.

[10] I chose this measure of economic development, rather then the obvious measure of gross national or domestic products, because it is more weakly correlated with most other national trends while being highly correlated with GDP and GNP measures.

[11] Core countries include the western European countries, NICs, Japan, the oil-exporters (both in the Middle East and in Latin America), Canada, U.S., Australia, and New Zealand.

importantly, the inclusion of the national development latent dimension clarifies the estimation of the relationship between science practice and its consequence.

In summary, the estimation model for testing the hypotheses set forth in Chapter 2 is a cross-national panel model, which includes science practice as its main independent element and development as a control element. The dependent element of this model is the various components of (a) standardization and (b) political participation. The investigated period is 1970 through the mid-1990s.

While these model specifications are much in line with the tradition of cross-national empirical investigations, I employ multiple indicators for each concept to overcome the shortfalls of previously used single-indicator methods. As mentioned earlier in this Chapter, I rely on these multiple indicators in two ways: first, by repeating an identical model for multiple consequences (i.e., dependent variables)[12], I show cumulative evidence for the validity and strength of the relationship. Second, when possible I employ a multiple indicator statistical method, namely structural equation modeling with latent variables (SEM; see, Bollen 1989; Bollen & Long 1993), while relying on EQS as the statistical package (see, Bentler 1989). SEM is an investigation of the relationships among latent variables (also called unobserved or unmeasured variables), while considering simultaneous equations with multiple observed or measured variables (i.e., indicators). I chose this as my method of estimation for the advantage it offers in a general and simultaneous consideration of the various levels of analysis and of the numerous indicators of each latent dimension.[13]

The panel SEM model of estimation is specified as follows:

$$\eta_t = \beta\eta_{t-tl} + \gamma\xi_{t-tl} + \zeta$$

[12] As in, for example, Table 5.1.1.

[13] Due to estimation problems (such as, high intercorrelation while relying on a small number of cases or negative error variances) I occasionally employ linear regression or Pearson correlation analyses. In these cases latent dimensions are established through SPSS's factor analysis. Nevertheless and most importantly, there is a substantive consistency among my findings through either estimation method.

where, η (eta; the dependent factor) at time t is determined by the β (beta; coefficient) of η (the time-lagged, independent factor) at an earlier time point (t- t_1), γ (gamma; a vector of coefficients) of ξ (ksi; a vector of the independent factors) at that earlier time point, and an error element (ζ; zeta).[14] Applied to my hypotheses testing, η represents the investigated dimension of nation-statehood (at both t and t-t_1), while ξ includes two latent variables for both science practice and national development (at t).[15]

The results of SEM estimations are presented in figures that follow the commonly used style of path diagrams (see, Bollen 1989:33-38). Hence, in addition to presenting the above mentioned model specifications, the figures also mark the reference indicator for each latent dimension, significance level[16], and both ζ and e error terms (standardized scores)[17]. The figures also offer summary statistics (e.g., the number of cases) and the correlated errors and covariance among indicators or latent dimensions. Finally, the figures offer two fit statistics to asses the overall validity of the model: chi square and comparative fit index (CFI). The statistical test chi square, while having the advantage of considering the degrees of freedom in the model, may offer a biased estimation when the indicators do not fully satisfy the assumptions in regards to distribution (Bollen & Long

[14] When execution of panel SEM is not possible, I rely on two steps: factor construction and then panel linear regression. The model specification for the panel linear regressions is: $Y_t = \alpha\, Y_{t-t1} + \beta\, X_{t-t1} + e$ where Y (the dependent factor) at time t is determined by the α (coefficient) of Y (the time-lagged factor) at an earlier time point (t- t_1), β (a vector of coefficients) of X (a vector of the independent factors) at that earlier time point, and an error element (e).

[15] When relying on a cross-sectional model, the model specification of a cross-sectional SEM is: $\eta_t = \gamma\, \xi_t + \zeta$, while a cross-sectional linear regression model is specified as: $Y_t = \beta\, X_t + e$.

[16] Only γ's significance level is marked. Obviously, the coefficient of each indicator with its latent dimension (marked as λ lambda in measurement equations) is significant for that indicator to be included in the model.

[17] Two matters are notable in regards to error terms. First, typically single-indicator latent dimensions in SEM are assigned zero error variance. Due to the questionable quality of cross-national data I assign a positive small term (on the unstandardized scale), most often .05 (see, for example, Figure 4.1.1). Second, of the ten SEMs in my dissertation work, three models would not solve due to high colinearity. To aid in solving these models, I assigned a fixed error variance (based on CFA results; see, for example, Figure 4.1.2). These cases are marked in the figures. Most importantly, once the error term for the dependent dimension's indicator is assigned a fixed and close-to-zero value, the effect on the coefficient is its reduction (while the unstandardized effect is un-biased). In this sense, my "solutions" are conservative in their estimation. And, moreover, the results are consistent with similar models which either did not include the specific indicator or were executed in a linear regression form.

1993:6-8). Hence, CFI, while also having degrees of freedom in its calculation, offers an additional dimension of the model's overall validity (scale 0-1; 0=no fit, 1=good fit).

In summary, I rely on a panel structural equation model with latent variables (SEM) for estimation of the relationship between science practice and its consequences since 1970. I estimate the effects of a latent dimension of science practice (which operationalizes scientization) and a control latent dimension of national development on a set of dependent latent dimensions. These dependent latent dimensions operationalize the two examples for social spheres that are affected by scientization processes, namely rationalization and participatory politics (operationalized as (a) standardization of national practices and (b) rights' discourses and political engagement, accordingly). These specifications of the latent dimensions and their indicators (Section 3.1) and of the model of estimation (Section 3.2) set the basis for the empirical investigations that are reported in Chapters 4 and 5.

CHAPTER 4

SCIENCE, RATIONALITY, AND STANDARDIZATION

As described at length earlier in this work, a pivotal consequence of the process of scientization is the greater rationalization of society. Such rationalization exhibits itself most obviously in greater standardization of social practices. Moreover, such standardization relies on international conventions and the transfer of knowledge categories from one social context to another. This Chapter aims at providing some evidence for the causal relations between scientization, rationalization, and standardization, by illustrating the shifts in various national procedures. By doing so, it examines the hypotheses (described in Chapter 2) as to the cross-national relationship between science practice and rationalization.

How does science practice encourage standardization cross-nationally? Science practice encourages cross-national standardization through the concepts of rationality and order. I demonstrate such effects in three social spheres: the information sector, management procedures, and perceptions of governance. First, I demonstrate the contribution of science practice to greater national efforts in gathering standardized information. I display the effects of science practice on a few dimensions of the information sector: the efforts at information management, the formation of an infrastructure for the information sector (both in terms of timing and in terms of linkages with new information technologies), and the complexity of that sector (Section 4.1). Second, I show that science practice encourages cross-national standardization of corporate management. I provide evidence for the strong standardizing and rationalizing effects of science practice on two measures of corporate management: standardization of accounting and of managerial control procedures (Section 4.2). Last, I show that science practice enhances the image of the nation-state as rational and standardized, by shaping its image as properly governed, or establishing a perception of standardized or legitimate governance (Section 4.3). Section 4.4 summarizes the findings and discusses the results. Overall,

this Chapter establishes that science practice enhances greater rationalization and standardization of a variety of social procedures and institutions.

4.1 Science Practice and the Information Sector

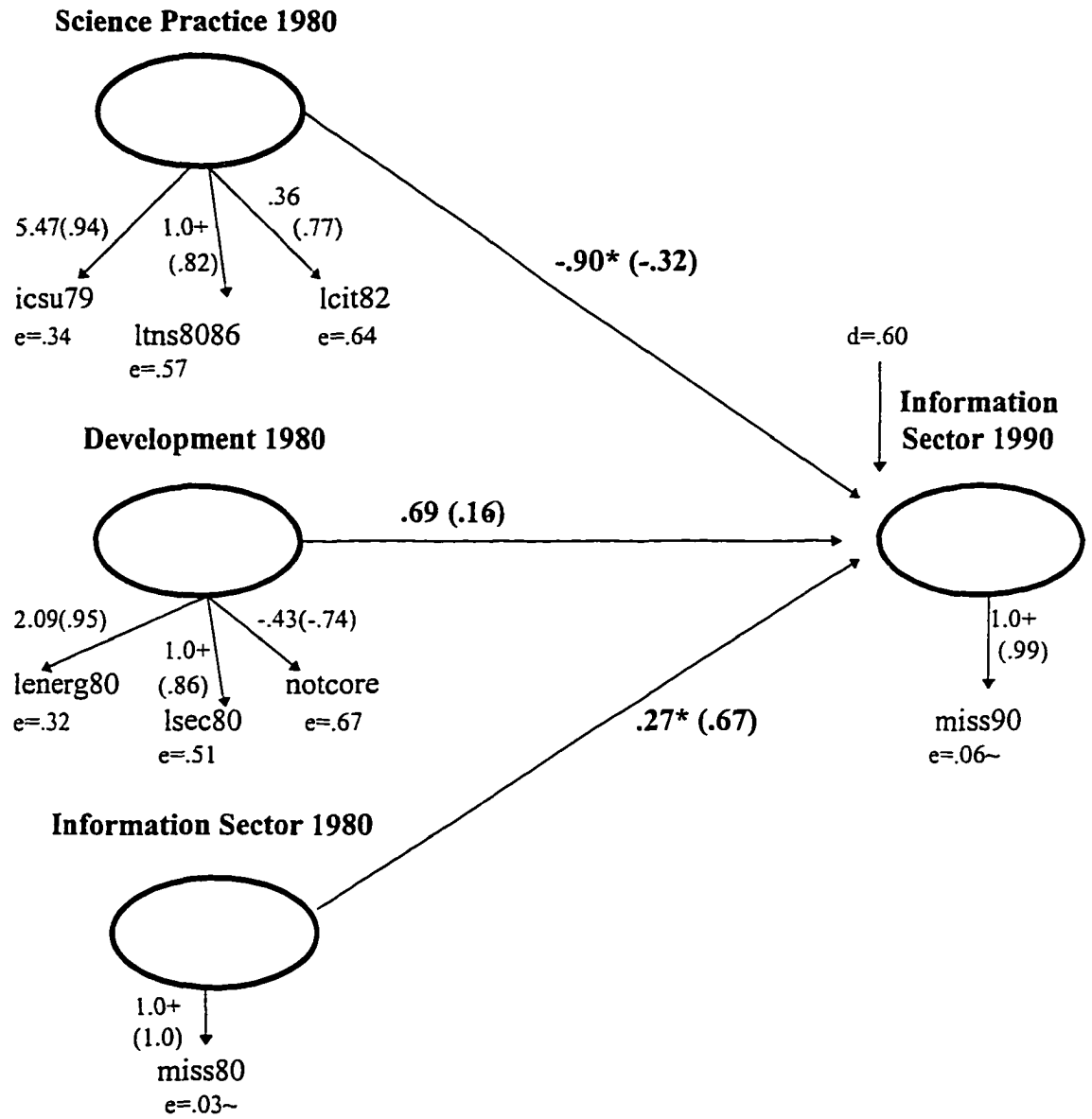
The social practice most obviously affected by science practice is the management of information. Since data are a taxonomic form of representation of reality, the gathering and management of data most dominantly reflect the general processes of rationalization and standardization. To implement the tasks of data management, national institutions of information gathering are established. These institutions (e.g., the National Census Bureau) work to collect, sort, and distribute information on various areas which are defined as of interest and relevant to social life. In doing so, these national agencies codify social reality by using standardized and legitimated categories of knowledge. Scientization encourages the perception that information is a necessity for decision making and, thus, for most social activity. In addition, science serves as a legitimatory tool for offering standardized categories of information. Science practice, thus, encourages the institutionalization of national procedures, and apparati, for data collection.

Cross-national analyses confirm that science practice encourages greater efforts to collect data and greater standardization of such information. Empirical evidence suggests that variations in the extent of local science activity are highly and causally related with increased efforts for data management. As an indicator for data management I use cross-national information on the quality of statistical data reported by each nation-state to UN agencies. This indicator enables me to differentiate among nation-states by the number of unreported data in UN statistical publications[1]: the countries with higher instances of unreported data display a small effort at, or ability for, data management, whereas countries that have a low score of unreported data display great effort at, or ability for,

Figure 4.1.1

The Cross-National Relationship between Science Practice and the Collection of Information

Results from Panel Structural Equation Model
1980-1990



* p<.01 + Reference indicator ~ Error term assigned fixed variance
Corr.(Cov): S80/Dev80=.76(.79)*; S80/Inf80=-.46(-5.28)*; Dev80/Inf80=-.32(-2.37)*
Correlated error: ltns8086/lcit82=.87(.29)
N=118
X^2=96.24 w/ 15 d.f.; CFI=.907

[1] The indicator records the number of times a nation-state failed to report statistical information in a sample of tables in UN's Statistical Yearbooks for 1980 and 1990. The sample includes 1/3-1/2 of the total number of tables in the volume, which were chosen for reporting as many nation-states as possible.

data management. As displayed in Figure 4.1.1, enhanced science practice contributes to greater effort at data management. More specifically, this SEM panel design model shows that a factor representing science practice in 1980 lowers the number of unreported, and presumably unavailable, national-level data in U.N. statistical publications in 1990 (coef.=-.90; standardized coef=-.32). This model indicates that variations in science practice in the 1980s positively and significantly decrease the number of unreported data in U.N. statistical publications in 1990. Thus, science practice lowers the incidents where data, which is regarded as an international legitimate information category, is neither collected, nor made available, by national authorities.

Science practice is also associated with establishing an infrastructure for the information sector. Such infrastructure consists of both (a) the establishment of agencies for information management and (b) the incorporation of new information-related technologies to optimize this sector's procedures. First, science practice is associated with an earlier establishment of a national information sector. I focus on two indicators for the establishment of this sector: (a) the execution date of the first national census following the date of independence and (b) the publication date of the first national statistical yearbook. These two events show the formation of active national information-related activities and provide the timing for its initiation. Cross-nationally both these dates correlate strongly and negatively with science practice. More specifically, the latent dimension of science practice in the 1980s is (a) negatively and significantly associated with the year of execution of first population census following the date of independence, and (b) negatively and significantly associated with the year of first publication of a national statistical yearbook (R^2=-.63; R^2=-.71; respectively; Table 4.1.1). In this sense, science practice is associated with earlier, rather then later, dates for the formation of national procedures for data management through the establishment of a national apparati.

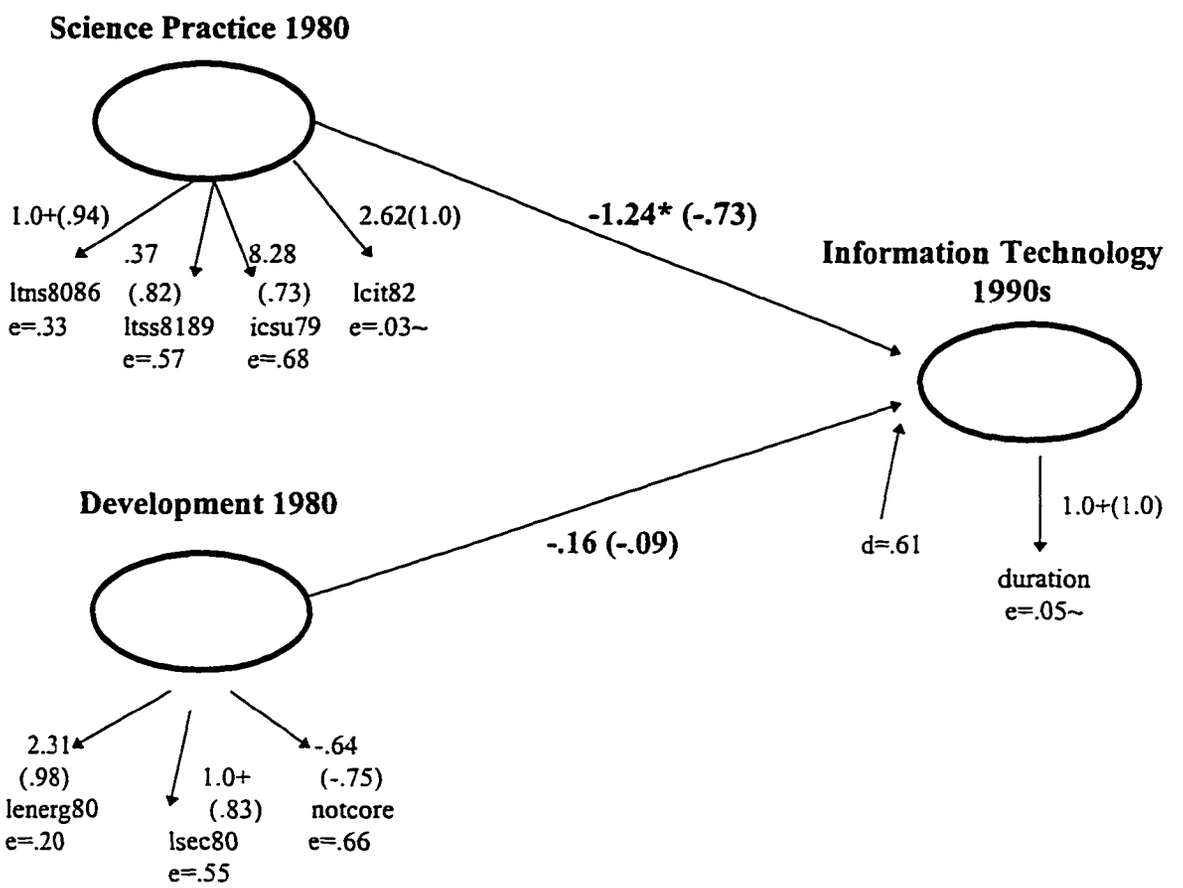
Table 4.1.1
The Cross-National Relationship between Science Practice and the Timing of Information Sector Institutionalization
Pearson Correlation
1980s

Information Sector: Date of Institutionalizing the Practice of...	**Science Practice 1980** [1]
Execution of first population census post national independence - year	-.63 * (97)
Publication of first national statistical yearbook - year	-.71 * (56)

* p<.01 (n=)
1. Science factor 1980 includes: scpdate, ltns8086, ricsu79, lcit82; Eigenvalue=3.06.

Second, science practice is also associated with greater utilization of new information-related technologies. Such technologies facilitate the work of the information sector and further establish its presence. Information-related technologies are being globalized at an unprecedented rate: since 1993 the number of World Wide Web sites has grown exponentially (Kahin 1995:17) and the number of European communication satellites has tripled (Garcia 1955:76). While the growth of information-related technologies, such as the Internet, transcends national boundaries or development barriers, science practice serves as a noted predictor of the incorporation of such technologies into a nation-state. To test these relationships I employ two measures of national incorporation of the Internet: first, duration (in months) between the date that Merit began managing the NSFNET backbone (July 1988) and the date of initial connection of the nation-state with NSFNET, and second, a calculated measure of the rate of expansion of Internet use (the number of local networks established during the period of time since initial linkage with NSFNET). The first measure indicates how quickly the information technology was introduced to a national audience. The second measure indicates how wide the technology spread once it was in existence. Both measures provide an added dimension for the creation of a national information sector infrastructure.

Figure 4.1.2
The Cross-National Relationship between Science Practice and Initial Connection with Internet
Results from Cross-sectional Structural Equation Model
1980-1990s

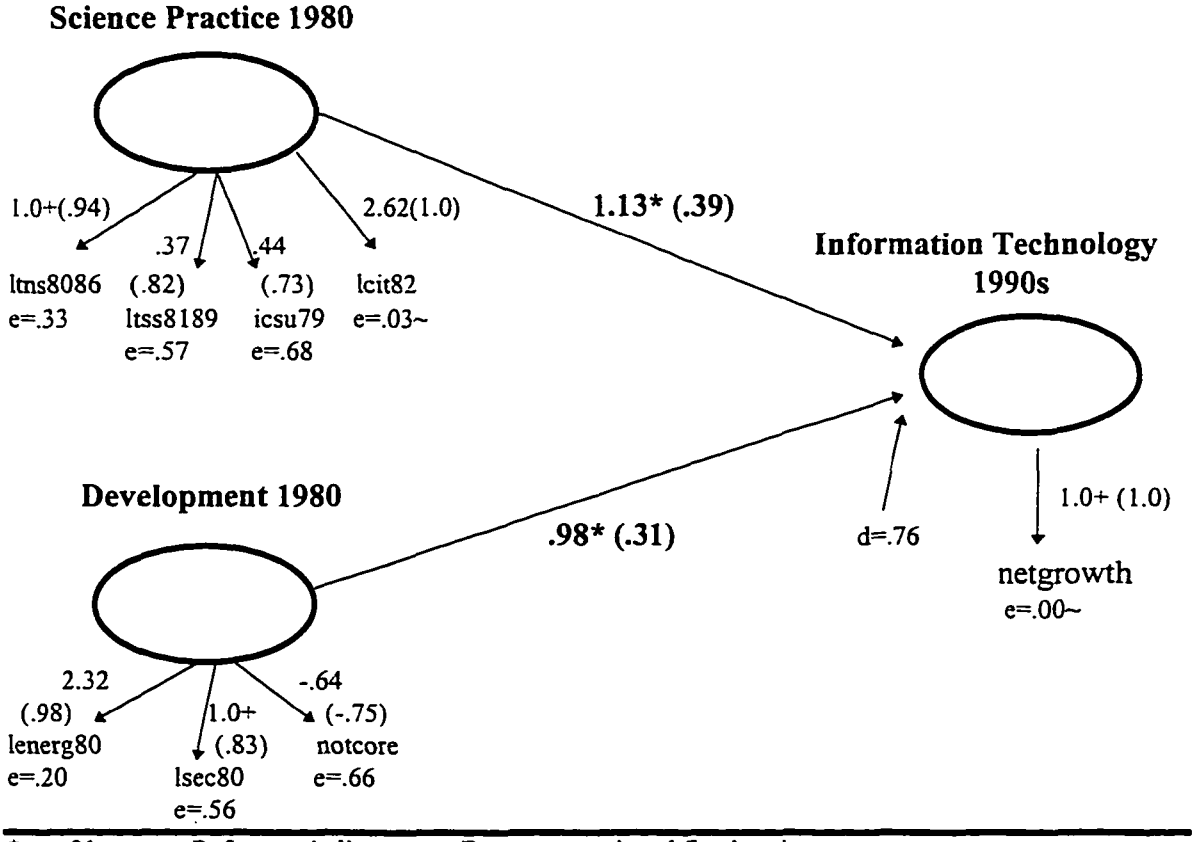


* p<.01 + Reference indicator ~ Error term assigned fixed variance
Corr.(Cov): S80/Dev80=.72(.28)*
Correlated error: ltns8086/ltss8189=.46(.02)*
N=66
X^2=49.56 w/ 18 d.f.; CFI=.941

Figures 4.1.2 and 4.1.3 show that science practice is a central component in creating this technology-base for the information sector. First, in regards to initial connection with the technology, science practice hastens this initial connection, or shortens the duration until initial connection is established. A SEM cross-sectional model shows that the latent dimension of science practice in the 1980s has a negative and significant effect on the

latent dimension of Internet duration measure (coef.=-1.24; standardized coef.=-.73; Figure 4.1.2). Second, science practice supports greater spread of the technology within the national boundaries. Again, a SEM cross-sectional model shows that the latent dimension of science practice in the 1980s has a positive and significant effect on the latent dimension representing the rate of growth in national usage of Internet communications after initial connection with the Net (coef.=1.13; standardized coef.=.39; Figure 4.1.3).

Figure 4.1.3
The Cross-National Relationship between Science Practice and the Growth of Internet Use
Results from Cross-sectional Structural Equation Model
1980-1990s



* p<.01 + Reference indicator ~ Error term assigned fixed variance
Corr.(Cov): S80/Dev80=.72(.28)*
Correlated error: ltns8086/ltss8189=.46(.02)*
N=66
X^2=56.45 w/ 18 d.f.; CFI=.925

This evidence suggests that science practice supports the establishment of an infrastructure for the information sector, in terms of both the institutionalization of information agencies and of information technologies.

In addition to the institutionalization of the information sector, science practice also affects the level of complexity within this sector. More scientized societies have more elaborate procedures for data management. The complexity of the information sector is indicated in my analysis by the number of comments that each country adds to its data reports in a sample of tables in the UN Statistical Yearbooks for 1980 and 1990. Such comments vary between the special nature of the data and its gathering procedures[2] to more general clarifications[3]. In spite of this variation, all such comments provide an insight into the complexity of the data gathering procedures.

As for the effects of science practice on the complexity of the information sector, the panel empirical model shows that science practice enhances an intricate form of information gathering and reporting. Specifically, a panel SEM shows that the latent dimension of science practice (circa 1980) increases the number of reporting qualifiers in 1990 (coef.=.23; standardized coef.=.59; Figure 4.1.4). This finding may reflect the tendencies of agencies that are subject to much organizational inertia and are therefore set in their ways. In other words, the effects of science practice on the greater complexity of information procedures are mediated by the construction of local histories. The existence

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[2] Such qualifying comments in regards to the data refer to the process of data gathering. For example, when reporting comparative data on education and literacy (UN 1992:91-103) Morocco, Barbados, the Cayman Islands, and others note that their reports on the number of schools, technical staff, and pupils enrolled refer to public schools only. Similar examples for data qualifications refer to the definition of a calendar year. For example, Table 116 in the UN Statistical Yearbook 1992 (pp. 746-752) lists eight different comments devoted to national particularities that deviate from the UN standard definition of a calendar year.

[3] Some nation-states include comments for general social conditions that affect their data reporting, thus making subtle political statements. For example, in UN 1992 Table 13 (pp. 65-72) Israel's information on its population is qualified as "including data for East Jerusalem and Israeli residents in certain other territories under occupation by Israeli military forces since June 1967" (p. 72). In the same year, Jordan comments that it "exclude[s] data for Jordanian territory under occupation since June 1967 by Israeli military forces" (p.73). Through these comments Israel asserts its sovereignty over a united Jerusalem and the Jewish occupants in the West Bank and Gaza Strip, while Jordan relinquishes its sovereignty over the West Bank.

of such traditions makes it more difficult for countries to adjust to international – i.e., standardized practices. Such is the case of the U.S. efforts to adopt the metric system of measurement: numerous federal attempts to introduce and enforce the international metric standards in the US have failed. Nevertheless, the pressures to conform to international standardized methods of operation, especially in regards to information, are carried worldwide on the wave of scientization.[4]

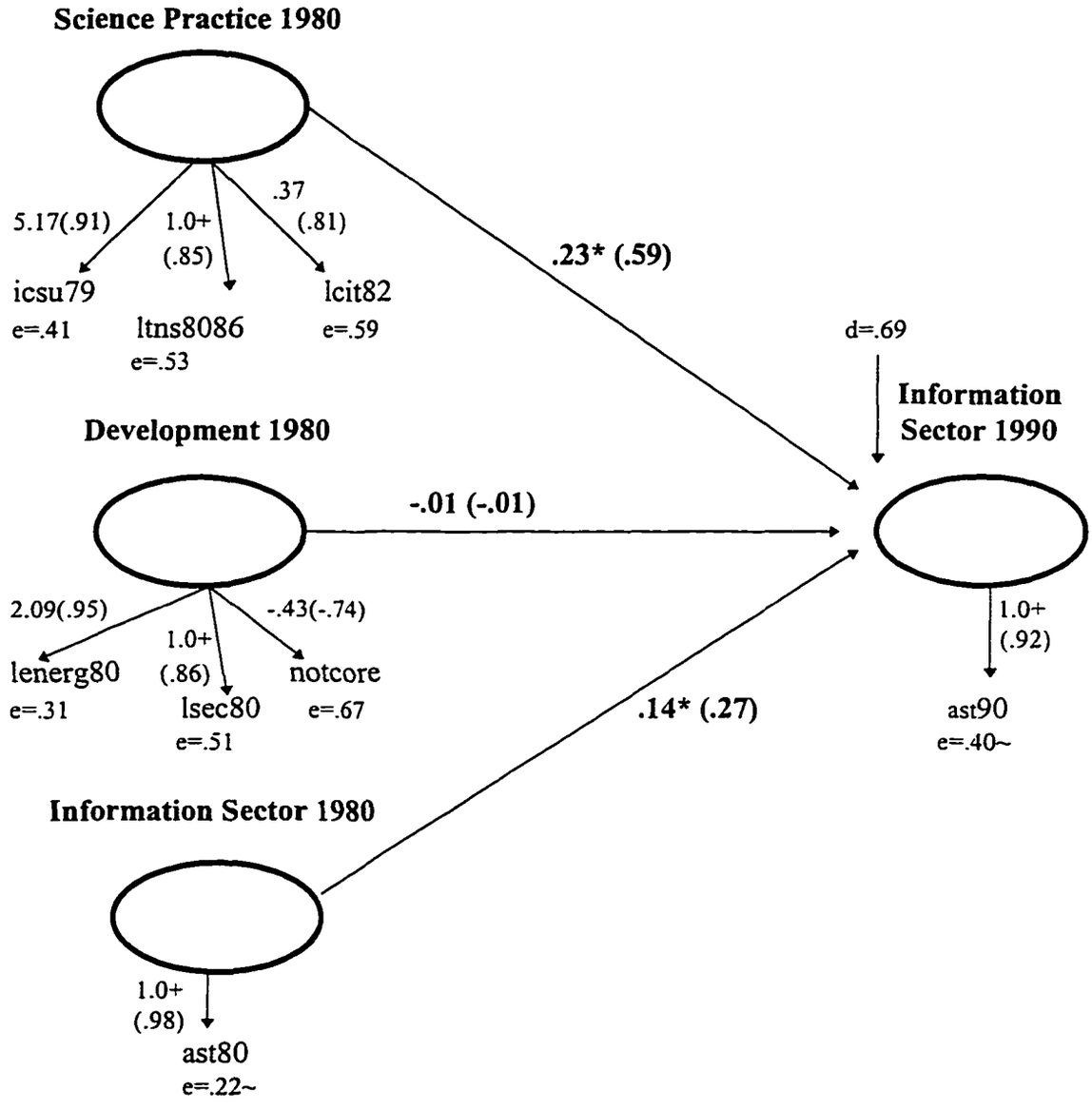
Overall, science practice enhances national efforts at information gathering and management. My examples concern only the collection of statistical information or economic indicators, yet my argument can be extended to other science-based data gathering, or information recording, efforts. One example is the national cartographic project. Cartography records the physical properties of a nation-state – its territory, its natural resources, and its population disbursement. In collecting such information, cartography categorizes reality and frames this reality in a standardized manner. Mapping concepts include human dwellings, topographic height, and waterways. Meaning and importance is attributed to these categories and reality is reconstructed in these standardized terms. For instance, significance is attributed to the size of human dwellings by differentiating between villages, towns, and cities. Such cartographic efforts are highly scientized as they rely on science-based skills and sophisticated technology. Additionally, they are rooted in scientization and reflect the processes of rationalization and standardization. One may, therefore, expect that science practice contributes to greater national cartographic efforts.

[4] The complexity of information procedures is related to the age of state institutions: the "older" a state is (indicated by the date of independence) the more complex its information gathering procedures. In technical terms, the correlation between the date of independence and the indicator of data complexity in 1990 is -.39 ($p<.01$; $N=161$). Yet, the positive effect of science practice on the complexity of the information sector is stable even when introducing this additional control variable.

Figure 4.1.4

The Cross-National Relationship between Science Practice and the Complexity of Reporting Procedures

Results from Panel Structural Equation Model
1980-1990



* p<.01 + Reference indicator ~ Error term assigned fixed variance
Correlation(Cov): S80/Dev80=.79(.84)*; S80/Inf80=.34(.45)*; Dev80/Inf80=.34(.28)*
Correlated error: ltns8086/lcit82=.84(.24); icsu79/lcit82=-.07(-.07)
N=118
X^2 =76.33 w/ 14 d.f.; CFI=.921

4.2 Science Practice and the Standardization of Management

Science-based effects extend beyond matters of information management. Scientized societies more readily adhere to international conventions of corporate management procedures. In investigating the standardization of corporate management I rely on two indicators: (a) use of internationally standardized procedures for financial accounting, and (b) use of internationally standardized procedures for corporate control as certified by ISO-9000.

An effective financial accounting system is regarded as a key for proper financial management and crucial for developing bureaucracies. Employing standard accounting formats serves as an instrument of financial control and proper management. The comparative data on adherence to international accounting conventions is an index (scale is 1-8) adapted from the 1979 International Survey of Accounting Principles and Reporting Practices (Fitzgerald, Stickler, & Watts 1979[5]). This publication lists the common terms and concepts used in corporate accountancy and indicates whether these notions exist in national accounting procedures or regulations. It is a part of the general effort by the International Accounting Standards Committee (IASC) to "harmonize" accounting principles in order to simplify international listings in foreign stock exchanges. IASC's goal is to achieve a global accounting standard by mid-1999. While a uniform standard has not yet been adopted, nation-states are still compared by their use of common accounting procedures. My indicator captures the degree to which the local accounting systems codifies a particular internationally recognized principle, term, concept, or procedure. For example, one dimension indicates whether a particular national accounting system refers to the accounting practice of historical cost convention[6]; in Argentina, Austria, Belgium, and Chile the reference to this practice is required by law, while in Australia, Denmark, and France it is merely the predominant practice, and in Portugal it is a minority practice. As demonstrated in this example,

[5] This survey is compiled and published by Price & Waterhouse, the international accounting firm.

nation-states vary greatly in their use of such rationalized and standardized formats of accountancy.

Science practice is central to the development of rationalized and standardized accounting. My empirical models show that science practice is tightly related to the adherence of international standards for corporate accounting. Specifically, the latent dimension of science practice in the 1980s is highly and significantly correlated with the score of adherence to accountancy standards (R^2=.40; Table 4.2.1). This evidence for the relationship between science practice and accountancy is in line with recent studies of accounting and its relationship to general social processes (see, Hopwood & Miller 1994; Porter 1996). Most of these studies point to (a) accounting as a form of management and (b) the effect of accounting in constructing entities. Through the seemingly-neutral labor of calculation, record, and bookkeeping, accounting conceives of corporations, employees, and nation-states as legitimate and standard entities. Michael Power (1995:299) describes accountancy as reaching beyond the domain of money transactions: "In addition to financial audits we now hear of environmental audits, value for money audits, management audits, quality audits, forensic audits, data audits, intellectual property audits, medical audits, and many other audits." The trend to expand the domains of accountancy reflects greater efforts for the standardization of additional social fields – here relying on the professional tools and legitimacy of accountancy – and such standardization is rooted in processes of scientization.

Consistent with these findings are the relationships between scientization and the standardization of managerial control procedures. The worldwide standardization of management procedures has been encoded in the ISO-9000 since 1987. The International Standards Organization (ISO) devised this scheme as a bench for corporations from various economic environments which are participating in the increasingly globalized economy. Such a bench is assumed to decrease uncertainty between business partners.

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[6] This accounting procedure requires that "assets, liabilities, revenue and expenses are recorded at the amounts at which the transaction took place" (Fitzgerald et al. 1979:12).

Yet, in a parallel move, this bench indicates the trend to rationalize and standardize the global field of corporate managerial control. ISO-9000 documents, which detail the standardized management procedures, include the specifications for such practices as design control, quality records, production control, internal auditing, and statistical techniques. Corporations apply to ISO to receive ISO-9000 certification reflecting their adherence to such standards of corporate managerial control. My indicator for standardized management procedures is the number of ISO-9000 certificates awarded to corporations in each nation-state by March 1995 (standardized by population size). This national score reflects the compliance with international conventions of management. As in the case of adherence to accounting conventions, science practice is tightly related with national compliance with ISO-9000 standards. The latent dimension of science practice in the 1980s is highly and significantly correlated with the number of ISO-9000 certificates per capita in 1995 (R^2=.39; Table 4.2.1). Again, science practice established the basis for the standardization and rationalization of corporate management.[7]

Table 4.2.1
The Cross-National Relationship between Science Practice and the Standardization of Corporate Management
Pearson Correlation
1980, 1995

Standardized Management	**Science Factor 1980** [1]
Adherence to International Standards of Accounting 1979 Index Score Logged	.40 * (59)
ISO-9000 Certificates Per Capita 3/1995	.39* (57)

* p<.01 (N=)
1. Science factor 1980 includes: scpdate, ltns8086, ricsu79, lcit82; Eigenvalue=3.06.

[7] Note that in both models, in Table 4.2.1, a control factor for national development is not included. As mentioned in Chapter 3, this is due to technical difficulties: the fact that the level of national development captures almost all the explanatory power of cross-national variations in management procedures.

4.3 Science Practice and Standardized Appearance

My last example deals with the practice of "proper" governance. While information and corporate management serve as examples for governance regimes, an additional dimension is the ethics of governance. Nation-states vary greatly in their perception of proper conduct: some countries are perceived as properly governed while others are perceived as corrupt, unpredictable, or disorganized. This notion of proper governance reflects a convention, or a standard, in regards to governance. Moreover, this standard, like those of corporate and information management, is cross-national in nature. Yet, while the standards for information and corporate management are set as guidelines, the international standards for proper governance are less prescriptive. For example, my indicator for proper governance relies on the perception of governance and hence it is not encoded into a formal regulation. The indicator of national conduct is an index of corruption as perceived by international business people and journalists for the years 1980-1985 and 1996.[8] Relying on several opinion surveys made by risk analysts and business organizations, Transparency International (INGO established in May 1993 and based in Berlin, Germany) ranks up to 54 nation-states on a 1-10 scale by the perception of rampant corruption. This measure, while obviously subjective in nature, is quite reliable; as Dr. Johann Graf Lambsdorff, the TI economist that complies this annual index, says that despite cultural differences "if I compare all the surveys, it is quite striking that they are highly correlated, as high as 90 percent" (Crossette 1995b:6). Overall, these annual indexes are a tentative step towards the cross-national ranking of corruption.

Although this dimension of standardized practice is less prescriptive and non-formal then previous measures of cross-national standardization, it is still strongly related to science practice. A panel SEM for the relationship between science practice and the index of perceived corruption confirms this assessment.

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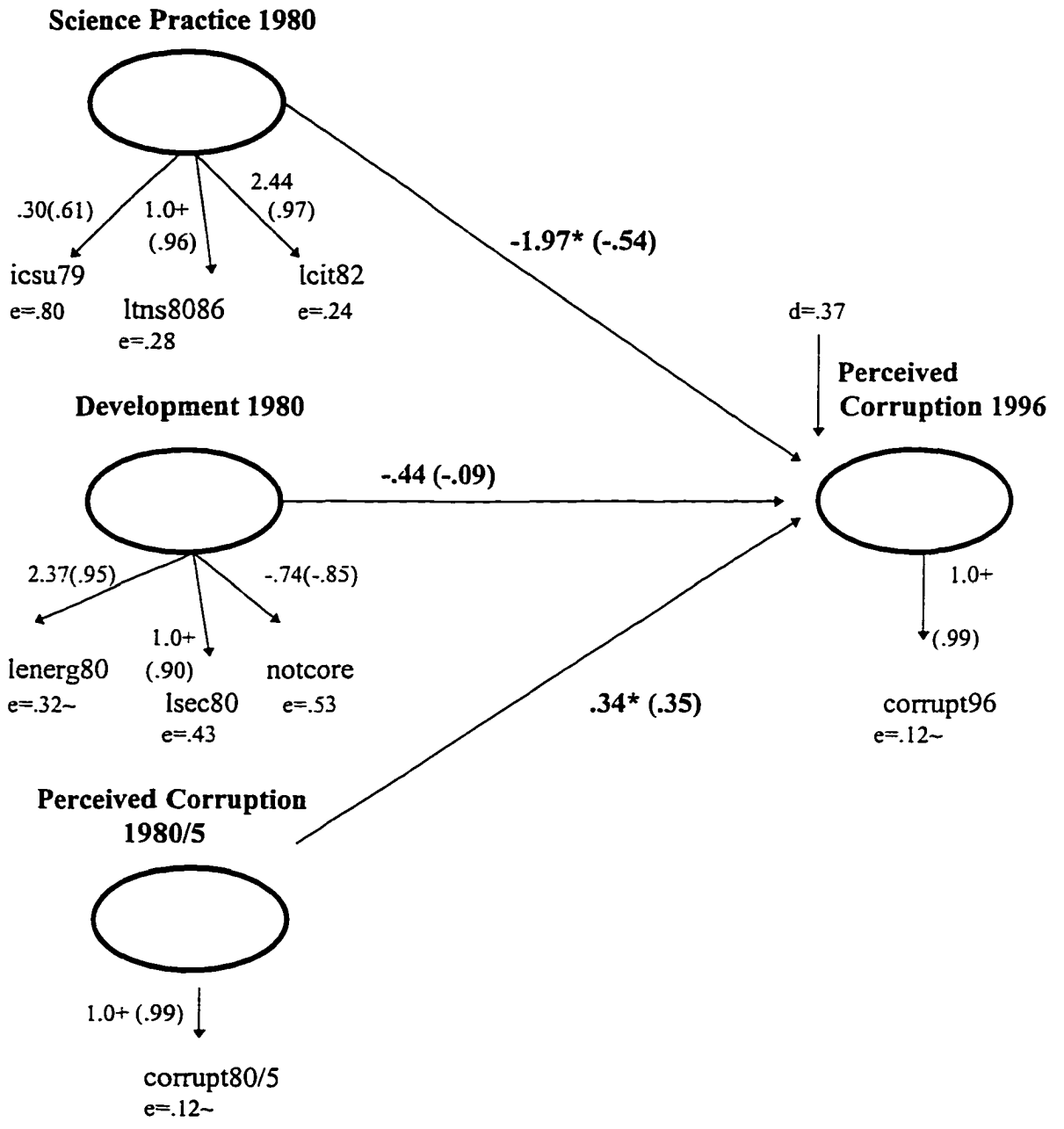
[8] The annual indexes are reported in the web page for Transparency International. See, Crossette 1995a for a report on the 1995 annual index.

Figure 4.3.1
The Cross-National Relationship between Science Practice and Perceived Corruption
Results from Panel Structural Equation Model
1980-1996



* p<.01 + Reference indicator ~ Error term assigned fixed variance
Correlation(Cov): S80/Dev80=.77(.31)*; S80/C80=-.83(-1.65)*; Dev80/C80=-.80(-1.19)*
Correlated error: ricsu79/lcit82=.85(.11); lsec80/notcore=.59(.04)
N=48
X^2=49.08 w/ 16 d.f.; CFI=.931

Figure 4.3.1 shows that the latent dimension of science practice in 1980 dramatically lowers the latent dimension of perceived corruption in 1996 (coef.=-1.97; standardized coef=.-54), over and above the effects of national development and of the perception of corruption in 1980-5. These results indicate that science practice minimizes the perception of uncontrolled governmental corruption. Hence, science practice contributes to greater rationalization of governance procedures and to greater cross-national standardization of conduct.

Following the same logic, science may also affect other dimensions of standardized governance. Such dimensions may be reflected cross-nationally by the degree of formalized governmental rules and regulations or by the existence and establishment of a national regulatory agency for standards in the production or distribution of goods. By "regulations" I do not mean national constitutions but rather rules or guidelines for particular fields. For example, indicators for the formalization of governance may be the existence of publications containing the regulations or the frequency of amendments to such published regulations. Such publications may concern economic matters (import/export regulations), the workplace (employee manuals), or the household (energy saving guidelines). One may expect that higher levels of scientization are related cross-nationally with greater specification and officialization of rules and regulations, or in other words, with greater codification of conduct.

4.4 Summary and Conclusions: On Science Practice and Rational Bureaucracies

The empirical cross-national models show that science practice promotes, or is associated with, greater standardization of various national practices: information management, corporate practices, and governance ethics and appearance (Table 4.4.1 summarizes the results of the numerous empirical models). What is it in science practice that promotes standardization? I argue that the link is the concept of rational order. The concept of rational order promotes the objectification, codification, and the impersonal tendencies of

the process of scientization. It is these tendencies that alter governance procedures. Overall, scientization promotes rationalization of various aspects of social life, through standardization of practices and codification of knowledge.

Table 4.4.1
Science Practice and the Standardization of National Practices: Summary of Results

The Dependent Concept	The Indicator	The Relation of Science Practice with Indicator
Information Sector	Data collection	+
	Organizational institutionalization	
	- dates	- [1]
	Information technology	
	- date of initial connection	- [1]
	- expansion rate	+
	Elaborated infrastructure	+
Corporate Management	Accountancy	+
	Managerial control (ISO-9000)	+
Governmental Appearance	Perceived corruption	-

1. In spite of the fact that the direction of the effect is negative, the finding is consistent with the other findings and with the general argument. The opposite sign appears due to the fact that the dependent variable is a date or an event on a chronological time-scale.

Scientization harbors the idea that one set of rules could apply to various nation-states regardless of their unique history or diverging social conditions. Scientization assumes that natural laws are relevant worldwide. It extends the notion of a natural world order to social laws as well. With this in mind, common wisdom now regards management procedures, information categories, and governance ethics as transferable from one social context to another. Moreover, this logic of cross-national standardization is infused into additional fields. For example, the IMF is currently drafting a set of common banking standards. These proposed standards (which include a disclosure of financial information and the degree of political independence of bank supervisors) are aimed at reducing the risk in the banking industry, especially in emerging economies (see, The Economist 1996). Regardless of its formal aim, this move reflects a trend towards cross-national

standardization. Scientization furthers such cross-national standardization of social practices, even if these practices are not directly linked with science-like procedures.

In addition, the trends of scientization -- and, therefore, of rationalization and standardization -- are intensified over time. For example, the institutionalization of a scientized information system, worldwide and nationally, is most dramatic in the post World War II period. Arturo Escobar (1995) claims that this change is due to the development of information-dependent professions and academic disciplines. In his study, Escobar stresses that the extensive efforts for information gathering and information standardization spring out of the need to develop, and implement, the highly-scientized model of developmentalism (1995:42). The construction of disciplines such as development economics during the late 1950s encouraged and relied on the construction and standardization of information processing. It is the availability of such cross-national standardized information that enabled developmentalism to construct universalistic models, to – in a purely non-reflexive manner – re-affirm the validity of these models and call for their worldwide implementation.

But, it is not only the traits of science that promotes the rationalization and standardization of society. Rather, it is also the role of science as a professional group. The cohesion of this professional group, bound by a common ethos and enjoying extensive legitimacy, makes science a powerful social group. However, scientists are not the only professional group to advance rationalization. Other professional groups, such as lawyers and accountants, are central to the standardization and rationalization of society and its governance procedures. For example, the existence of a large law profession encourages the formalization of regulations and creation of laws. Law also involves the categorization of issues into regulatory frameworks to analyze the consequences upon known precedents. In this sense, law, like science, encourages the categorization of reality. Accountancy encourages rationalization and standardization in a similar fashion. Accountants formalize transactions, and judge their validity, through the categorization and codification of the financial information. While science practice

does not directly contribute to the expansion of such rationalization-carrying occupations, it is associated with their growth and contributes greatly to the expansion of the general service sector.

In addition, international bodies play a central role in the processes of rationalization and standardization. Various international organizations encourage standardization by (a) providing the worldwide guidelines and (b) infusing such guidelines with value, or importance, by the sheer fact that they are engaging in their construction. Both governmental organizations (e.g., UN Statistical Office) and non-governmental organizations (e.g., the IASC) formulate and distribute standards relevant to their field. For example, the UN Statistical Office formulated its rules for data reporting and distributed them to all its member states immediately following its establishment. While its general rules have been published periodically since 1955 in the Directory of International Standards for Statistics, it also publishes more focused guidelines for particular sets of data. In a series of booklets the UN Statistical Office offers principles, standards, definitions, and recommendations for conducting a national census[9], to name only one such field.

International organizations also actively collect information about standardization. For example, Mobil Corporation's European office is collecting the cross-national data on ISO-9000 certification. In doing so, Mobil shows its appreciation towards cross-national standardization, acknowledges that (standardized) cross-national information regarding standardized practices are of value, and legitimizes the efforts towards standardization of management. The efforts of such international organizations to support standardization are done in the name of increasing the effectiveness of their operations. For example, Mobil refers to its need for cross-national information about standardized corporate practices as the reason for its efforts to collect data on ISO-9000 certification. Mobil relies on such cross-national information when making its business decisions. They may

rely on the certification information when searching for local business partners, assuming that corporations who abide by ISO-9000 standards are more rational and more accustomed to Western working styles.

The question remains: Are the relations between scientization and standardization reflecting general trends towards expanded bureaucracies in both the private and public sectors? It seems that both scientization and bureaucratization are parallel moves towards a greater rationalization of society. Rationality, being a core element in modernity, calls for the replacement of various forms of authority with the authority of deliberation, calculation, and impartial judgment (Weber 1978:212-271). Its translation into the language of organizational efficiency makes rationality serve as a justification for various sorts of modern reforms. In this sense, both scientization and bureaucratization are being globalized with this expectation. The globalization of science is associated with the general expansion of bureaucracies: the expansion of the state, of the rationalizing professions, and of the service sector. Overall, therefore, science and bureaucratization are intertwined global processes of the modern era.

[9] Such booklets include, for example, Principles for a Vital Statistics System (Series M, No. 19), General Principles for Housing Census (Series M, No. 28), and the International Standard Industrial Classification for All Industrial Activities (Series M, No. 4).

CHAPTER 5

SCIENCE, ACTORHOOD, AND POLITICAL CULTURE

During the August 1991 uprising against Mikhail Gorbachev's regime, the world followed the events as they unfolded. University faculty in Moscow used their e-mail to inform and update the global community, circumventing the Soviet censorship. Reports through this medium helped shape this political episode: once foreign powers learned of the political turmoil they exerted pressure on Yeltsin and helped bring about a peaceful conclusion to this political drama. This story and similar ones regarding Yugoslavia are often cited as examples of how scientific activities, such as the availability of academic e-mail, shape political events.

While these examples show a direct effect of scientific practices on the shape of political events, my argument, as described in Chapter 2, considers the indirect influences that science practice has on its political environment. I argue that science globalization alters nation-statehood by changing the nature of the local polity. These relationships are mediated by scientization processes and by the introduction of science-embedded modernist concepts. Specifically, the modernist concept of actorhood changes the nature of local polities to participatory polities. The modernist concept of actorhood encourages: (a) the construction of political entities and (b) the empowerment of such political actors, moving them towards greater political engagement. This Chapter empirically examines the hypothesized relationships between science practice and the nature of local polity. Section 5.1 examines the relationship between science practice and the construction of political actors, while Section 5.2 investigates the relations between science practice and political engagement. Section 5.3 summarizes the results and concludes that science practice introduces the Western form of governmentality worldwide.

5.1 Science Practice and the Construction of the Political Actor

The taxonomic nature of science makes the construction of categories, social and natural, into an accepted social activity. Once the category is constructed, the basis is set for members of the category to claim their distinctiveness and to demand rights based on such distinctiveness. Science practice is highly related to the expansion of the discourse of rights worldwide. My empirical models confirm that science practice is associated with the extension of political rights to various groups. The political categories I present are (a) women, (b) humans, (c) consumers, (d) gays and lesbians, and (e) the environment. My claim for the effects of science practice on the expansion of the discourse of rights is not particular to any of these specific social categories or rights, but rather general. I argue that scientization, through the immersion of countries in the notion of actorhood, enhances the construction of political entities and the legitimacy of their claims for political rights.

Women's Rights. The acceptance of universalistic individualistic principles, which re-defined the social standing of women as full citizens, resulted in an explosion in state action on behalf of women (Berkovitch 1994). While in 1960 only 2% of states had a formal state agency for the promotion of women's equality, by 1980 45% of countries institutionalized such practice; while in 1970 no state had a governmental ministry for women's affairs, by 1990 36 countries established such governmental domain (Berkovitch 1994:155). Women's rights define a distinct group with political privileges based on womanhood, and claims political privileges based on this distinction. There are numerous cross-national indicators of womanhood from which I chose three: (a) an index score for women's social status for 1986-8 (scale 0-75; Camp 1988), (b) an index score for women's social equality for 1986-8 (scale 0-100; Camp 1988)[1], and (c) UNDP's gender development index for 1992 (scale 0-1; UNDP 1992:74-80). Together these indicators present a general picture for the acceptance of womanhood as a valid political entity.

Table 5.1.1
The Cross-National Relationship between Science Practice and Women's Rights
Results from Cross-Sectional Regression Analyses
1980-1990s

Independent Variables	**Dependent Variables**		
	Women's Status Index Score 1985 **Model 1**	Women's Equality Index Score 1985 **Model 2**	Gender Development Index 1992 **Model 3**
Science Factor 1980 [1]	2.61 (.20)*	3.72 (.22)*	.03 (.16)**
Development Factor 1980 [2]	10.69 (.74)*	13.23 (.78)*	.19 (.79)*
Summary Statistics			
R^2	.80	.76	.82
N	81	81	73

* p<.01 (two-tailed)
1. Science factor 1980 in models 1 and 2 includes: scpdate, lcit82, ricsu79, ltns8086; Eigenvalue=3.16. Science factor 1980 in model 3 includes: ltns8086, ltss8189, ricsu79, lcit82; Eigenvalue=3.29.
2. Development factor 1980 includes: lenerg80, lsec80; Eigenvalue=1.83.

The expansion of the discourse of womanhood cross-nationally is strongly related to science practice. Table 5.1.1 shows the results from three cross-sectional models, each showing the effect of science practice on a different index of women's social conditions. The empirical investigations demonstrate that science practice is associated with higher, rather then lower, social status for women (model 1), with greater, rather then smaller, overall equality for women (model 2), and with greater, rather then smaller, overall gender development (model 3). Specifically, the latent dimension of science practice in the 1980s has a positive and significant cross-sectional effect on the index score of women's status in 1985 (coef.=2.61; standardized coef.=.20), a positive and significant cross-sectional effect on the index score of women's equality in 1985 (coef.=3.72; standardized coef=.22), and a positive and significant effect on an index of gender development in 1992 (coef.=.03; standardized coef.=16). All such effects of science

[1] Indicators (a) and (b) were compiled by the Population Crisis Committee.

practice are over and above the effect of general developmental trends; that is, development is employed as a control variable in these models.[2] Overall, these models show that science practice enhances the national action to establish and expand women's rights.

Human Rights. Consistent with these findings, there exists evidence of a strong relationship between science practice and human rights discourse. Here, the category is very inclusive: all humans are privileged. While the definition of the social category is different from that of women, still there is a similar overwhelming worldwide expansion of human rights as well. For example, dictatorships have collapsed since the 1970s[3] and even Asian autocracies, such as South Korea and Taiwan, have become more democratic. I chose four indicators to represent the discourse of human rights: (1) a latent dimension of national compliance with international human rights' initiatives by 1991[4], (2) Charles Humana's index of human rights 1985, (3) the Human Development Index for 1992 calculated by UNDP (1991:1119-121, 1995:18-20), and (4) Ruth Sivard's (World Priorities Inc.) index of repression for 1986.

The empirical models, while employing cross-sectional modeling for two time points (namely, the 1970s and the 1980s), demonstrate that overall there exists a positive association between science practice and human rights. First, Model 1 in Table 5.1.2

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[2] The date of introduction of female suffrage was used as a fourth measure of women's rights. The results of a cross-sectional regression analysis show that science practice in 1980 has a negative and significant cross-sectional relationship with the date of introduction of universal female suffrage (coef.=-9.48; standardized coef.=-.56; R^2=.53; n=97), while a factor for national development serves as a control dimension. While temporal order in this model is somewhat deceiving, this evidence does demonstrate that science practice is associated with an earlier, rather then later, introduction of female suffrage.

[3] The 1970s saw the collapse of European dictatorships in Greece, Spain, and Portugal; most of the Latin American dictatorships collapsed during the 1980s; most communist regimes collapsed during, or shortly after, 1989.

[4] The latent dimension of compliance with international human rights' initiatives is composed of three variables: (a) the time lag (in years) between the signing of the International Covenant on Economic, Social and Cultural Rights (ICESCR) in 1966 and the date of national ratification, (b) the time lag (in years) between the signing of the International Covenant on Civil and Political Rights (ICCPR) in 1966 and the date of national ratification, and (c) the number of reminders sent by Amnesty International to national authorities because their human rights' reports were belated. All indicators are adapted from Amnesty International 1992:300-304, 307-309.

illustrates how science practice increases compliance with international initiatives in the field of human rights. Specifically, the latent dimension of science practice in the 1970s has a positive and significant cross-sectional effect on the latent dimension of compliance with international conventions of human rights (coef.=.27; standardized coef.=.31).

Table 5.1.2
The Cross-National Relationship between Science Practice and Human Rights
Results from Cross-Sectional Regression Analyses
1970-1990s

Independent Variables	**Dependent Variables**			
	Compliance w/ International Initiatives [5] **Model 1**	Humana's Human Rights' Index 1985 **Model 2**	Human Development Index 1992 **Model 3**	Sivard's Repression Index 1986 **Model 4**
Science Factor				
1970 [1]	.27 (.31)***			
1980 [2]		13.55 (.59)*	.02(.10)***	-.49 (-.21)***
Development Factor				
1970 [3]	-.51(-.55)*			
1980 [4]		.82 (.03)	.20 (.84)*	-.01 (-.01)
Summary Statistics				
R^2	.12	.37	.84	.05
N	80	79	97	89

* p<.01 ***p<.10 (two-tailed)
1. Science factor 1970 includes: ltns7479,ltss7279,ricsu79,lcit82; Eigenvalue=3.29.
2. Science factor 1980 includes: scpdate, ltns8086, lcit82, ricsu79; Eigenvalue=3.16
3. Development factor 1970 includes: lenerg70, lsec70, notcore; Eigenvalue=2.40
4. Development factor 1980 includes: lenerg80, lsec80, notcore; Eigenvalue=2.35
5. Factor for compliance with international human rights' initiatives includes: ICCPR, ICESCR, remind91; Eigenvalue=2.09.

Second, science practice is associated with greater exercising of human rights (Model 2; Table 5.1.2). The latent dimension of science practice in the 1980s has a positive and significant cross-sectional effect on Humana's index of human rights in 1985 (coef.=13.55; standardized coef.=.59). Third and similarly, science practice is associated with greater human progress (Model 3; Table 5.1.2). The latent dimension of science practice in the 1980s has a positive and significant cross-sectional effect on UNDP's

index of human development 1992 (coef.=.02; standardized coef.=.10). Last, science practice is associated with less repression (Model 4; Table 5.1.2). The latent dimension of science practice in the 1980s has a negative and significant cross-sectional effect on Sivard's index of repression for 1986 (coef.=-.49; standardized coef=-.21). As mentioned earlier, all such cross-sectional effects are net of developmental effects, as a factor of development variables is employed as a control factor. Overall, these cross-sectional regression models show that science practice enhances the discourse of human rights worldwide.

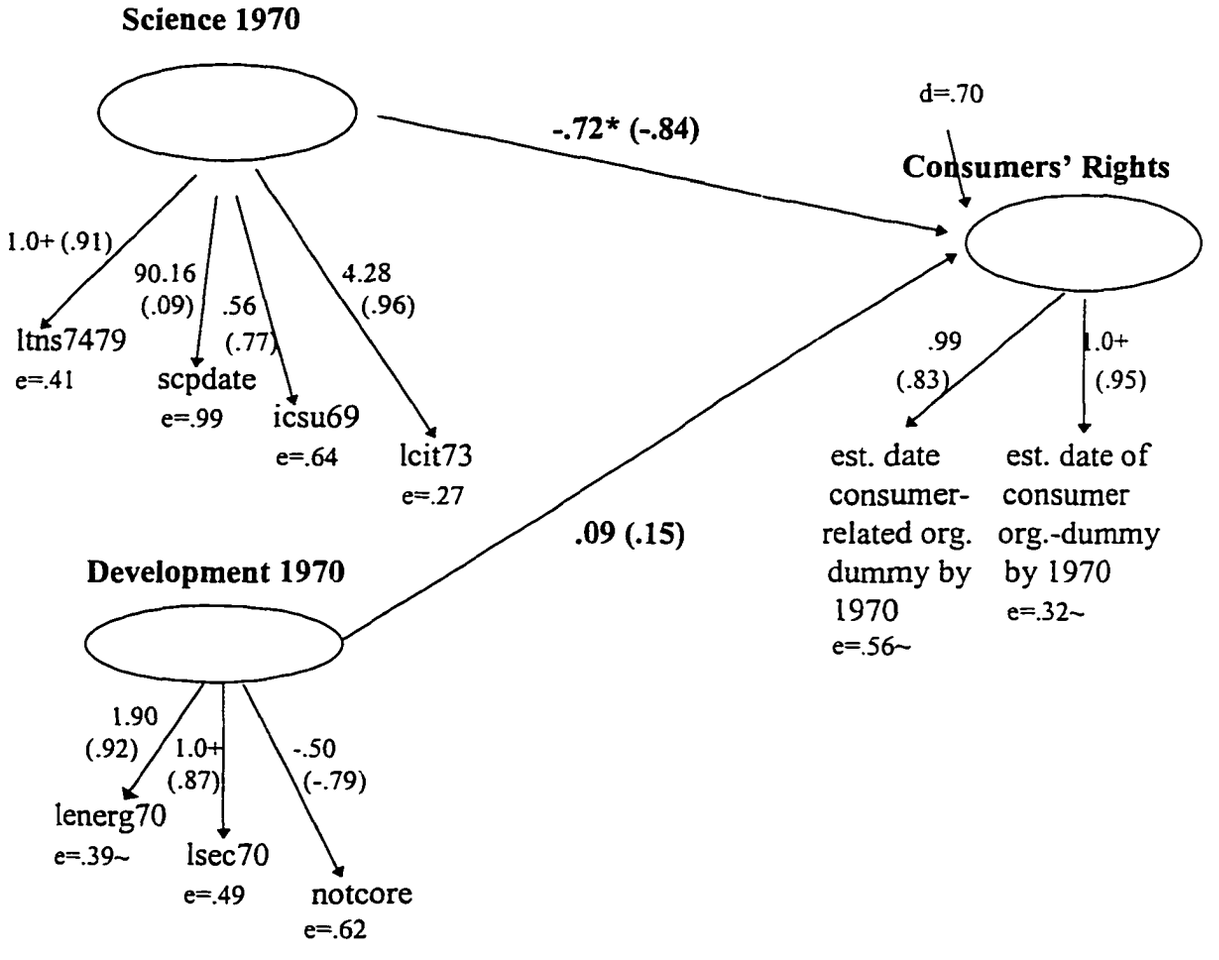
Consumers' Rights. Consumer-oriented rights, like human and women's rights, is an individualistic form of conceptualizing actorhood. As mentioned earlier, this constructed category is defined by one's role in market relations: consumers' rights define one's privileges as a buyer of goods and services. Nation-states vary greatly in their emphasis on consumers' rights, as reflected in the number of consumer-oriented national organizations. In 1992 the number of these organizations varied from 1 in most non-Western countries to 17 in the US and 28 in India. Yet, by 1989 90% of all existing nation-states had at least one consumer-oriented national organization, and 1/3 of all nation-states had more then 3 such organizations. Overall, tracing consumers' rights by both the founding dates and the number of consumer organizations shows that these rights are expanding worldwide.

Empirical evidence shows that the trend towards greater awareness of consumers' rights is supported by high levels of science practice in society. Science practice affects both indicators of consumers' rights: (a) the founding dates of national consumer organizations[5] and (b) their number, both of which are gathered from the 1992 directory

[5] I differentiate between two types of national consumer organizations: those that are specifically concerned with consumer matters and those that include consumer matters as a part of their general agenda. The first category includes such organizations as the Consumer Federation of America in the US and the Consumer Protection Association in India. The second category includes such organizations as the Center for Science in the Public Interest in the US and the Delhi Housewives' Association in India. The latent dimension of consumers' rights in Figure 5.1.1 combines both indicators.

of the International Organization of Consumer Unions (IOCU; recently re-named Consumers International).

Figure 5.1.1
The Cross-National Relationship between Science Practice and the Timing of Consumers' Rights
Results from Cross-Sectional Structural Equation Model
1970-1990s



* p<.01 (two-tailed) + Reference indicator ~ Error term assigned fixed variance
Correlation(Cov): S70/Dev70=.84(.36)*
N=70
X^2=51.28 w/27 d.f.; CFI= .949

First, a cross-sectional SEM model shows that cross-national science practice hastens the institutionalization of national-level consumers' rights organizations (Figure 5.1.1). The latent dimension of science practice in the 1970s is significantly associated with a pre-

1970 establishment of the first consumers' rights organizations (coef=-.72; standardized coef.=-.84).[6]

Second, science practice also assists with the growth of the consumer-related organizational field. Table 5.1.3 shows that science practice in the 1970s is associated with a greater number of national consumer-oriented organizations in 1992 (coef.=2.32; standardized coef.=.47). All such cross-sectional effects are net of development effects. In general, science practice is consistently allied with the institutionalization of consumers' rights by being associated with an early establishment of the first national consumers' organizations, or by 1992, being associated with an expanded national organizational field of consumers' rights. Science practice is, hence, associated with the overall expansion of consumers' rights.

Table 5.1.3
The Cross-National Relationship between Science Practice and the Size of the Consumer-Related Organizational Field
Results from a Cross-Sectional Regression Analysis
1970-1992

	Dependent Variable
Independent Variables	Number of National Consumer Organizations 1992
Science Factor 1980 [1]	2.32 (.47)*
Development Factor 1980 [2]	-.39 (-.07)
Summary Statistics	
R2	.17
N	70

* p<.01 (two-tailed)
1. Science factor 1970 includes: scpdate, tns8086, ricsu79, lcit82; Eigenvalue=3.06.
2. Development factor 1970 includes: lsec80, lenerg80, notcore; Eigenvalue=2.35

[6] Note that the dependent variables are re-coded to confirm with the logic of the empirical model in regards to temporal sequencing. The variables of the dates of establishment of the national consumer organizations were dummy coded. The dummy variables, which are later combined into a single score, reflect dates prior to 1970 (value=0) and after 1970 (value=1).

Gays and Lesbians' Rights. The distinction for gays and lesbians' rights is based on sexual orientation. A cross-national description on the condition of gays and lesbians' rights can be found in The Pink Book[7] (e.g., legislation issues, the state of the gay and lesbian movement), and the indicator for gays and lesbians' rights is compiled from these narratives (Frank & McEneaney forthcoming). As in the expansion of other rights' discourses worldwide, science practice is also a core factor in the expansion of gays and lesbians' rights. This is demonstrated in a cross-national panel SEM for the years 1980 through 1994 (Figure 5.1.2). Although in this sample of 74 countries there is great time-lagged dependency (coef. of 10-year-lagged rights' factor=.95; standardized coef.=.68), the latent dimension of science practice in the 1980s has an added positive and significant effect on the latent dimension representing gays and lesbians' rights in 1994 (coef.=.52; standardized coef.=.26). In other words, while it seems that the societal attitude towards gays and lesbians is stable over time, science practice is a key to any change in such attitudes. Considering the fact that these rights are not yet fully legitimate in the Core liberal countries, due to the strong opposition from conservative and religious movements, their expansion worldwide still relies heavily on their definition as rights that were already "sanctified" in the liberal world polity (e.g., human or citizen rights). In this process, science practice sets the cultural atmosphere for the promotion of currently-marginalized discourses of actorhood.

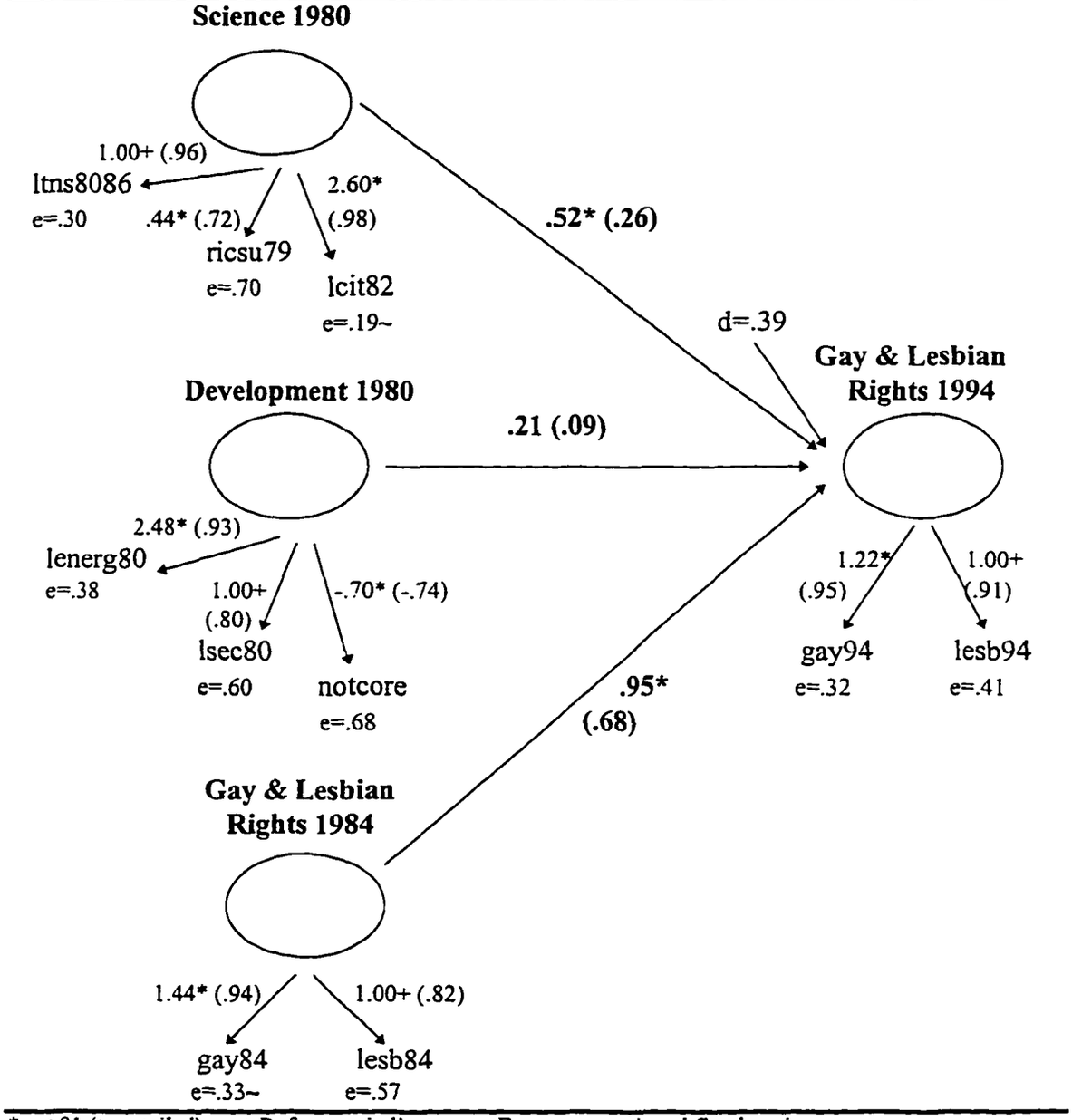
Environmental Rights. The discourse on environmental rights is an extension of the general rights' discourse to non-humans (the earth, animals, plants, etc.). While other non-human entities are used as subjects of various still contested rights campaigns[8], the discourse on environmental rights is by now a legitimate forum. In my models a national commitment to environmental rights' issues is indicated by the number of international environmental protection treaties ratified by each nation-state in the years 1980 and 1990 (Frank 1994). While the issue of environmental concerns was initially constructed in a highly scientized manner (Frank 1994), science practice also greatly affects the expansion

[7] Compiled and published by the International Lesbian and Gay Association.

Figure 5.1.2

The Cross-National Relationship between Science Practice and Gays & Lesbians' Rights

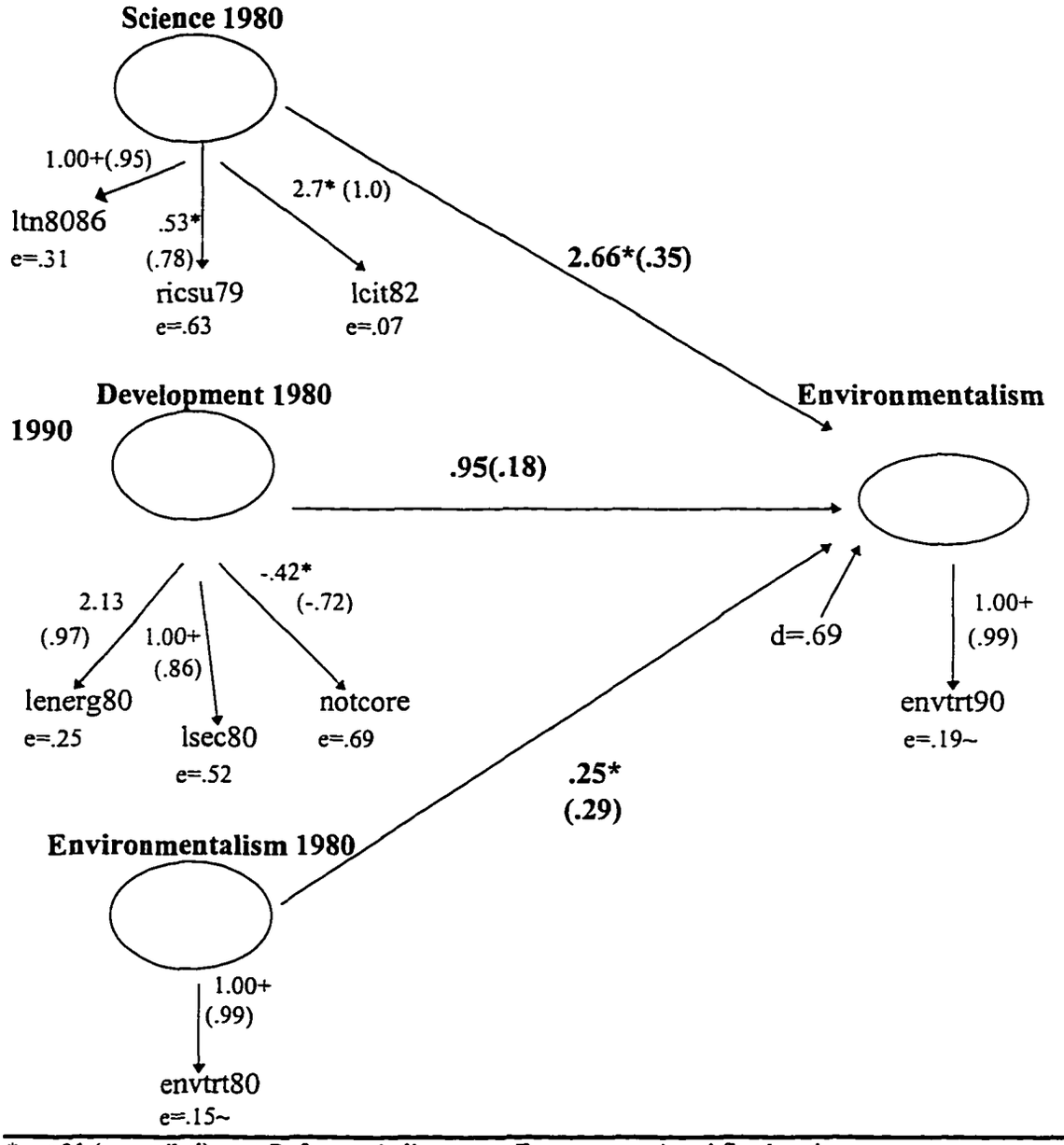
Results from Panel Structural Equation Model
1980-1994



* p<.01 (two-tailed) + Reference indicator ~ Error term assigned fixed variance
Correlation(Cov.): S80/Dev80=.74(.25)*; S80/GL84=.55(.31)*; Dev80/GL84=.58(.27)*
N=74
X^2=80.68 w/ 31 d.f.; CFI=.928

[8] For example, anti-abortion/pro-life claims are framed as a matter of embryo rights, and anti-fur campaigns are the flagships of animal rights' groups.

Figure 5.1.3
The Cross-National Relationship between Science Practice and Environmental Rights
Results from Panel Structural Equation Model
1980-1990



* p<.01 (two-tailed) + Reference indicator ~ Error term assigned fixed variance
Correlation(Cov):S80/Dev80=.70(.32)*;S80/Env80=.68(1.97)*;Dev80/Env80=.56(2.35)*
N=121
X^2= 96.5 w/ 16 d.f.;CFI=.912

of the national commitment to environmental issues, as shown in a panel SEM (Figure 5.1.3). Specifically, the latent dimension of science practice in the 1980s positively and significantly affects the number of international environmental treaties that each nation-state ratified in 1990 (coef.=2.66, standardized coef.=.35), while controlling for the level of national development and for time-lagged environmental commitment. Therefore, science practice promotes the discourse of environmental rights as a newly-fashioned right.

To summarize, empirical evidence suggests that science practice is associated with the expansion of various discourses of rights: women's, human's, consumers', gays and lesbians', and environmental rights. These various rights' discourses offer a spectrum of rights issues: humanistic versus market rights, individualistic versus group rights, human versus non-human rights. However, the arguments are valid in spite of this variety, and, moreover, are not limited to this spectrum of social groups. Rather, additional social groups – such as ethnic minorities, racial groups, or children – may be the focus of future studies. In spite of this variety of claims of actorhood, all rights' discourses share a strong dependence on the process of scientization. More specifically, the expansion of such discourses (but not necessarily their practice) depends on the science-based, modern notion of actorhood.

Here I wish to emphasize that this cross-national empirical evidence (that since the 1970s science practice is associated with, or contributes to, the worldwide expansion of various rights) is not intended to provide support for the "science for human rights" (SHR) model, described in Chapter 1. True, the fact that science practice encourages the expansion of rights may be seen as demonstrating that SHR's negative attitude towards the effects of science should take a more meliorist tone. I do not wish to partake in this functionalist and reductionist discourse. In my study, I transcend it. Thus, I regard the empirical evidence as demonstrating that science is not <u>for</u> human (or other) rights, but rather that science brings with it a modernist conceptual "package" that includes the discourses of rights. The role of science in relation to these rights' discourses, which is

fully explored in Section 5.3, is in establishing the conceptual basis for such discourses to be thinkable and practicable. Science practice promotes the modernist notion of actorhood and actorhood is translated into the construction of political actors and a rights-type of political action.

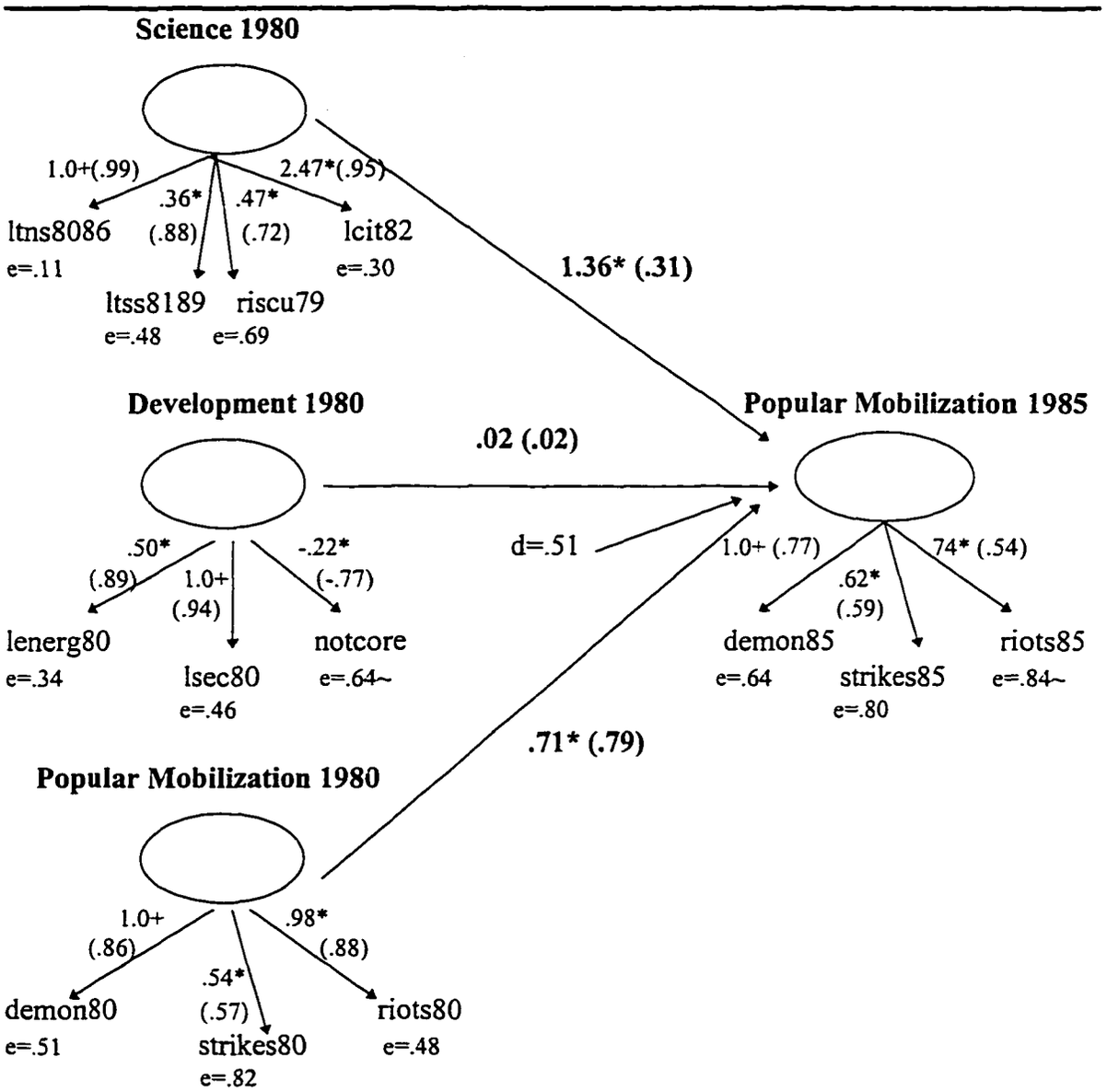
5.2 Science Practice and the Empowerment of Political Actors

The influence of scientization processes over actorhood does not end with the construction of political actors. Rather, scientization also promotes a sense of agency, thus infusing the constructed actors with a sense that they have a stake in the political process and encourages them to take an active role (see, Chapter 2). In this Section, I describe cross-national analyses that support the argument that science practice encourages expressions of political agency.

The first dimension of political agency is popular mobilization for political action. Such action represents the extent to which individuals believe that they can impact their social environment and destiny. Popular mobilization for political action is indicated by two variables: (a) a latent dimension of popular political action and (b) participation in elections. The latent dimension of popular political action combines three indicators: the five-year annual averages of the numbers of demonstrations, strikes, and riots (Eigenvalue for 1980 factor=2.15; Eigenvalue for 1985 factor=2.04; Figure 5.2.1). Together they serve as expressions of street level political pressure. Science practice, through its notion of agency, sets the basis for such popular exertion of political pressure. A panel SEM shows that in spite of the great effect that the history of political mobilization has on current levels of such political activity (coef. of time-lagged variable=.71; standardized coef=.79; Figure 5.2.1), the latent dimension science practice in the 1980 has a positive and significant effect on the latent dimension of popular mobilization in 1985 (coef.=1.36; standardized coef.=.31). In other words, in spite of the fact that the nature of the political culture, as indicated by popular mobilization, is generally stable over time, science practice has an additional influence on any changes in

this form of political engagement. As in most other models, such effects are net of the effect of the level of national development.

Figure 5.2.1
The Cross-National Relationship between Science Practice and Popular Mobilization for Political Action
Results from Panel Structural Equation Model
1980-1985



* p<.01 (two-tailed) + Reference indicator ~ Error term assigned fixed variance
Correlation(Cov): S80/Dev80=.70(.70)*; S80/PM80=.03(.05);Dev80/PM80=.20(.87)*
N=121
X^2=176 w/ 58 d.f.; CFI=.904

Overall, thus, we can surmise that during the 1980s science practice encouraged greater political activism, as expressed in a popular mobilization for "street action." Yet, the focus on the social actor as a political agent is also reflected in the "insistence on consent as a requirement for the exercise of authority" (Ezrahi 1988:187). This is evident in the association between science practice and additional forms of political action, such as participation in elections. While voter participation is affected by a multitude of social factors (such as the type of regime and level of confidence in the election process), and while reliable data on such patterns is available for only a limited sample of nation-states, the relationship between science practice and voting is evident. The latent dimension of science practice in the 1980s is associated with greater numbers of registered voters (standardized by population size). In Table 5.2.1, the cross-sectional regression analysis shows that during the early 1980s, the latent dimension of science practice is positively and significantly associated with greater voter participation (coef=.04; standardized coef.=.30; Model 1). Overall, enhanced science practice is associated with a greater mobilization for popular action through the legal channel of voter participation.

Table 5.2.1
The Cross-National Relationship of Science Practice with Popular Mobilization and Political Resources
Results from Cross-Sectional Regression Analyses
1980s

Independent Variables	**Dependent Variables**	
	Number of Registered Voters - per capita 1980 **Model 1**	Freedom of Association Index 1985 [3] **Model 2**
Science Factor 1980 [1]	.04 (.30)**	.35 (.28)**
Development Factor 1980 [2]	.11 (.59)*	.39 (.31)**
Summary Statistics		
R^2	.67	.29
N	37	99

* p<.01 ** p<.05 (two-tailed)
1. Science factor 1980 includes: scpdate, lcit82, ricsu79, ltns8086; Eigenvalue=3.16.
2. Development factor 1980 includes: lenerg80, lsec80; Eigenvalue=1.83.
3. The freedom of association index has a 4-point scale: 1=low freedom, 4=high freedom (see, Table 5.2.2).

Similarly, science practice is associated with the institutionalization of two cornerstones for all political action: (a) freedom for political association and (b) access to information through the news media. Political association enables actors to construct a political apparatus, to conduct political activity, and to guide future action. The index of political association clusters four groups of nation-states by the nature of their political association: countries where no restrictions apply to political organizing, countries which impose minor restrictions on political organizing, countries where restrictions are applied only to political organizing, and countries where no political organizing is permitted.[9] Science practice is a major factor in determining a polity's attitude towards political organizing. A cross-sectional model shows that during the 1980s a latent dimension of science practice has a positive cross-sectional relationship with an index of freedom of association (coef.=.35; standardized coef.=28; Table 5.2.1, Model 2), while controlling for a latent dimension of national development. Science practice is, hence, coupled with greater liberty for political conferencing.

To further demonstrate the strong relationship between science practice and the freedom to organize, Table 5.2.2 presents a cross-tabulation of (a) the existence of a scientific and technological base[10] and (b) the index of freedom to politically organize. This shows that the existence of an effective scientific and technological base is commonly associated with fewer restrictions on political organizing, while the absence of a scientific and technological base is commonly associated with greater limits, or a total ban, on political organizing. Technically speaking, the chi square for Table 5.2.2 is highly significant (42.26 with 9 d.f.), suggesting that the variables of a scientific base and the freedom to organize are highly related to each other.

[9] The scale: 1=low freedom of association, 4=high freedom.

[10] The effectiveness of the scientific and technological base is defined in terms of its fusion with the industrial sector (see, UNESCO 1992:66-69). The index is a 4-point scale: (1) having an effective national science base, (2) having an established national science base, (3) having fundamental elements of a national science base, and (4) having no national science base.

This pattern of relations between science practice and freedom for political organizing groups various nations. Western countries (i.e., North America, Europe, Japan, Australia, and New Zealand) tend to have an effective scientific base and no restrictions on political organizing, while less developed countries with totalitarian regimes (i.e., most sub-Saharan African countries, several Asian countries, and Albania) have neither an effective scientific base nor the freedom for political organizing. Few are the exceptions to this pattern. The highly advanced communist countries (Czechoslovakia, Bulgaria, Hungary, and the USSR) represented the countries where political organizing was banned but there existed an effective institutionalized scientific base. Less developed countries that are more oriented towards Western models (Botswana, a few Central and Latin American countries, and a few small island countries) maintain no restrictions on political organizing yet have no effective scientific base.

Table 5.2.2
The Cross-National Relationship between Science Practice and Freedom of Association
Results of Cross-Tabulation
1985

Freedom of Association 1985	**Science Base - 1985**			
	Effective Science Base	Science Base Established	Fundamental Elements of Science Base	No Science Base
No Restrictions	17	19	6	9
Minor Restrictions		13	8	6
Restriction only on Political Association	2	8	8	9
No Association Allowed	4	5	14	23

X^2=42.26 w/ 9 d.f.

Table 5.2.3
The Cross-National Relationship between Science Practice and Public Access to the News Media
Results from Panel Regression Analysis
1980-1984

Independent Variables	Dependent Variable
	Access to News Media Factor 1984 [1]
Science Factor 1980 [2]	.13 (.13)**
Development Factor 1980 [3]	.06 (.06)
Access to News Media 1980 [4]	.81 (.80)*
Summary Statistics	
R2	.83
N	119

* p<.01 ** p<.05 (two-tailed)
1. Access to media factor 1984 includes: broad84, print84; Eigenvalue=1.86.
2. Science factor 1980 includes: ltns8086, ltss8189, ricsu79, lcit82; Eigenvalue=3.29.
3. Development factor 1980 includes: lenerg80, lsec80; Eigenvalue=1.83.
4. Access to media factor 1980 includes: broad80, print80; Eigenvalue=1.88.

As mentioned earlier, freedom of information is a second political resource which is regarded as vital for political participation. Information enables political actors not only to exchange ideas but also to make educated political decisions. Access to the news media as purveyors of information is, therefore, a feature of political engagement. Furthermore, in some polities, access to information is defined as either a civil or political right, anchoring it in a broader discourse of political matters. As is its contribution to other dimensions of political life, science practice also greatly promotes access to the news media, both broadcast or print media.[11] Results of a panel regression analysis show that the latent variable of science practice in the 1980s has a positive and significant effect on the latent variable of access to the news media in 1984 (coef.=.13; standardized coef.=.13; Table 5.2.3), in spite of the great time-lagged dependency of such access (coef.=81; standardized coef.=.80). This shows how science practice encourages access

[11] The latent dimension of access to the news media is a combination of two indexes, access to broadcast media and access to print media. Both are 3-point scale (0=not free; 2=free). See, Sussman 1989.

to the news media and supports the establishment of this forum for political interaction and activity. Freedom House's survey of journalism morbidity, which traces repression of journalists in 84 nation-states, may serve as an additional indicator of access to news media. Similar model specifications may also show that greater science practice is associated with lower levels of repression of journalists, thus describing a similar relationship between science practice and access to the news media.

Finally, science practice promotes greater civil and political liberties. Nation-states with greater civil and political liberties are those polities that cherish the status of individuals and attribute an active political role to individuals. The comparative indicators for civil- and political liberties are from Freedom House's Comparative Survey of Freedom (see, Ryan 1993). In these annual surveys, Freedom House monitors the progress, or decline, of political rights and civil liberties in numerous nation-states and territories. It summarizes these trends into annual indexes, scaled 1-7: value 1 indicates countries with (a) no civil freedom[12] or (b) no political rights[13]; value 7 indicates ideal levels of (a) civil freedom or (b) political rights, respectively. Between the 1970s and the 1990s there were dramatic changes in the civil and political liberties in various nation-states, most obviously, after 1989, in the former communist bloc countries. Countries such as Hungary, Czechoslovakia, and Poland are leading all others in introducing greater civil and political liberties. On the other hand, during this period other countries regressed in regards to liberties: Indonesia and China dramatically curbed the liberties of their citizens. In spite of the great time-lagged dependency in regards to liberties, to the degree that changes in political rights and civil liberties occur, such changes are attributed to the foundations set by science practice.

This assertion is grounded in empirical findings. First, science practice is found to encourage greater civil liberties. A panel SEM shows that the latent dimension of science practice in the1970s has a positive and significant effect on civil liberties in 1989

[12] Civil freedom is defined as freedom of expression, assembly, demonstration, religion, and association.
[13] Political rights are defined as political freedom and competitive politics.

(coef.=2.80; standardized coef.=.35; Figure 5.2.2). In this sense, science practice encourages freedom of association (political, business or cooperative, union, or other), freedom of information, and freedoms derived from opportunity, equality, and choice. In the words of Freedom House's editors, science practice enhances "...freedoms to develop views, institutions, and personal autonomy apart from the state" (Ryan 1993:11).

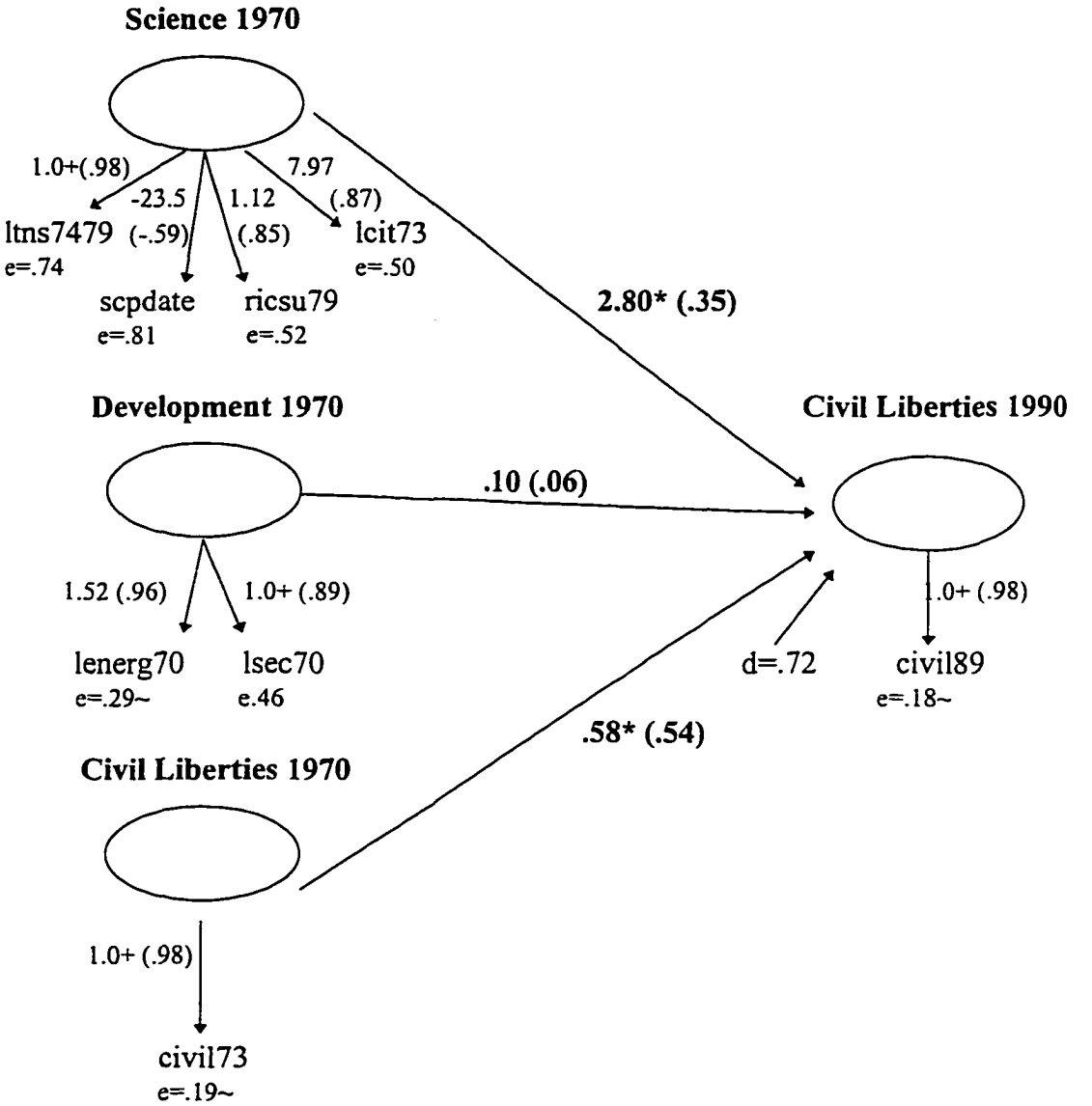
Political rights exhibit another dimension of the notions of actorhood and agency in the political process. That is, nation-states that grant a wide variety of political rights encourage its members to participate in the political process. Freedom House's Comparative Survey of Freedom defines political rights as "enabling people to participate freely in the political process" (Ryan 1993:11).[14] Accordingly, science practice is a key factor in enhancing greater political liberties, and empirical evidence supports this assertion. In a panel regression model, the latent dimension of science practice in the 1980s positively and significantly affects the index of political rights in 1993 (coef.=.57; standardized coef.=.25; Table 5.2.4 Model 1). Moreover, science practice plays an important role in the transition towards greater political rights in previously communist countries. In a sample of ten countries defined as communist before the 1989 watershed events[15], the latent dimension of science practice positively and significantly affects the change in an index of their political rights between 1988 and 1993 (coef.=1.19; standardized coef.=41; Table 5.2.4 Model 2). Hence, science practice greatly affected the chances of previously communist countries to grant greater political rights after the 1989 collapse of the communist bloc.

[14] Freedom House's "checklists" for political liberties focus on competitiveness and openness of the political process, on democratic and free election procedures, and on the inclusiveness of political decision-making processes.

[15] For the purpose of these panel regression models, cases need to have information for both time points, namely 1980 and 1993. Thus, the ten countries include only nation-states that were in existence before and after the 1989 events. It excludes all newly independent countries (such as the Baltic and the Asia Minor states), most of which made dramatic alterations to their political structures and cultures. Yet, I decided to exclude them from the analysis, so as not to assume that they share the 1980 developmental, political, and scientific characteristics with the USSR.

Figure 5.2.2

The Cross-National Relationship between Science Practice and Civil Liberties
Results from Panel Structural Equation Model
1970-1990



* p<.01 (two-tailed) + Reference indicator ~ Error term assigned fixed variance
Correlation(Cov): S70/Dev70=.78(.16)*; S70/CL70=.08(.03); Dev70/CL70=.16(.26)*
Correlated Errors: ltns7479/lcit73=.41(.09); ricsu69/lcit73=-.35(-.06)
N=81
X^2=43.36 w/ 15 d.f.; CFI=.922

Ted Robert Gurr's (1990) indexes of institutional democracy provide another dimension of political participation. Such indexes (scaled 1-10) include the notions of

competitiveness in political participation, competitiveness in executive recruitment, openness of executive recruitment, and constraints on the chief executive. These notions place the focus on the procedures of a democratic and pluralistic political system. Such pluralistic democracies offer a greater involvement of citizens in the political process and reflect nations of agentic political actors.

Table 5.2.4
The Cross-National Relationship between Science Practice and Political Liberties and Democratization
Results from Panel and Cross-Sectional Regression Analyses
1980-1993

	Dependent Variables			
Independent Variables	Political Rights Index 1993 **Model 1**	Change in Political Rights Index 1988-1993 **Model 2** [3]	Institutional Democracy Index 1980 **Model 3** [4]	Institutional Democracy Index 1985 **Model 4** [4]
Science Factor 1980 [1]	.57 (.25) **	1.19 (.41)**	1.13 (.33)**	
Science Base 1985				.78 (.22)***
Development Factor 1980 [2]	.51 (.23)**	2.06 (.60)*	.66 (.19)	.85 (.24)***
Political Rights Index 1980	.39 (.39)*	-2.54 (-.59)*		
Summary Statistics				
R2	.56	.92	.22	.18
N	98	10	83	99

* p<.01 ** p<.05 *** p<.10 (two-tailed)
1. Science factor 1980 includes: scpdate, lcit82, ricsu79, ltns8086; Eigenvalue=2.98.
2. Development factor 1980 includes: lenerg80, lsec80; Eigenvalue=1.80.
3. Model includes only nation-states with pre-1989 communist regimes: Cuba, China, Laos, Mongolia, Bulgaria, Czechoslovakia, Hungary, Poland, Romania, and USSR.
4. Model includes only non-Western countries.

Science practice plays a central role in enhancing pluralistic democracies worldwide, and empirical evidence supports this assertion. Cross-sectional regression analyses (Table 5.2.4) show that (a) the latent dimension of science practice in the 1980s is positively and significantly associated with institutional democracy in 1980 (coef.=.1.13; standardized coef.=.33; Model 3) and (b) the existence of an effective science base in 1985 is positively and significantly associated with institutional democracy in 1985 (coef.=.78; standardized coef.=.22; Model 4).

Overall, the empirical models in this Section indicate that since the 1970s science practice is associated with greater political engagement, indicated by forms of popular action, availability of political resources, or liberties. Therefore, science practice is closely associated with various dimensions of participatory politics.

5.3 Summary and Conclusions: On Science Practice and Participatory Politics

My aim in this Chapter is to empirically investigate the relationships between scientization and national polities. I do so by juxtaposing science practice first with numerous measures of the construction of political actors, and, second, with numerous measures of political engagement. The results of the empirical models show consistent patterns, which are summarized in Tables 5.3.1 and 5.3.2.

As Table 5.3.1 shows, since the 1970s science practice is consistently associated with greater attention to the rights of various social categories. Science practice is associated with the promotion of various discourses of rights. These discourses define human beings by their gender (women's rights), sexual preference (gays and lesbians' rights), market position (consumers' rights), generalized "selfhood" as humans (human rights), or their relation with their natural environment (environmental rights). All these different rights' discourses share the notion that humans are social actors. In other words, the premise of the expansion of the rights' discourses is that humans have (a) the capacity or ability to act, (b) the responsibility to act, and (c) the responsibility to act for others

(Meyer & Jepperson 1996). The legitimated format for addressing such responsibilities is "a right." Hence, it is the people's right, and duty, to define themselves and others by these stylized categories and, thus, becoming actively involved in these politics of representation.

Table 5.3.1
Science Practice and the Construction of Political Actors: Summary of Results

Concept	Indicators	The Relationship of Science Practice with Indicator
Women's Rights	women's status index women's equality index gender development index	+ + +
Human Rights	compliance w/international initiatives human rights' index human development index repression index	+ + + -
Consumers' Rights	organizational inst. - dates size of field	-[1] +
Gays & Lesbians' Rights	G&L rights' index	+
Environmental Rights	environmental treaties	+

1. In spite of the fact that the direction of the effect is negative, the finding is consistent with the other findings and with the general argument. The opposite sign appears due to the fact that the dependent variable is a date or an event on a chronological time-scale.

Science practice is also consistently associated with the empowerment of political actors. As Table 5.3.2 shows, since the 1970s science practice is associated with enhanced political action (contesting and legal forms of political action), with greater availability of political resources (association and information), and with greater liberties (civil, political, and democratization).

Table 5.3.2
Science Practice and Political Engagement: Summary of Results

Concept	Indicators	The Relationship of Science Practice with Indicator
Popular Action	popular mobilization factor voting	+ +
Political Resources	freedom of association access to media factor	+ +
Liberties	civil liberties index political liberties index democracy index	+ + +

Overall, the empirical evidence in this Chapter confirms that scientization influences political cultures worldwide. The scientization of society, through the introduction of science practices and their embedded modernist notions, supports a political culture of participation and mobilization. That is, the existence of local science (due to the process of science globalization) sets the normative basis for this institutionalization of participatory politics. In a similar and parallel move, science-based modernist ideals of objectivity and impartiality may adversely affect political habits of nepotism, for example. Hence, it may be that trends of instrumentalism in science discourse support instrumentalism of political culture, such as "the replacement of various forms of the politics of charisma and mass enthusiasm by a cooler politics of deliberation, calculation, and public opinion disciplined by enlightenment" (Ezrahi 1988:184). In this sense, as in other dimensions that are fully explored in Chapter 6, scientization and liberal democracy compliment each other.

CHAPTER 6

SCIENCE AND NATION-STATEHOOD

Much like the Greek classical idea that the humanities are an education for democratic politics, scientization provides a conceptual, or normative, basis for contemporary politics. The previous Chapters describe the contribution of science practice to (a) the standardization and rationalization of national practices (Chapter 4) and (b) the construction of social groups and their empowerment (Chapter 5). In this sense, science practice encourages (a) the construction of representations through the establishment of standardized and scientized knowledge categories, (b) the empowerment of such constructed categories (social and other) by conceptualizing them as agentic actors, and (c) rational bureaucratization. Scientized societies more willingly accept standardized categories and practices, more readily employ claims for actorhood based on such categorizations, and more easily mobilize for political action, thus asserting their actorhood. As Barnett and Finnemore (1997:17) write, "categorization and classification is a ubiquitous feature of bureaucratization that has potentially important implications for those who are being classified." International discourses, which are carried by international bureaucracies, diffuse such fixed meanings (see, Keeley 1990). In the domain of science, the international science/development bureaucracy fixes meanings of actorhood. Thus, scientization produces "homo scientized" – a constructed actor, infused with the logic of scientism and drawing on scientific legitimacy for its definition. And, most importantly, "homo scientized" serves as the basis for the reigning liberal model of national polities.

Through the overwhelming processes of science globalization, scientization plays a role in the shaping of local polities. I demonstrate that through the infusion of local societies with science-embedded modernist notions of standardization, actorhood and agency, the globalization of science alters the nature of polities worldwide. Such alterations include changes in procedures of governance, such as the institutionalization of the information sector, and changes to the political culture, such as its infusion with political actorhood.

Similarly, Skolnikoff (1993) shows that technological globalization, most dramatically the globalization of information technologies, shapes the organization of society. He shows that technological globalization leads to a more open, rather then closed, society; to a decentralized, rather then centralized, political structure; to a decentralized, rather then centralized, economic structure; and, to a lesser degree, to a diffused, rather then a concentrated, military power. In other words, the introduction of new technologies leads "to a loosening of the bonds of a tightly controlled society," "tends to favor decentralized political societies," "is far more congenial" to decentralized economic structure, and is also related with a general trend towards greater diffusion of military power. Yet, while Skolnikoff's analysis recognizes the role of science and technology in shaping international relations, (mainly through the re-shaping of various nation-states), it still regards science and technology in an instrumentalist manner. By doing so, Skolnikoff fails to recognize the indirect effects that science institutionalization has on polities through the process of scientization. Nevertheless, his conclusions support my assessment that science globalization alters the nature of nation-statehood.

Modern science, hence, is integrally linked with the modern notions of nation-statehood. In this Chapter, I expand the discussion of the effects of science globalization on nation-states (as it appears in Chapter 2) in light of the empirical evidence. I argue that science and nation-statehood – both being modern institutions which depend on modern global myths and organizational networks – are mutually supportive. Yet, while acknowledging that science depends on the nation-statehood in practice and in discourse[1], I emphasize that nation-statehood is supported by the discourse and operations of global science and is re-shaped by the process of science globalization. In Section 6.1, I explore the manner in which scientization alters the mode of governmentality, or the practice and logic of governance. Nation-states are remade into participatory polities and they incorporate rational bureaucratic procedures under the inspiration of scientization. Moreover, defining science policy as a global myth (Section 6.2) allows us to expand the notion of

the effects of science globalization on nation-statehood. In this Section, I describe how nation-states draw support for their actions from scientized practices, and nation-statehood draws support from science discourse, which, through its focus on national development, reaffirms the notion of nation-statehood. In this sense, science practice is a ritual of modern nation-statehood (Section 6.3), and the exercise of this ritual is de-coupled from its formal goals.

6.1 Science and Governmentality

Scientization encourages a particular model of nation-statehood - a liberal progressive[2] modern version. The empirical models (Chapters 4 and 5) confirm that science practice encourages the institutionalization of rational bureaucratic practices and participatory politics. This observed connection between scientization and progressive nation-statehood is most particular to the liberal era of the world polity. Again, the empirical models display such effects only for the time period between the 1970s and the mid-1990s. Historically, greater scientization did not necessarily produce consequences such as greater political mobilization and an expansion of the rights' discourse. Nazi Germany and the communist bloc countries set examples for historical periods and cultural environments where great scientific activity did not produce progressive politics and the rationalization and empowerment of representations that it entails. In these societies, while scientific efforts did result in greater standardization and taxonomy of knowledge[3], this trend did not bring about political liberalization. In Nazi Germany, for example, rapid scientific growth and achievement paralleled disrespect of individual and group rights, and a dominance of collectivist, or national, ideologies.

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[1] Through reliance on state funding for operating, on inter-state networks for diffusion of its products, and on gaining legitimacy for its practice through its link with national goals. See Appendix B for further discussion of the ways through which nation-statehood affects science.

[2] By "progressive" I do not refer to New Deal progressive ideals nor to any radical-liberal political platform. Rather, my intention is to describe an optimistic vision of progress which relies on social and moral improvement in human conditions.

[3] Nazi race theories being an ultimate example for a scientized taxonomy.

What, then, enables my observed connection between science and political engagement? What in the liberal era of the 1980s and 1990s further binds scientization, on the one hand, and the construction and empowerment of political actors, on the other? During this time period the global world polity consolidated around liberal models, and both science and politics drew on such liberal thinking in their globalization. Liberal models[4] define, and legitimate, nation-states, corporations, and individuals as actors. They also value freedoms in the political and economic spheres. In a general way, all these features emphasize sovereignty – of the individual, of the group, of the market. In this sense, according to liberal thinking, science and liberal democracy are regarded as complimentary elements, because they share the essential themes of actorhood, freedom, and entrepreneurship. Ezrahi, for example, argues that science and liberal democracy share a sense of authority. First, science, in its search for universal laws, rejects "claims in the name of transcendental, hierarchical, personal, or other democratically illegitimate principles of authority" and thus reinforces the principles of democratic speech and action (1988:186). Second, "the authority of science and technology is consistent with liberal-democratic decentralization [because in both social spheres; GD] action is not arbitrary, but guided and checked by a functional test of technical adequacy" (Ezrahi 1988:197). Most importantly, while science is held up as the means for achieving this utopia of liberalism (see, Ben-David 1990:528-529), it is merely an additional social sphere defined in liberal terms and thus connected with liberalism. The liberal model is multi-faceted, thus meaningful to and addressing various social spheres. Its globalization is the worldwide diffusion of the bureaucratic marriage not only between science and development, but also with democratization and security concerns. In this sense, the globalization of science is a part of a qualitative transformation of the world towards liberalism as a general world model, or a package of reforms.

The rapid worldwide expansion of the liberal model reached its peak in the 1980s. Throughout the 1980s, under the leadership of Reagan and Thatcher, liberal thinking took

[4] Which, in the academic discourse are embodied in, for example, psychological and biological theories (Meyer & Jepperson 1996:5).

a global stronghold, and this trend reached its pinnacle with the 1989 "victory of liberal democracy" through the collapse of the communist bloc. During this decade market-oriented econo-centricity[5] is the most dominant episteme in social policy, as well as in science and in developmentalism. In this cultural atmosphere, which repeatedly employs the constructed script of the economic miracle of the Tiger economies, liberalization, privatization, and democratization are the worldwide policy "buzz words." All these buzz words call for similar policy measures, namely the return of Adam Smith's "invisible hand" to social life. All are also fashioned as the assured "prescriptions" for national development. Science policies were recently amended to reflect this latest trend in developmentalism: state-centered and state-sponsored science initiatives were re-written to reflect more market-oriented ventures. Such amendments highlight both agency and science-based recipes for achieving economic success and they reflect the tight discursive link between science and notions of national progress.

Scientization not only shares modernist themes with other social spheres[6], but rather scientization makes modernist themes thinkable and practicable. The alliance between science and government, in terms of linking science with the nation-state, is the Western version of the art of governance, or "the principle of governmentality" (Foucault 1991). Governmentality describes the state as transcending civil society. As an analytic concept, it joins together the discourses of state power, national identity, and instrumentality. Furthermore, governmentality, both in general and in particular through the loaded discourse of science, is simultaneously individualizing and totalizing. It defines particularistic social entities (such as, women, minorities, and racial groups), and subjects these entities to the totalizing effects of nation-statehood, international relations, and global processes. In other words, it concurrently permits the construction and

[5] What came to be known as the "Washington consensus," which is described by Wade (1996:5) as "reflecting the demise of Keynesianism and the ascendancy of supply-side economics...[and being] based on the twin ideas of the state as the provider of the regulatory framework for private-sector exchanges...and of the world economy as open to movements of goods, services, and capital, if not labour."

[6] Such as, the notion of actorhood which is reflected in both scientific activism and in political participation.

empowerment of individualistic identities and subjects such identities to the homogenizing pressures of globalization.[7] Ronald Robertson (1994) refers to this self-contradictory process as the "universalism of particularism." Post World War II neo-liberal thought is a prime instance of such *Omnes et Singulatim*[8] form of governmentality.

This liberal mode of governmentality has two additional features: it is based on bureaucratic rationalization and it transforms knowledge into a form of power. First, governmentality is embodied in a set of seemingly rational and bureaucratic procedures. Such procedures include some that are described in this work: the standardization of the gathering of information, management procedures, and the perception of governance. Arguably, it also addresses such bureaucratic procedures as law and economic policy. Second, the search for, and definition of, knowledge is an act of power. On a superficial level, since science is regarded as a prime source of knowledge, science is a central key to power. Scientific evidence, backed by the broad legitimacy of science, is commonly used as a justification for governmental decision-making and other acts of control. On a deeper level, science itself is a mechanism of control – over nature and social life. Scientific methodology sets the techniques of power relations[9] and the discourse of science constructs, or defines, the "thinkable" categories, whether "omnipotent" or "disenfranchised."[10] For example, the Indians of Latin America employ the already existing and legitimate category of "indigenous peoples" to establish their political rights, thus employing a "thinkable" category that connotes the socially under-privileged. When relying on science-based theories or evidence of their distinctiveness, their political voice is clearer.

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[7] Globalization processes diffuse notions of identity worldwide (e.g., notions of ethnic or tribal affiliation), thus homogenizing even this very particularistic, or localized, notion.

[8] Meaning "each and all." Foucault used this as the title for a series of lectures he gave on governmentality during the late 1960s.

[9] As Foucault says: "...[T]he production of effective instruments for the formation and accumulation of knowledge – methods of observation, techniques of registration, procedures for investigation and research, apparatus of control...all this means power" (1980:102).

[10] See, Foucault 1970, 1972.

Overall, science-embedded governmentality is knowledge-based power in the name of rationality. During the past 50 years, globalization processes – which are intensified by visions of the "global village" and which include the globalization of science – resulted in the diffusion of this mode of governmentality worldwide.[11]

6.2 "Science for National Development" as a Global Myth

As much as this mode of governmentality is diffused worldwide in the name of rationality, the process of its globalization is infused with non-rational elements. In other words, Weber's "iron cage," once revisited, exposes the non-rational facets of rationalization and bureaucratization processes.[12] In regards to science globalization, its dominant features of isomorphism and loose-coupling suggest that it is also infused with non-rational elements, such as mimetic tendencies. The worldwide standardization of science – in organizational formats, rhetorical arguments, and activity patterns (as shown in Section 1.1), suggests that the institutionalization of national science is not a reflection of national interests or needs. Empirical studies support this assertion. Jang (1995) shows that internal functional needs, such as the size of the local field of science, do not predict the institutionalization of a governmental ministry for science affairs. While such local functional factors do encourage the institutionalization of science ministries in the early years of this globalization process, namely in DCs, it is institutional factors, such as direct linkage with world-level organizations, that encourage the diffusion of this science activity to most other nation-states. Similarly, Finnemore (1991, 1993) shows that at the

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[11] Here, when concluding as to the effects of scientization on nation-statehood, a reminder of the context is in order. I, therefore, wish to emphasize the relationship between science and modernity, so as not to over-state the role of science in such processes. The science-embedded modernist notions of rational order and of agentic actorhood are core traits of the institution of modern science. However, they are not "natural" traits of science. Rather, these notions are constructed traits that were embedded into modern science since its institutionalization during the seventeenth century. These traits are rooted in the modernist episteme, and hence set the link between science and modernism. Science and modernism are not, however, interchangeable in my scheme of the effects of scientization on nation-statehood. True, scientization carries modernist notions, yet science epitomizes modernism. In other words, scientization condenses processes of modernization. In this sense, science is not an instance of modernity, but rather its axis.

[12] Similar to Bourdieu's (1977:158) conceptualization of "incoherent coherence," although Bourdieu aims at the level of practice, rather then at organizational features.

time of institutionalization of a national agency for science policy in most nation-states the size of the national science field is small and insignificant. Therefore, the science sector could not have exerted the pressure needed to establish the national agency for science policy. Last, Shenhav and Kamens (1991) find that science practice bears "a cost" for the more under-developed countries. They show that although all nation-states engage in scientific activity, during the 1970s the volume of scientific activity is related to the economic success of the country only in highly industrialized countries. Overall, these three empirical studies, which employ different statistical methods and different measures of science, agree that the institutionalization of national science is divorced from local needs. They argue that the institutionalization of national science is a reflection of trends in the world polity[13].

The world polity supports the trends of expansion, isomorphism, and loose-coupling in science through its various organizational carriers, particularly international organizations. Science and development-oriented international organizations, such as UNESCO[14] and the World Bank, serve as "teachers of norms" for all nation-states.[15] In this scheme the nation-state, while being widely assumed to be an initiative-taking agent, is a relatively passive participant in global processes. International organizations, in contrast, formally set the agenda of science policy by distributing the SND model and organizing the national science agenda and structures along its conceptual parameters.[16]

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[13] The world polity is a web of globalized myths and their organizational carriers. In other words, this "umbrella" of international culture includes (a) the hegemonic ideals and (b) the organizational network that sponsors these ideals and transfers them to all member nation-states. For further discussions of world polity perspective, which is the comparative variant of institutional theory, see Thomas et al. 1987. For a review of institutional theory, see Scott 1987b; Zucker 1987.

[14] Membership in UNESCO is practically universal. Hence, it is not merely the membership in, and hence formal interaction with, UNESCO that establishes the growth in national science. Rather, it is the national involvement in the web of international organizations, especially science organizations.

[15] See, Finnemore 1991, 1993 for an investigation of the normative power exerted by UNESCO on national science policy, and Finnemore 1992 for a study of the International Red Cross and humanitarian norms.

[16] David Frank (1994), for example, finds that the establishment of the UN Environment Program in 1972 is a watershed event for the field of environmental rights. In his cross-national event-history model, he finds that a dummy variable for 1972 accounts for almost all the explanatory power for the worldwide diffusion of state environmental agencies, while national characteristics account for the marginal difference.

The dominance of the discourse of SND in the field of science and national development, coupled with some evidence for the possible ineffectiveness of its policy[17], implies that science policy is better described as a global myth[18], or a desired social characteristic. Regarding this discussion, the global myth concerns the social role of science and the content of this global myth is the conceptual SND model. Daniel Sarewitz (1996), when studying American science policy, refers to what I label SND as "the myth of infinite benefit."[19]

What is a global myth? How is the policy-oriented SND model a global myth? A global myth is a world value; it is a desired social merit of modern nation-states, or a characteristic which is perceived as a highly valued national trait. Thomas, Meyer, Ramirez, & Boli (1987) describe the global myths of national society: (a) the state is the guardian of the nation, (b) the individual is the relevant social "unit," and (c) the nation-state is an aggregate of individuals. Much like these global myths, the SND model maintains the defining features of a global myth of national society:

- It is global; in other words, science – as a concept, a policy, and as governmental action – is institutionalized worldwide. As mentioned earlier, there is a trend towards

[17] The issue of the possible ineffectiveness of the science policy that reflects the SND model is somewhat irrelevant to the discussion of the effects of this discourse and of its nature as a global force. On the contrary, the sustainability of this policy model regardless of its effectiveness (and, maybe, in spite of its ineffectiveness), shows the power of this image of science. However, to offer an immediate response to those who question the relevance of studying the effects of science on national political conditions, while science policy formally aims at affecting economic conditions, I add the arguments set in Appendix C. Appendix C reviews the evidence for both the success and failures of science in promoting national economic development.

[18] I conceptualize "myth" in the anthropological sense. That is, myth is a taken-for-granted, non-contested, "sacred" cultural element, or social belief.

[19] Sarewitz' (1996) use of the term "myth" is very different then mine: he employs this term to describe a gap between policy and practice, or between what is preached and what is exercised in a society. It, therefore, denotes a notion of ineffectiveness and false assumptions. Sarewitz describes four additional myths with which science policy is infused. First, the myth of unfettered research, which claims that any scientifically reasonable research into fundamental natural processes is as likely to yield societal benefits as any other. Second, the myth of accountability, which claims that there exists measures of quality control within science (e.g., peer review and reproducibility of results), and that they embody the principle of ethical responsibility of the research system. Third, the myth of authoritativeness, which claims that scientific knowledge provides an objective basis for resolving any political dispute or social problem. Last, the myth of the endless frontier, which claims that new knowledge generated at the frontier of science is autonomous from its moral and practical consequences in society. Together these myths embody a reflection of science as a highly irrational rationalized system.

worldwide expansion of this policy model, and SND is among the concerns of global affairs.

- It is legitimized; in other words, all nation-states consider the social role of science to be a valid and central concern of modern society. The national preoccupation with science is considered proper. Such legitimacy relies upon the link between science and national progress, as development is a pivotal element in Western thought.
- It is highly rationalized and scientized; in other words, the modeling of the social role of science is formatted according to scientific definitions and procedures of logic and testing. Hence, science programs are structured in a logical manner and scientifically analyzed, tested, and measured.
- Most central to my argument, the SND model is a common article of faith or a social convention. This model, unlike some of its components (such as specific science education techniques or particular standards for science-industry connections), is rarely questioned and re-evaluated. In other words, both the general premise and the specific arguments of serial causal relations between the model's elements are rarely tested[20].

Science, (along with education, citizenship, and lately environmental concerns), is among the social institutions that are mythologized. These institutions are defined as desired components of modern nation-statehood, and as such, they become "sacred." Yet, unlike other global myths of national society, science carries the glory of the totalizing effect of technology and general education in the shaping of modern society. With education and technology, science shares the stature as a central element of modernity and an important factor in bringing "salvation" (see, Rosenberg 1976; Eisenstadt & Silber 1988; Midgley 1992[21]). In this sense, science is a perfect exemplar of Jacques Ellul's discussion of modern desacralizing forces that themselves become the fonts of sanctity (1975).

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[20] For example, is primary and secondary mass science schooling necessary? Should nation-states promote "elite" science schooling? Or, is a scientific infrastructure required for technological advances?

[21] Escobar (1995) describes how explicit the visions of salvation are in the discourse of "science for national development." For example, the first mission of the World Bank to Columbia in 1949 was

Defining SND as a global myth means that the social role of science is taken-for-granted: we assume it as such, we act upon it, and rarely do we question our opinion of science. There is a shared belief that science is an effective and necessary institution and that it produces the expected technological and economic results, while there is little proof for the empirical validity of such a common belief. Rather, as shown in Appendix C, empirical testing of the relationship between science and economic development yields contradictory results from both cross-national and case studies. Such evidence points to the feticism of science: from a culture-embedded institution science is re-defined as a supra-social functional entity. Science expands its authority and globalizes because of the meanings that are infused into it, without the reflexive realization that this infusion is essentially a political process.

This "sacred" stature assigned to the global myth of SND results in a gap between the rhetoric of science policy and the reality that such policy produces. This gap between science policy declarations and scientific action was shown to be empirically true in LDCs (Ramirez & Drori 1992). Is this gap merely a matter of an ineffective social policy? I think not. This gap is a result of the ritualistic affirmation of the myth of SND by these nation-states. It is a result of an act of pronouncement of the utility of science and the paramount status of nation-statehood. These ideas are historically constructed to be a part of modernity. The idea as for the utility of science for human society can be traced in scholarly writings from the time of the emergence of modern science in seventeenth century Europe. In these texts science is described as the means to achieve the desired conditions of prosperity. Later, with the eighteenth century emergence and elaboration of utilitarian philosophy, utility became synonymous with economic utility. Moreover, eighteenth century secularization substituted theological ideals of redemption with progress, and science became central to this modern doctrine of salvation. Parallel to these processes developed the notion of "public good," which evolved to mean "the public in the state," and defined the nation-state as the relevant social group. Thus, by the

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consumed by secularized visions of deliverance through science, as is evident in the proceedings of this mission and the personal accounts of its participants (1995:24-26).

middle of the nineteenth century, modern thought constructed these issues into a three-dimensional model – science, utility, nation-state (Drori 1994). In summary, in spite of the failure to show consistent results, the harnessing of science for national benefits is an "old" ideal. This conceptual link between science, utility, and the nation-state is the essence of the narrative of science policy, regardless of the empirical support for its claims.

6.3 Science as a Ritual of Modern Nation-Statehood

Why, then, does this narrative of science policy continue to be globalized? Why does the myth of the SND model still expand its worldwide basis, in spite of its doubtful effectiveness? The myth of SND is being globalized because it is a part of the Western, now global, model of national society. The globalization of science is promoted by international organizations, shaped by the global discourse, and carried by the world polity. Science is, hence, a part of the project of modernity and nation-statehood is a core element in the construction of modern identities. The model of national society, which is diffused worldwide by international organizations, defines the necessary institutions and organizations that compose a nation-state, and counts science as one of these national institutions. Today, there exists an inextricable conceptual link between science, utility and the nation-state – where utility is most commonly defined in economic terms. These intertwined issues are co-constitutive elements of modernity. In other words, the discourses of science, of utility, and of nation-statehood (and the dominant myths in each of these discourses), support each other by referring to the other as a taken-for-granted element of modernity. For example, the SND policy model, which is the dominant theme in the discourse of science, regards utility and the nation-state as taken-for-granted elements. Similarly (and simultaneously) the econo-centric discourse of utility regards science and the nation-state as taken-for-granted elements in its causal scheme of source-benefactor. In summary, the discourse of state identity and the instrumental discourse of science are co-constitutive and mutually supportive. At this point of discursive junction among science, utility, and nation-statehood, science is no longer for national

development, but rather science is national development.

How is science transformed into a matter of nation-statehood? How does the SND myth support nation-statehood? In juxtaposing science in reference to nation-statehood, the SND model reasserts nation-statehood. In other words, the supreme stand of science as a legitimate agent for developmentalism – in the name of universal truths and logic – has great consequences for the structuration of modern nation-statehood. It does so in three main manners: first, national-level institutionalization of science impacts the procedures of governance; second, SND constructs legitimate social actors – both the nation-state and its participants; last, SND promotes nation-statehood through the construction of perceptions of the nation-state, its agencies, and actions. Following, is a further explanation of these three paths between science and nation-statehood.

First, scientization has great ramifications for the increasing complexity of nation-statehood, as is evident from its effect on the procedures of governance. On a superficial level, scientization leads to an increase in governmental duties by defining science as yet another field in need of national support. In this manner, scientized nation-states establish national agencies and ministries for science affairs, devote a certain percent of their GDP to R&D, and put efforts into formatting national policies of science and technology. On a deeper level, scientization alters the "mechanics" of governance through the rationalization of social procedures and through its encouragement of participatory politics, as is evident from the empirical investigation in Chapters 4 and 5. In this sense, governmentality depends on this mixture of administrative reality and mythologized identity or meaning. As Foucault says (1991:103): "the state is no more than a composite reality and mythicized abstraction...[W]hat is important to our modernity...is not so much the *etatisation*[22] of society as the 'governmentality' of the state." Therefore, from the Foucauldian perspective, the consistent failure of SND

[22] Meaning, subordination to the authority, practice, or regime of the state.

programs has the unintended consequence of furthering the rationalized and controlled nature of the world polity[23], in which the nation-state is a pivotal actor.

Second, the dominant discourse of science policy – the SND model – constructs the nation-state as the legitimate social unit relevant for economic growth and the market as the legitimate parameter for social change. Hence, science-based developmentalism reaffirms the status of the nation-state as the legitimate format for political organization. This form of national-level actorhood is commonly referred to as "sovereignty." In this sense, science policy texts reflect a "decorative agentic capability" (Meyer & Jepperson 1996:6), re-affirming the definition of the nation-state as a social actor, or the myth of nation-states' actorhood. Furthermore, scientization is associated with the structuration of actorhood – citizenship, human, individual, and group rights. In this sense, science encourages the construction of political actors and sets the boundaries for the polity by legitimating these actors.

Last, the SND narrative promotes a sense of nation-statehood through the creation of perceptions. By establishing science-related national structures – such as national agencies for science policy, universities, industrial parks[24], programs for science education in schools, and formal procedures for patent registration – the globalization of science forms a perception of orderly and legitimate national structure. Since such national structures are isomorphically institutionalized worldwide and since, simultaneously, their existence and composition are accepted as the legitimate model of nation-statehood, countries which display such structures are perceived as "normal" nation-states. A nation-state which incorporates such institutions is seen as a modern state, which is assimilated into current world affairs, both political and economic. In

[23] See, Barnett & Finnemore 1997:27.

[24] Industrial parks, an example not previously mentioned, are commonly perceived as the loci for science-industry connections, and, hence, are prime exemplars of the institutionalization of the SND model. For an exemplary analysis of the impact of industrial parks in linking scientific research with industrial development, in attracting foreign high-tech firms, and in facilitating effective technology transfer, while focusing on the 1974 creation of the Daeduk Science Town in South Korea, see Eisemon & Davis 1991:291.

addition, the national establishment of the SND model creates the perception that the nation-state has a master plan for achieving the goal of national development. More specifically, the existence of a document of national policy for science signals that the nation-state drew a scientized, systematic program for addressing national concerns. This perception implies rationalized action on behalf of the nation-state, thus assuring its fellow nation-states of its political and economic stability. These perceptions of nation-statehood – (a) orderly, legitimate structures and procedures and (b) rational, systematic action – are aimed at gaining legitimacy for the institution of nation-statehood.[25] The ritualistic affirmation of the SND myth serves the need for international recognition. It also affects both global and local "audiences." As is critical in democratic regimes, such perceptions reassure local people of the validity of state operations. In addition, such perceptions signal an image of "normality" to other members of the international community with whom the nation-state desires to connect.

Furthermore, science provides the cultural scripts[26] for nation-states to act upon (or, to appear to be acting upon). Specifically in regards to science, it does so through the incorporation of internationally legitimate science policies; in regards to general social *desiderata*, it does so through the incorporation of such global "norms" as human rights, economic policy, or mass education. Such action reflects the rationality of irrational national policy: nation-states are obliged by their role as actors/agents to move towards the achievement of social goals (such as, progress); in their search for successful paths to achieve these goals they rely on the available cultural scripts (such as, the SND model), and on the perceptions of successful models (such as, the constructed story of the success of the Tiger economies); and, because of conditions of uncertainty, they re-enact these cultural scripts. In other words, when faced with uncertain future conditions and with multiple models for the achievement of social goals, nation-states rely on world renowned, seemingly successful "recipes." One such available "recipe" is the SND

[25] See, Ezrahi's (1988:190) differentiation between ritualistic instrumentalism (as a form of legitimacy) and substantive instrumentalism (as functional rationality and effectiveness-driven political speech and action).
[26] What Meyer & Jepperson (1996:4) call "cultural technology," i.e., scientized policy models, such as the SND model.

policy model. LDCs look for success stories, such as that of the Tiger economies, and attribute – even construct – their success to their science and technology policies. Moreover, in uncertain circumstances all nation-states rely on expert advice to guide their policies. Policy experts share the vision of SND, and, hence, recommend its implementation into governmental action. Overall, hence, SND and it organizational carriers (while not being subjected to some organizational pathologies that are prevalent in other international organizations; see, Barnett & Finnemore 1997), still suffer from the irrationality of the rationalization processes to which they are subjected. The result of this global diffusion of policy models, such as SND, expresses yet another dimension of the individualizing/totalizing effects of the current form of governmentality, this time on a global scale: national identity and national governance are regarded as particularistic or local forms, yet the scripts for such national actions are provided by homogenizing global forces.

In summary, science is consequencial for (a) the definition of both nation-statehood and the legitimate actors/agents in this national-based society, and (b) the organization and operations of the nation-state. The effects of scientization on nation-statehood, while advocated in the name of national economic progress, go beyond the limited scope of economic consequences. The commitment of nation-states to the project of science employs teleological notions to conceal its ritualistic nature. Science serves as a ritual of modern nation-statehood, and the commitment to science is an act of affirmation of modernist themes.

Supporting this ritualistic commitment to the science project are the professional scientists. Acting as agents of consultancy, whether in a reflexive or a non-reflexive mode, they further advocate the social role of science as a means for national progress. Relying on their legitimacy and clout, they serve as agents for isomorphism and cross-national standardization. "...[T]he authoritative voice of the sciences or professions – major structures of "otherhood" in the modern system – lies in their claim to speak for wider truths, beyond any local situation or interest" (Meyer & Jepperson 1996:7). Such

truths are that of the collective good (e.g., science), of the collective as a nation-state, and of the economy as both the logic of social life and the "bottom line" of social action. Again, the myth of SND embodies all such truths.

Global myths have a life of their own, independent of, what is positivistically referred to as, their real effective performance. This is evident in the case of the SND policy model, which has been consistently globalized for the past forty years or more with intense promotion by international organizations. The sustainability of global myths is permitted by the process of "double globalization," or "globalization of globalization." This process describes the expansion of the legitimacy of "globalization" and of "the global." Under the canopy of legitimating globalization, it further encourages the previously described global diffusion of science practices.

Global myths are also sustained due to two organizational tendencies. The first tendency relates to the uncertainty which nation-states face when devising social policy, and its effects on the perpetuation of the SND model were discussed earlier. The second organizational tendency relates to the forces of inertia within the organizational carriers of these myths. Inertia constrains organizational change and limits the adaptation of the organizational field to the changing conditions in its environment (see, Hannan & Freeman 1977, 1984; Scott 1987a:200-203). In this case, the organizational fields of development and science are already institutionalized and their procedures homogenized. Inertial forces in international organizations of science and development result in the dismissal of challenges to their discourse, and in their persistent promotion of the SND model. During this forty year period of the promotion of the SND model, the main theme underwent only minor changes. For example, the 1950s focus on local, or endogenous, science was replaced with the understanding that it is international action that results in development, and the concept of international cooperation and sharing of knowledge was replaced by the notions of competition and of market-related science development. Nevertheless, science is still essentially viewed as a means for national progress, and these thematic changes reflect amendments to the notion of development more than

reflecting a break between science and utility.[27]

Being a discursive narrative and a basis for establishing perceptions, the SND model may be thought of as an epiphenomenon, or "mere words" which reflect a particular social context. Yet, such "words" have great impact on their social environment. While the discourse is a social construct and a reflection of global values and ideals, its consequences are real. On the basis of this discourse, nation-states divert funds for R&D, incorporate innovative technologies into the manufacturing of goods, and encourage individuals to choose science as their vocation. In this sense, policy directives guide action and form organizations, even if some outcomes are not those initially intended by policy-makers. These unintended consequences of the current discourse of science policy shape local cultures, civil practices, and political arrangements. Yet, the consequences of such science policies are not recognized by policy-makers. Science policies do not conceive of the effects of science on society in terms of scientization of society; they, instead, focus only on the technical and instrumental qualities of science. Science policies, hence, do not regard science as a cultural framework, which is both global and a diffused secularized source of legitimacy and authority; they, instead, have a tendency to instrumentalize and localize science. Thus, current science policy fails to acknowledge, that science globalization (and the incorporation of science into the different national contexts that it entails) affects the foundations of social life. Science globalization brings with it the nature of science, most importantly the secularized faith in a rationalized world order and a sense of social agency.

My dissertation only begins to discuss the junction between the issues of science policy, globalization processes, and nation-statehood; it leaves much of these matters unexplored and thus opens several avenues for future research. One such research avenue follows directly from my dissertation work. It involves another example of a science-embedded modernist notion that alters nation-statehood to conform with the liberal form of governmentality. As suggested in Chapter 2, scientization, through science's notion of

[27] See, Ruivo (1994) and Elzinga & Jamison (1995) for historical analyses of science policy agendas.

competitiveness, influences national economic policy. Arguably, in the past two decades, scientific competitiveness has encouraged the cross-national establishment of an open liberal economy – namely trends of privatization, decentralization, and liberalization. Evidence of this linkage between scientization and liberal economic practices will strengthen my conclusion that science, being a modern cultural institution, reifies the modern institution of nation-statehood and, most particularly, its liberal model of governmentality.

Centering on science, the evidence of loose-coupling offers another avenue for future research. This evidence suggests that national scientific activity is not homogeneous, but rather that science is fragmented into un-related spheres. If so, then particular spheres of scientific activity (such as, international-oriented science, scientific labor force, or the governmental commitment to science) may have a distinct impact on their social environment. Arguably, the orientation of science – towards international audiences or towards the particular needs of the local economy; towards bio-medical sciences or towards the traditional "hard" sciences – bears unique effects on the linkages of the nation-state with these "audiences." Following this line of reasoning, such research may explore the link between a particular scientific orientation and its distinct social consequence.

Last and more general, my conclusions address the matter of the interplay between the global and the local. Globalization theories emphasize the homogenizing pressures that such processes exert on local environments, yet they also acknowledge the differences in the permeation of local society by global forces. Ronald Robertson (1994) refers to this process of linking the global and the local as "glocalization." This term, though suggestive of a "middle ground" between global and local pressures, is currently merely a label. Further research is required in order for one to explore the terms under which such a "midpoint" is reached. Arguably, national traits (such as the dependence on economic partners, openness towards the world polity, or affiliation with particular political blocs) shape the national submission to global trends. Also, immigrant societies may be more

inclined to accept "foreign flavors" then would homogeneous societies, thus implying that the composition of the "local" determines the point of "glocalization." Finally, such a definition may depend on the nature of the global field; global economic pressures, for example, may lead to a "glocalized" pattern sooner then would political or cultural global pressures. Overall, future research will expand the current understanding of the consequences of globalization processes.

APPENDIX A

INDICATORS IN THE ANALYSES: DESCRIPTIVE STATISTICS BY CONCEPTUAL CATEGORY OR LATENT DIMENSION

Indicator	Indicator's Label	Mean (STD) N	Comments
Date of Establishment-national science policy agency	scpdate	1964.4 (13.25) 108	
Membership in ICSU 1969	icsu69	3.59 (5.80) 203	
Ratio - membership in ICSU 1969	ricsu69	3.1 .21 (.34) 203	
Titles-natural sciences 1974-79	ltns7479	.01 (.01) 199	logged
Titles-social sciences 1972-79	ltss7279	.01 (.01) 200	logged
Citations in SCI 1973	lcit73	.07 (.17) 134	logged
Membership in ICSU 1979	icsu79	4.47 (6.61) 203	
Ratio - membership in ICSU 1979	ricsu79	.24 (.35) 203	
Titles-natural sciences 1980-86	ltns8086	.01 (.01) 200	logged
Titles-social sciences 1981-89	ltss8189	.01 (.01) 202	logged
Citations in SCI 1982	lcit82	.06 (.13) 134	logged
Existence of a national science base 1985	sbase	2.26 (1.08) 150	index 1-4; 1=non existent, 4=effective
Energy consumption 1970	lenerg70	1705 (3065) 184	per capita; logged
Secondary enrollment ratio 1970	lsec70	33.19 (26.98) 140	logged
Energy consumption 1980	lenerg80	2176 (3510) 187	per capita; logged
Secondary enrollment ratio 1980	lsec80	44.41 (28.92) 137	logged
Non core countries	notcore	.82 (.39) 258	0=Core; 1=non-Core

Missing data in UN statistical yearbook 1980	miss80	29.80 (21.24) 230	logged
Missing data in UN statistical yearbook 1980	miss90	12.63 (10.35) 230	logged
Execution of 1st census post independence - date	census	1922 (54.75) 125	
Publication of 1st national statistical yearbook - date	pubstat	1927 (38.69) 78	
Initial connection to Internet-duration (in months) since July 1988	duration	46.07 (24.64) 93	
Growth Internet usage-local nets per time since initial link	netgrowth	4.70 (10.71) 93	logged
Deviations from UN statistical standards 1980	ast80	8.17 (6.76) 190	logged
Deviations from UN statistical standards 1990	ast90	6.14 (4.39) 197	logged
Adherence to International Standards of Accounting 1979	account79	23.11 (5.07) 79	index 1-8; 1=low, 8=high; logged
ISO-9000 certificates 3/1995	ISO395	1186 (5063) 79	per capita
Perceived corruption 1980-85	corrupt805	4.75 (2.74) 52	index 1-10; 1=low, 10=high corruption
Perceived corruption 1996	corrupt96	4.68 (2.64) 52	index 1-10; 1=low, 10=high corruption
Women's status score 1985	wstatus	41.71 (12.88) 99	index 1-75
Women's equality score 1985	wequality	57.76 (16.78) 57.77 99	index 1-100
Gender development 1992	gdi92	.64 (.20) 79	index 0-1
Duration (in years) until ratification of ICCPR	ICCPR	14.32 (7.20) 129	
Duration (in years) until ratification of ICESCR	ICESCR	14.25 (7.17) 134	
Number-reminders by Amnesty International for overdue reports by 1991	remind91	2.12 (5.56) 137	
Humana's human rights 1985	humana85	60.60 (26.23) 88	index 1-100
Human development 1986	humdev92	.66 (.22) 174	index 0-1

Sivard's repression 1986	repress86	2.22 (.67) 109	index 1-3
Establishment date of 1st consumer-related organization	dgcon	.57 (.50) 99	0 = pre or during 1970; 1 = post 1970
Dummy-establishment date of 1st consumer-specific national organization	dscon	.65 (.48) 92	0 = pre or during 1970;1 = post 1970
Consumer organizations - number in 1992	conorgn92	3.56 (4.43) 103	
Gays' rights 1984	gay84	2.40 (1.36) 85	index 1-5; 1=very restrictive, 5=liberal
Gays' rights 1994	gay94	2.55 (1.58) 165	index1-5; 1=very restrictive, 5=liberal
Lesbians' rights 1984	lesb84	2.87 (1.08) 85	index1-5; 1=very restrictive, 5=liberal
Lesbians' rights 1994	lesb94	2.92 (1.43) 163	index1-5; 1=very restrictive, 5=liberal
Environmental treaties - number 1980	envtrt80	4.30 (4.80) 174	
Environmental treaties - number 1990	envtrt90	4.90 (4.13) 174	
Demonstrations, anti-government 1980	demon80	.44 (1.11) 166	5-year mean
Demonstrations, anti-government 1985	demon85	.60 (1.54) 171	5-year mean
Strikes 1980	strk80	.10 (.23) 166	5-year mean
Strikes 1985	strk85	.13 (.37) 171	5-year mean
Riots 1980	riot80	.40 (1.19) 166	5-year mean
Riots 1985	riot85	.39 (1.27) 171	5-year mean
Registered voters-number 1980	voters80	.58 (.23) 47	per capita
Freedom of organization 1985	freeorg	2.36 (1.26) 168	index 1-4
Broadcast control 1980	broad80	.72 (.84) 153	index 0-2; 0=not free; 2=free
Broadcast control 1984	broad84	.67 (.84) 156	index 0-2; 0=not free; 2=free

Print media control 1980	print80	.93 (.87) 153	index 0-2; 0=not free; 2=free
Print media control 1984	print84	.92 (.87) 157	index 0-2; 0=not free; 2=free
Civil liberties 1973		3.85 (1.99) 160	index 1-7; 1=low, 7=high
Civil liberties 1989		4.50 (2.10) 203	index 1-7; 1=low, 7=high
Political liberties 1980		3.74 (2.14) 162	index 1-7; 1=low, 7=high
Political liberties 1993		4.44 (2.20) 186	index 1-7; 1=low, 7=high
Political liberties, change 1988-93		1.73 (2.25) 15	range (-1)-(5); (-1)=regression; 5=improvement; only ex-communist countries
Institutional democracy 1980		3.62 (4.04) 133	index 1-10; 1=low, 7=high

1. Logged indicates the execution of a natural logarithmic transformation.

APPENDIX B

THE EFFECTS OF NATION-STATES ON SCIENCE

The practices of nation-states bear great relevance for the operations of science. Since its institutionalization during the seventeenth century, the key factor in the growth of science has been, and still is, state support. Monarchs, governments, and national agencies serve as patrons of science and technology. Early modern scientists, such as Galileo (Biagioli 1994), were members of royal courts and relied on royal patronage for their research. Later, governments took up the role of supporting scientific work and technological advancements. For example, President Thomas Jefferson initiated American federal sponsorship of Lewis and Clark's expedition to study the West, to record its flora and fauna, and to map this new territory. Today, universities worldwide – whether formally claiming to be private or public – rely on funding from governmental sources to conduct their research. Governments also sponsor a variety of research: space exploration, disease patterns and remedies, international relations etc. Governmental support of the sciences has grown increasingly more substantial and more secure. While the late nineteenth century governmental sponsorship of science and technology "tended to be erratic and sometimes capricious" (Skolnikoff 1993:19), since then, and particularly after World War II, the channels of sponsorship for the sciences have become stable. For example, OECD countries consistently devote about 3% of their GNP to R&D (Skolnikoff 1993:20), and most all other nations cite this figure as their goal for national R&D sponsorship. This reflects an increase and a convergence in the cross-national commitment to science sponsorship.

National commitment to the sponsorship of science relies on various justifications. Most often, nations cite security concerns as the main goal for science sponsorship. Governments devote huge sums of money in support of science for military applications. Military R&D, whether under the auspices of national research institutions or of corporations, relies on scientific knowledge and scientific methods when developing and producing, for example, "smart bombs," "invisible" airplanes, or cryptonics' software. Second, science sponsorship is justified in the name of enhancing national wealth. Early wealth-oriented science patronage, as in The Age of Exploration, regarded scientific expeditions as a way to claim additional territory and discover new sources of wealth. Today, while the goal of national wealth stays the same, science is linked to more advanced ways of contributing to national development. For example, scientific research contributes to discovering new ways of increasing food production, and science education provides the national labor force with more advanced skills. Last, science is used as a source of national prestige, and national agencies engage in the sponsorship of science for enhancing national glory. The scientific endeavor of court scientists contributed to the image of their sponsoring monarch as modern and advanced compared with other royal contemporaries (Wuthnow 1980, 1987). Nation-states are still ordered by their level of scientific achievements, such as levels of scientific literacy of school children or the number of scientific publications (Lapointe at al. 1992a, 1992b; The Economist 1997b).

In summary, science sponsorship has been, and still is, a justifiable contribution to the nation, whether for its wealth, for war, or for its greater glory. In this sense, science relies on national competitiveness with other nation-states to assure its patronage.

In addition to national sponsorship of science, nation-states also determine the types of scientific work that are most commonly practiced in each nation-state. Types of nation-states greatly vary (a) in their level of commitment to, and engagement in, science, and (b) in their emphasis on one type of science over another. First, characteristics of the nation-state shape the level of commitment to, and institutional arrangements of, local science. Most obviously, developmental characteristics differentiate among scientific communities – namely core countries are the main producers of scientific knowledge, while LDCs are marginal to the overall production of science. For example, in 1982, 26 core countries produced 92.8% of the world's papers in scientific journals (as recorded in SCI), while 88 LDCs produce the remaining 7.2%[1]. Core countries also adopt new scientific practices and new technologies faster than LDCs. For example, DCs were the only countries linked with the Internet during its first 8 months after initiation, when Mexico was the first LDC to join Internet. LDCs are still lagging behind in their use of this technology, as they are in regards to other aspects of scientific activity (see, Shrum & Shenhav 1995). Similarly, the size of the country determines the format for scientific work: scientists from small countries must rely on greater integration into the global, or Core, scientific community for their work because their national scientific community lacks the "critical mass" for a fruitful exchange of ideas[2]. Second, national characteristics determine national patterns, or "styles," of science practice. In 1973 East Bloc countries centered most of their scientific activities on physical sciences, while the US and the UK focused on clinical medicine, and while western European countries focused on a combination of the physical sciences and clinical medicine (Frame, Narin, & Carpenter 1977).

The research on national patterns of scientific activity is mostly descriptive. Such research does not indicate the national characteristics that determine an adherence to one style of science practice over another. Yet, one can point to cultural, political, and organizational traditions, or conditions, as contributors to these unique patterns of science practice. For example, since scientific work relies heavily on cross-national networks, it is not surprising that during the years of the Cold War Western and East-Bloc countries differed greatly in their patterns of scientific activity, as the findings of Frame, Narin, and Carpenter (1977) indicate. Similarly, national conditions lead to the emphasis of some social goals over others. For example, countries that are involved in war (or that are consumed by the perception of external danger) set their national priorities in support of the war effort, and are more likely to sponsor military-directed scientific work. Accordingly, in 1988 the US devoted about 65% of its federal budget to defense, while Japan allocated only 5% of its budget to this purpose (see, Skolnikoff 1993:20). Like the

[1] Gini value (calculated Lorenz curve) for scientific publications in 1973 is .9082 (Frame, Narin, & Carpenter 1977:502-503).

[2] See, Schott (1987) for a study of the disciplines of mathematics in Denmark and Israel.

US, Israel, Pakistan, and Iraq devote great governmental sums to defense-oriented science projects. Cultural traditions also contribute to the variation in scientific "styles." Comparative and historical studies show that national social characteristics shape national scientific practices. For example, Lange (1985) explains that scientific practices in the two German states, which share language and history, were determined during the years of the Cold War not by such common cultural traits but rather by their political affiliation. She demonstrates that during the 1970s West German scientists tended to cite mostly American scientific literature, while East German scientists tended to cite more Soviet research. This evidence shows that some national characteristics are central to determining the style of scientific work. In this sense, the variations in scientific work reflect a localized version of the global model of science. That is, while all nation-states are put under the burden of global isomorphic pressures towards standardized formats of their national and scientific practices (see Chapter 1), still national "styles" determine scientific "styles."

Last, science is shaped not only by the practices of the nation-state, but also by the general notion of nation-statehood. The prime status of nation-statehood as the core organizing concept in the modern polity re-orients science towards the nation-state. Science, hence, is molded into a national and state-oriented frame because such a nation-state-based frame is the most dominant organizing principle. The myth of nation-statehood defines the nation as the legitimate and relevant social group and the state as the relevant and legitimate political structure. The myth of nation-statehood is embedded into the dominant discourse in science policy, which, as described in Chapter 1, is the model of "science for national development." This model links science with the nation-state by stressing that the goal of science is to deliver national, mostly economic, benefits. By claiming to contribute to the nation-state, science draws both monetary support and legitimacy. With the increased relevance of nation-statehood in the global polity, science's claims for legitimacy increase its appeal for relevance to the nation-state. That is, the discourse of science defines its relevant beneficiaries as bounded by national and governmental boundaries. Over time, science, while still holding on to its ethos of universalism, no longer appeals to general humanity when searching for support, but rather to national audiences. Hence, science's products are increasingly defined as national assets, rather then global benefits. In this sense, science is aligning itself with the dominant myth of the current world polity, namely the myth of nation-statehood. Overall, nation-statehood – in practice and as a myth – shapes science.

APPENDIX C

EVIDENCE FOR THE EFFECT OF SCIENCE ON NATIONAL ECONOMIC CONDITIONS: EVALUATING THE EFFECTIVENESS OF THE FORMAL GOALS OF SCIENCE POLICY

The model of "science for national development" (SND) sets the basis for national and international plans of action. Modernization and human capital theories inspired this SND model and its related policy guidelines and academic research (e.g., Moravcsik 1966, 1971; Cooper 1973). This Appendix focuses on the effectiveness of this science policy and research, by describing the evidence for the existence (and lack) of positive and significant empirical effects of science practice on economic growth.

In spite of the intensive promotion of SND, research into the effects of science on economic growth is relatively rare. Few researchers have investigated the empirical causal relations between science and development, whether cross-nationally or by studying specific cases. This relative lack of research implies that the link between science and national economic development is taken-for-granted. In addition and more importantly, current research provides contradictory evidence as to the causal links between science and national progress. Some studies show positive and significant relationships between science and economic growth, while other studies show either no such relationships or even negative effects of science on the economy.

B.1 Positive and Significant Effects of Science on Economic Conditions

Early cross-national comparative research shows a significant positive effect of a scientific labor force on economic progress. The number of scientists and engineers (Harbison & Myers 1964; Blute 1972; Harbison 1973), the number of scientific authors in technical journals (Inhaber 1977:517), and the number of "publishing scientists" per capita (Inhaber 1977) were found to positively and significantly correlate with, or affect, either national economic level or national economic growth. Other studies, which focus on the effects of science education, show that tertiary science and engineering enrollments (Lee 1990; Ramirez & Lee 1995), and the share of primary and secondary school curriculum devoted to mathematics and science (Benavot 1992), have a significant and positive effect on national economic conditions.

In addition, case-studies show that industrial expenditure on R&D in the U.S. positively affected economic conditions (Mansfield 1972; Griliches 1987), and that in sub-Saharan Africa the number of scientific publications positively and significantly correlates with GDP (Zymelman 1990). Most importantly, analyses of two groups of nation-states – the West and the newly industrialized countries (NICs) – are most frequently quoted as exemplars of the positive effect of science on economic prosperity. The past and future

of Western countries – their economy, security, global status, and "attractiveness to human society" – is believed to depend on their successful scientific activity (e.g., Rutherford 1985:207). It is a widely shared idea that the progress of Western nations – their industrialization and capitalist expansion – is mainly due to technological breakthroughs and to the cumulative scientific knowledge on which these innovations are based. In the NICs, where "access to science education is near universal...the quality of teaching and material resources is comparable to that found in the industrialized countries" (Lewis 1993:2). Furthermore, in nation-states where science education enjoys high levels of legitimacy and prestige, science is credited with the remarkable technology-based economic success, especially in Taiwan, South Korea, Japan, and Malaysia (Altbach 1989).

B.2 Opposing Evidence

Other empirical studies reveal findings that contradict our everyday notion of science and the predictions made by the SND model. These findings show that science education has no effect on local economic conditions. More specifically, official emphasis on mathematics and science studies in primary schools (Kamens & Benavot 1991) and the share of instruction time devoted to mathematics, natural sciences, or social sciences (Benavot et al. 1991:95) have no effect on economic conditions. Similar findings are found in regards to science in higher education and to scientific output. In addition, tertiary education (Meyer at al. 1979) and scientific paper publication (Shenhav & Drori 1988; Shenhav & Kamens 1991) were found to have no effect on economic growth. Furthermore, Shenhav & Kamens (1991) show that in the poorest of countries, paper publication has a negative effect on economic growth. Paper publication in the "hard" sciences is found to have no effect on the number of registered patents or on economic conditions, thus this finding disproves the assumption of a hierarchical relationship between science, technology, and the economy (Drori 1993).

Case studies also support these findings by showing that a national commitment to science is adversely related to economic development in certain countries. U.S. college enrollments between 1933 and 1969 (Walters & Rubinson 1983) and college degrees awarded in science-related fields in the U.S. (Walters 1989; Walters & O'Connell 1990) have no effect on productivity or on economic output. Others studies show that the phenomenal economic development of the NICs does not correspond with a high emphasis on science education. On the contrary, the NICs trail other regions, most notably sub-Saharan Africa, in their relative share of curriculum devoted to science and mathematics (Lee & Wong 1990:21-22; Kamens & Benavot 1991). This comparison between African countries and NICs, in light of their diverging economic conditions, sheds further doubts on the causal link between science and economic prosperity.[1]

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[1] Dependency theory, which presents the globalization of science as a form of capitalist expansion and cultural enslavement, appears in many theoretical publications (e.g., Sagasti 1973; Mazrui 1975; Nandy 1988; Alvares 1992). While empirical findings for the adverse effects of science activity on economic growth may serve to support such theoretical arguments, none of the authors mentioned here explicitly

The more recent empirical tests of the relationships between science and economic growth challenge the previously held assumptions that the path to national progress is universal. In other words, these studies show that "recipes" for economic progress, such as through science and technology, do not produce globally uniform results. By showing that such relations vary widely between groups of countries and greatly depend on the location of the nation-state within the world system, they add a new challenge to the SND model and carry important policy implications.

B.3 The Empirical Impasse of Realist Perspectives

In spite of the wide acceptance of the SND model as a basis for national and international policies, social science research provides weak support for these policy assumptions. Whereas research performed during the 1960s and 1970s shows a positive link between scientific activity and economic development, more recent research raises doubts as to the existence of such a link. This later research shows either weak science-development effects or no relationships at all. Moreover, this later research shows significant differences in the pattern of such relations between LDCs and DCs. These findings reveal that the causal relationships between science and economic development are more complex and diverse than the science policies of the 1960s and 1970s anticipated. Such empirical evidence implies that whereas even today's national socio-political rhetoric manifests the SND model, national action does not necessarily support it.

The lack of conclusive evidence regarding the effects of science on economic development prohibits any adjudication between claims of the competing liberal- and Marxist-based theories of national development (namely, modernization and dependency theories, respectively). Their value-laden positions have brought them to a theoretical impasse. Similarly, the arguments over empirical matters (such as, the nature of the quantitative measures, the accuracy of the estimation models, or possible time period effects) cannot be perfectly resolved. Additional research, such as the research currently conducted in Stanford University's sociology department, provides merely more inconclusive evidence.

Furthermore, researchers shed a different theoretical light on empirical evidence which is seemingly similar. Ramirez & Lee (1995) and Benavot (1992), while providing evidence for the positive effects of science education on economic development, conclude that such findings do not support modernization theory and human capital arguments. Rather, Benavot states most clearly, that the use of this evidence in support of functionalist arguments is a narrow interpretation of his findings. These studies offer the alternative of world polity theory to interpret their empirical evidence. In summary, theoretical boundaries further differentiate between empirical findings of the positive effects of science.

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sides with dependency theory.

This causal link between science and national progress is, thus, empirically problematic and conceptually misleading. Empirically, there is an impassable argument over the nature of the indicators, their accuracy and the validity of the models. Theoretically, modernization and dependency theories, while taking opposing stands in regards to the motives and processes involved in the science-development link[2], share a functionalist and realist perspective on social institutions and processes, in general, and on science in particular. In other words, both theories argue that science does produce results, and their debate is over which science produces the best results. The claims set by dependency theory criticize current international and national science policies and their value-laden assumptions in the name of real science. In conclusion, the realist perspective offers no new direction for future research or for a fruitful debate between its conservative and radical variants.

[2] Regarding the social role of science, modernization and dependency theory diverge on their definition of the motives and processes which lead to the institutionalization of science (functionalist needs and innovations versus imperialist impositions), in their conceptualization of the type of benefits and beneficiaries from, and interests in, the institutionalization of science (national versus foreign; mass versus elite), and in their analysis of the processes and mechanisms that connect science with economic development.

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