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ARTICLES

The "Publicness Puzzle" in Organization Theory: A Test of Alternative Explanations of Differences between Public and Private Organizations*

Barry Bozeman and Stuart Bretschneider
Syracuse University

ABSTRACT

"Publicness" is defined as a characteristic of an organization which reflects the extent the organization is influenced by political authority. The concept, operationalized as a series of interval measures, is placed in direct competition with the traditional core definition of publicness as ownership (i.e., formal legal status). Using a sample of research and development laboratories, the two approaches are compared in terms of their ability to explain organizational outputs and process in the context of an explanatory model. The results suggest that both approaches tap unique characteristics of publicness and contribute to a more complete understanding of the role of publicness in the study of organizations.

INTRODUCTION

As is so often the case with elemental questions, researchers have been hard pressed to provide satisfying answers to the simple question: How are public and private organizations different from one another? To be sure, some pieces of the "publicness puzzle" were put into place during the twelve years that elapsed between the two most comprehensive reviews (Rainey, Backoff, and Levine 1976; Perry and Rainey 1988) of research on differences between public and private organizations. But the publicness puzzle—whether the public context of organizations affects their behavior (Bozeman 1987)—continues to challenge researchers and theorists. The set of issues suggested by the publicness puzzle goes to the very heart of political and administrative

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life. The puzzle is relevant to prescriptive questions about the allocation of functions and responsibilities across legal, institutional, and organizational contexts.

Recently, organization theorists captivated by the "new economics of organization" (Moe 1984) have provided alternative frameworks based on transaction costs (Williamson 1979 and 1989; Heckathorn and Maser 1987; Masten, Meehan, and Snyder 1991), and principal agent theories (Eisenhardt 1989; Ross 1973). These more recent approaches have much in common with still influential, but more venerable, property rights approaches (De Alessi 1980; Alchian and Demsetz 1973)—namely, only limited concern with structural or production factors not rooted in economics.

Traditional theoretical guidelines for research and theory on the publicness puzzle, including those provided by various political economy frameworks, fail to shed much light on organization structure and management issues. Likewise, much of mainstream organization theory, dominated by sociology and industrial psychology, provides few clues. As Rainey (1989, 229) notes, "[w]e have a political economy based in large part on the assumption that it makes a difference whether activities are controlled by government authority or economic markets. Yet much of the management literature has treated this distinction as irrelevant or harmful."

The limited progress toward resolution of the publicness puzzle can be traced, at least in part, to the failure to develop theories that link the internal and external structures and components of public organizations. Moe (1991) rightly discusses the failure of traditional public administration approaches to organization theory to move beyond a concern with internal management structures and notes that despite the widespread recognition of unrealism of the politics/administration dichotomy, much of organization theory continues to ignore external political and economic forces. Unfortunately, most political economy approaches to organization theory can be faulted for paying limited attention to the internal structural features of organizations. Internal features typically are altogether ignored or derived (without benefit of empirical observation) from theoretical premises.

The research presented here seeks to contribute to empirically based theory about the effects of public attributes of organizations on their behavior. More specifically, the focus is on the effects of publicness, measured in different ways, on such

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elemental components of organizations as levels of bureaucratiza-
tion, composition of output, mission diversity and environmental
interactions, and boundary spanning. The effects of publicness
are considered for a set of organizations involved in roughly
similar functions—creation and expropriation of technical knowl-
dge—in the setting of research and development laboratories.

A "public organization" may, depending on usage, be a
government organization, an organization charged with operating
in the public interest, or one with goods and services having
public goods characteristics (to name just a few of the possi-
bilities). The study makes no pretense of examining the many
conceptualizations of publicness now presented in the literature.
Instead, the comparison is simply between a "core model," based
on ownership and a "dimensional model," based on external
political authority.

The next section elaborates the different perspectives pro-
vided by core and dimensional models and then describes and
tests models of public-private differences. The overview of
approaches underscores the fact that each has significant strengths
and inherent limitations. This is followed by a description of a
data collection effort designed to test the alternative explanatory
power of the "core" and "dimensional" models. Section four pre-
sents a formal theoretical structure for explaining the composition
of organizational outcomes, bureaucratization, and buffering
against which the test of alternative explanatory power can be
made. This section includes detailed discussion of operational
measures for the relevant variables. The next section discusses
the formal statistical test of hypothesis and its results. The article
concludes with a summary of the findings and its relevance to
future research.

PUBLIC ADMINISTRATION THEORY AND PUBLIC-
PRIVATE DIFFERENCES: TWO CONTRASTING MODELS

The excellent reviews (Perry and Rainey 1988; Rainey
1991) of research on differences in public and private organi-
izations that have been produced recently obviate the need for a
similar review in this article. However, it is useful to contrast
two major approaches to the publicness puzzle and to identify the
central assumptions of each.

The Core Approach to Publicness

Most students of public organizations, especially those
working from a public management or public policy perspective,
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have been drawn to the core approach. Basically, this perspective implies that there are essential differences between public and private organizations and that those differences are elegantly captured in a simple distinction based on legal type (government owned vs. privately owned). While similarities between core private and core public organizations are not denied and exceptions to the rule are permitted, the central assumption is that legal type provides a simple but nonetheless powerful distinction. Some disagreement exists about the nature of the "essential differences"—public interest values (Benn and Gaus 1983), political accountability (Appleby 1953), legitimacy (Dewey 1927; Friedrich 1963)—but most of the alleged determinants of essential differences are perceived as related to one another.

The core approach has a number of advantages. In the first place, it seems to match personal observations of many high level practitioners who have experience in both core public and core private organizations (Blumenthal 1979; Rumsfeld 1979; Meyers 1964) and who seem to subscribe to the views that "public and private organizations are alike in all unimportant respects" (Sayre 1953) and that "government administration differs from all other administrative work to a degree not even faintly realized outside" (Appleby 1945, 7). Many contemporary scholars (Lynn 1981; Allison 1979; Warwick 1975) share the views of practitioners about the validity of distinctions implied in the core model.

Much impressive research evidence supports the core model, evidence provided by systematic empirical comparisons of core public and core private organizations. Research evidence (see Perry and Rainey 1988) has begun to accumulate and to affirm that public organizations are distinctive in many ways. Researchers have found differences in job satisfaction and commitment (Bruce Buchanan 1974; Porter and Perry 1979), motivation (Rainey 1979 and 1983), perceptions of rewards (Rainey et al. 1976), structure (Hood and Dunshire 1981; Pitt and Smith 1981), decision patterns (Hickson et al. 1986; Coursey and Bozeman 1990), and performance (Bozeman and Loveless 1987; Bozeman et al. 1992). Other studies have focused on functional management areas and have found differences (Bryson 1988; Ring and Perry 1985). Most impressive, the differences observed in one study often match up well against those found in another—even when the studies are undertaken with a quite different theoretical lens (see Bozeman 1987, chap. 3).

While the issue of spurious and underspecified models has not yet been set to rest (Meyer and Williams 1977), there is mounting evidence that public-private differences are not easily
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dischussed as methodological artifact. Recently, Bozeman and Loveless (1987) examined a set of public and private organizations matched by size, technology, structure, and function; they found significant differences in performance patterns and internal administrative practice. Similarly, Hickson and associates (1986) and Coursey and Bozeman (1990) found significant differences in the decision-making patterns of public and private organizations, even when they controlled for mission and function.

Despite its many advantages, one weakness of the core approach is not easily overcome: The approach is ill-equipped to handle the exceptions, and the organizations are not easily classified (by any conventional scheme) as either purely public or purely private. In some institutional domains this poses a more serious problem than in others. Thus in elementary and secondary schools (Chubb and Moe 1988) it is usually possible to derive a classification scheme, based simply on legal status, that conveniently groups the vast majority of schools as either public or private. In the case of research and technology development organizations, however, the meaning of public or private, at least in the sense of ownership or formal legal status, is often much more ambiguous. In one recent study (Crow and Bozeman 1987) 30 percent of energy R&D organizations defied any straightforward classification as either public or private. In a general sample of more than one thousand of the approximately sixteen thousand R&D organizations in the United States, about 17 percent were not easily classified as either public or private in terms of ownership (Bozeman and Crow 1988 and 1989).

Perhaps even more formidable as a limitation to the core approach is the limited theoretical progress the approach has yielded. Mainstream public organization research tends to be long on empiricism and short on theoretical explanation. A related body of work in economics is much more strongly motivated by theoretical concerns, and it provides useful, if sometimes restricted or flawed, explanations of differences between public and private organizations. Property rights theorists (for overviews see De Alessi 1980; Alchian and Demsetz 1973) propose elaborate theoretical explanations as to why public organizations should differ from private ones, but often there is no empirical test of the theory or, more commonly, the test is poorly grounded in the theory. There are some conspicuous exceptions where theory and measures seem well matched (e.g., Clarkson 1972).

Property rights theorists work out of a much different tradition than do most organization researchers who compare public and private organizations. But the approach is still "core" in the

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sense that comparisons are made between public and private organizations, usually organizations with quite similar functions. Generally speaking, the renewed interest in economic-based approaches to organizations has not had the effect of opening up communications between property rights theorists and public management researchers working on similar problems. Perhaps this is due in part to the tendency of property rights theorists to focus on technical efficiency and market-based performance criteria rather than on individual level variables or structure variables.

The Dimensional Approach to Publicness

The dimensional approach does not have the conceptual tidiness of the core approach. The basic notion is that publicness is not a single, discrete attribute; rather, organizations (whether government, business, nonprofit, or hybrid) are more or less public depending on the extent to which externally imposed political authority affects them.

Bozeman (1984 and 1987) suggests a dimensional model of publicness that gives particular attention to organization resource processes and also considers other fundamental organizational activities such as goal setting, structuring and design, and organizational maintenance. According to Bozeman's dimensional model, few, if any, complex organizations are purely public or purely private. Instead, some mix of public and private authority influences the behavior of most organizations. If publicness is independent of the formal legal status of the organization, it is convenient to think that some government organizations are "more public" than others, that some business organizations are "more private" than others, and that it is possible for specific business organizations to be "more public" in some respects than specific government organizations.

While the dimensional approach to comparative public-private organization research has not been as well developed as the core approach, there are some reasonably lengthy theoretical threads. More than three decades ago, Dahl and Lindblom (1953) developed typologies that sought to relate political and economic dimensions and compare agencies to enterprises. Even more directly relevant is Wamsley and Zald's work (1973), which distinguishes organizations according to their basis of economic and political authority.

The dimensional model has theoretical precursors (Wamsley and Zald 1973; Dahl and Lindblom 1953) and there is much
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indirectly related work in economics (e.g., James Buchanan 1973), but organization researchers have begun only recently to use dimensional approaches in empirical analysis of differences between public and private organizations. Bozeman (1984) uses historical analysis of the aerospace industry to identify "dimensions of publicness" among a group of organizations that are, from an ownership perspective, purely private. Two studies (Bozeman and Crow 1989; Crow and Bozeman 1987) use different data sets for research organizations to determine the effects of variance in two dimensions—government-based resources as a percentage of total resources and public domain-private domain focus of organization outputs—on the structure, management, and performance of energy technology producers with a variety of ownership attributes. In a related work, Crow and Emmert (1988) examine similar dimensional concepts of publicness to determine effects on 250 R&D laboratories, many of which were of ambiguous ownership. None of these studies, though, provides a comparison of the explanatory power of core approaches and dimensional approaches. Two recent studies, one focusing on information management functions in a variety of business and government organizations (Bretschneider 1990), the other (Coursey and Bozeman 1990) examining government, business, and nonprofit organizations in a variety of functional areas, provide a more direct comparison of core and dimensional approaches and find that each approach has some explanatory power.

As is the case with the core approach to public-private organization comparison, the dimensional approach brings with it both advantages and disadvantages. The major advantage of the dimensional approach is that it provides some promise of dealing with organizations that are not "pure types." It is able to deal with hybrid organizations, sector blurring, business-like characteristics of government agencies, and the influence of political authority on private organizations. Perhaps the most important disadvantage of the dimensional model is that it is much more complicated and employs fewer elegant conceptual devices than the core approach. As a result, there is greater likelihood of construct validity, criterion stability, and measurement problems along the way.

DESCRIPTION OF DATA AND METHODS

The data for testing the model presented in the next section were derived from Phase II of the National Comparative R&D Project (Bozeman and Crow 1988). One objective of the data collection effort was to understand the influence of political and market forces on the institutional structure and design of the U.S.

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system of R&D providers. The dimensional publicness model (Bozeman 1987) was used as a basis for developing constructs and measures to facilitate a test of alternative explanations of the effects of publicness. Data for Phase II of the National Comparative R&D Project used in this study were derived from mail questionnaires which were collected, recorded, and validated in 1987 and 1988.1

The definition of the universe of R&D organizations presents certain problems and thus care was taken to ensure the integrity of the population definition. Four major research center directories were used to establish a population of U.S. R&D organizations.2 Organizations with fewer than thirty reported employees were excluded from the study as were those that conduct research chiefly in the social sciences. This yielded a study population of 16,597 R&D laboratories from which a random probability sample of 1,300 was drawn. Because of their importance in the U.S. R&D system, the largest (in terms of scientific and technical personnel) 200 laboratories were added to this list.

Because they were aware that standard research directories, even those of the highest quality, tend to be somewhat out of date and to have errors, the researchers telephoned each laboratory chosen for the initial sample to confirm the existence of the laboratory and its correct address, to develop data about research focus and total personnel, and to confirm the name of the current director (who would receive the questionnaire). As a result of this process the study sample was reduced from 1,500 to 1,341.

Concurrent with development of the sampling frame, the researchers developed an initial draft of a mail questionnaire. The questionnaire was examined by a group of nine laboratory directors with whom the researchers were acquainted personally. The purpose of this procedure was to obtain information about ambiguities, omissions, and sensitivities in the questionnaire. The questionnaire was revised after the nine laboratory directors were interviewed about its perceived problems. This revised draft was sent to a pretest sample of eighty laboratories, sixty chosen randomly from the population and twenty chosen randomly from those labs with between 201 and 300 employees.3 With no follow-up for the pretest, the response rate for the pretest of the mail questionnaire was 31 percent. In the questionnaire’s final draft, questions were eliminated to reduce overall length and the metrics were changed on some Likert-scale items.

Since research directors tend to be asked frequently to respond to questionnaires and the pretest response was low,
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numerous steps were taken to improve the likelihood of response. Two weeks after final pretest results were analyzed and after the questionnaire had been modified, an alert letter was sent to each person (all laboratory directors) in the sample. Final questionnaires were mailed two weeks later. Seven hundred thirty-three usable responses were received for a response rate of 54.6 percent. The operations that were undertaken to determine representativeness and response validity indicated that nonresponse bias and measurement error posed no significant threats to validity.

Industrial laboratories are by far the most pervasive in the U.S. R&D system, and their dominance is reflected in this sample. The composition of the respondents by institutional context is: 27 percent university research units, 20 percent government, 53 percent industry, and 7 percent other (for example, multiple ownership forms). A complete list of respondents is available upon request. In the analysis presented here, a subset of the NCRDP data base is employed, with the subset defined by data availability for each variable in the model.

EMPIRICAL MODEL FOR TESTING DIMENSIONAL AND CORE EXPLANATIONS OF PUBLICNESS

Building on Bozeman's earlier (1987) conceptual work, the dimensional model presented in exhibit 1 can be employed to test the explanatory power compared to the core (or legal type) model.

Exhibit 1
Dimensional Model of the Effects of Publicness

- Publicness Dimensions
  - Resource publicness
  - Goal/agenda publicness
  - Communications publicness

- Bureaucratization
  - Personnel
  - Equipment
  - Knowledge

- Sector

- Buffers

- Controls
  - Size
  - Technology

- Output Composition
  - Patents
  - Articles

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The model presented in exhibit 1 can be organized into the following system of equations:

\[ O = F(BF, C, Pc, Pd) \]  \hspace{1cm} (1)
\[ BF = F(BU, C, Pc, Pd) \]  \hspace{1cm} (2)
\[ BU = F(BF, C, Pc, Pd) \]  \hspace{1cm} (3)

where

- \( O \) is a vector of variables representing output composition, (e.g., number of patents and articles),
- \( BF \) is a vector of variables representing buffers between the organization and its environment,
- \( BU \) is a vector of variables representing the extent of bureaucratization within the lab,
- \( C \) is a vector of control variables (e.g., size and technology),
- \( Pc \) is a vector of dummy variables representing legal distinctions in ownership, such as government and industry, to operationalize the core concept of publicness, and
- \( Pd \) is a vector of variables to operationalize the dimensional concept of publicness.

The explanation considers core and dimensional publicness as mitigated by buffer variables. Size and some measures that differentiate technological process are used as controls. In capsule, the model maintains that an organization’s output composition and bureaucratization can be viewed as a function of organization publicness (including resource, agenda control, and communications publicness dimensions, and core publicness based on ownership status) as mitigated by buffering devices (diversity of organizational mission and boundary-spanning activity), while controlling for size and distinctions in technological core. The chief interest here is in determining the additional contribution, if any, that dimensional variables generate when added to the core model.

Dependent Variables

The first set of dependent variables pertains to the composition of the research unit’s R&D. Respondents were asked to indicate the percentage of the unit’s work time allocated to each of several categories of technical output including scientific articles and books, patents and licenses, internal papers, papers presented at scientific conferences, prototype devices, and algorithms and software. Two of the categories are classic embodiments of proprietary (patents and licenses) and public domain (scientific articles) outputs. Several studies (e.g., Link 1977)

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have reported that the composition of the organization's R&D is a key issue relating to performance requirements, inputs, and strategy.

One common allegation about differences between public and private organizations is that public organizations have higher levels of bureaucratization/red tape. According to property rights theory and similar economic-based approaches to organizations (Breton and Wintrobe 1982; Davies 1971 and 1981; Ahlbrandt 1973; Bruggink 1982), higher levels of red tape are found in public organizations due to the absence of clear profit measures and the inability to transfer property rights. This causes organizations to engage in side payments which have little to do with technical efficiency and to center instead on self-aggrandizement or enhancing one's political position in the organization. Thus, creation of new positions merely for the purpose of increasing one's managerial scope is an example of a side payment reducing the efficiency of the public organization. According to comparative research in public management, higher levels of red tape are found in public organizations because of lack of goal clarity (Rainey [1983] presents some counterevidence), external demands for accountability, or substitution of structure and formalism for authority and control (Bruce Buchanan 1975).

Bureaucratization/red tape was measured in the NCRDP database in much the same fashion as in Andrews's (1979) cross-national study. Respondents were asked to report how much time, on average, elapsed between the time a request was made (for any of several organizational activities) and the request was granted or denied. In this analysis, three types of red tape were examined. Red tape in personnel decisions considered the amount of time for the hiring and the dismissal of full-time personnel. Red tape in knowledge flows considered the amount of time required until research was circulated outside the organization and the amount of time required for permission to submit research for publication. The final red tape variable examined decisions about the purchase of research equipment costing more than one thousand dollars.

Buffer Variables

The effects of political authority often are distributed according to organization technology and organization product type (Emery and Trist 1965; Downs 1967). Organizations have various means of sheltering their core technology (Thompson 1963) from the environment, including interactions associated with external political authority. One such means is manipulation
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of the internal structure of the organization (for an overview see Dalton et al. 1980; Bozeman 1982).

Probably a more easily recognized and deliberate means of mediating authority and other environmental demands is through boundary-spanning activities. Miles (1980, 316) observes that "organizations do not scan their environments, interpret what they see, and translate and communicate findings to their decision makers . . . decision makers rely on people occupying special roles to perform these boundary-spanning and maintaining functions on behalf of their organizations." Organizations vary substantially in the level and formality of boundary-spanning activity (Aldrich 1979; Aldrich and Herker 1977). Boundary-spanning activities help determine the amount, timing, and quality of information about the environment and, perhaps more important, sometimes permit the organization to shape its enacted environment.

Research-intensive organizations generally are involved much more in boundary spanning than are most organizations. One straightforward measure is simply the percentage of work time the laboratory director spends dealing with people outside the organization. A more formal measure is the number of inter-laboratory research agreements enacted. This form of organizational interdependence, more common of late (Link and Tassey 1989), is a means of learning about the environment and also of expanding capacity to respond.

Control Variables

One approach to determining control variables in a study that compares public and private organizations is simply to assume that all major variables are endogenous (Chubb and Moe 1988; Tweedie et al. 1990). This study takes a middle position between specifying a long list of controls and dispensing altogether with the notion of controls.

Even though all the organizations surveyed were similar in terms of general function—generation and dissemination of knowledge—important distinctions must be controlled for in any formal test of hypothesis. Organization size has been shown to exert economies of scale with respect to economic production, but it also affects the general level of bureaucratization and reflects access to resources and ability to buffer itself from the environment. In this regard, two similar firms that differ only in size may exhibit important differences in terms of the dependent variables. The total number of employees was used to account for the effects of size in the formal model.

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Within the context of research organizations of differing size, differences in core technology (Thompson 1963) are also significant. The sample used to test our hypothesis includes energy research labs along with biomedical facilities. In order to account for important differences in the actual productive process it was necessary to develop some metrics for distinguishing among labs' core technologies. To this end a maximum likelihood factor analysis was conducted on a series of variables which measured the number of professional staff in various research fields employed at each lab. These included the number of professionals in medical science, biomedical science, biology, chemistry, physics, earth science, mathematics, and engineering sciences. Appendix A reports these results. A chi-square test supports the view that four factors are necessary, though three factors are sufficient to explain all variance in these eight variables. The three-factor solution has a useful empirical interpretation—the first factor represents physics-mathematics research, the second factor represents biomedical research, and the final factor captures major disciplinary research (for example, biology, chemistry, physics, and earth science). Factors scores from the three-factor model were used to characterize differences across core technologies.

Publicness Variables

The publicness variables used to test the explanatory power of the core approach consisted of a series of binary variables to distinguish among industrial, government, university, and other research units. Though many previous studies that employ the core approach to publicness have used just a single binary variable (for example, 0 = industry, 1 = government), there was insufficient justification here for classifying universities in terms of ownership for the following reasons: there is good reason to believe ownership is not as important in discriminating among universities (at least in the United States) as are a host of other variables; private university research units have much more in common with other public university research units than they have with private industrial research units; universities, even more than most research organizations, are beset with innumerable public-private interactions that sometimes render ownership-based classifications meaningless. Likewise, the "other" category was retained because a number of highly diverse organizations, many with multiple ownership forms, defied conventional binary classification. Moreover, by providing a somewhat more elaborate classification of core type but retaining the spirit of the core approach, there is a stronger likelihood that the core approach will offer a more realistic alternative to a dimensional approach.

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to publicness. Three binary variables were used to model the four qualitative groups, with industrial labs acting as the reference class.

Previous investigations in the dimensional tradition of publicness (Crow and Bozeman 1987; Crow and Emmert 1988) have focused exclusively on resource publicness, usually defined in terms of the percent of the organization's budget derived from government sources. One reason for this focus was measurement convenience, though there are theoretical reasons to believe that resource publicness is fundamental (Bozeman and Straussman 1983). One objective of this study was to consider other public dimensions and to provide additional measures of resource publicness.

The resource publicness dimension was measured by three variables. One variable measured responses to the questionnaire item: What percentage of your R&D unit's total budget is from government contracts or grants? Another variable measured the percentage of the R&D budget (not the total budget) derived from government appropriations. A third variable measured responses to this questionnaire item: What percentage of the total value of your scientific and technical equipment and facilities was financed directly (appropriations or objects of expenditures) by government?

The publicness of the organization's goals and agenda was measured in terms of responses to two Likert-scale items: Without government-financing of our R&D we probably would cease to exist within two years, and Without government-financing of our R&D there would be a major shift in our lab's R&D focus. These were only partial indicators of government influence on the agenda of the research unit.

Communications publicness relates to transactions with external government actors. One variable measured responses to this question: During the last two weeks, about what percentage of your (not the lab's) business-related telephone calls were with government personnel? Similarly, another variable considered responses to the following question: During the last two weeks, about what percentage of the first class mail you received was from government agencies or personnel?

Exhibit 2 summarizes the variables described above in terms of the number of cases, the mean, standard deviation, minimum value, and maximum values in the sample. We also group variables within the table and provide shorthand variable names for each.

3The scale for each of these items is
4 = strongly agree; 3 = agree;
2 = disagree; 1 = strongly disagree.
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Exhibit 2
Summary of Variables by Type

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<td>Binary Variables</td>
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<td>0.0545</td>
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</table>

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The "Publicness Puzzle" in Organization Theory

FINDINGS

This study focuses on the extent to which a dimensional concept of publicness provides additional explanatory power over the core concept of publicness. Hence our attention is on the incremental explanatory power of different groups of variables. The appropriate statistical test of this hypothesis should therefore determine the effects of alternative explanation within the context of a given theory or model. Both dimensional and core publicness are operationalized as multivariate concepts within the context of a system of equations, therefore simultaneous hypothesis tests on the effects of a number of independent variables must be applied. The Chow F-test provides a mechanism for dealing with this situation. Despite the presence of simultaneous reciprocal causality, we begin our analysis with a series of independently estimated equations. For each equation, a single regression model, including all competing forms of explanation, was estimated using ordinary least squares. This model is referred to as the unrestricted model. Exhibit 3 contains the results of estimating these unrestricted models using ordinary least squares for each of the nine dependent variables.

An examination of the detailed results, equation by equation, demonstrates considerable variation in explanatory power. The best model explains over 53 percent of the variance in allocated resources toward the generation of articles as outputs, while the worst model explains less than 1 percent of the variation in bureaucratic rules on requirements to circulate research reports within the lab. An examination of simple and complex forms of intercorrelation between the independent variables indicates that though some intercorrelation exists within each group of variables used to operationalize publicness, no other statistical problems could be uncovered.8 The Chow F-test is insensitive to intercorrelation within the group of variables being simultaneously tested.

Once the unrestricted model is obtained, for each equation a restricted form of the model is estimated that leaves out one block of variables being considered. The formal test statistic is then based on the incremental effects of the missing variables on the unrestricted estimation relative to the restricted model. In the context of publicness, the overall unrestricted model includes both core and dimensional publicness variables. Thus different restricted models are estimated, one that tests the effects of core and one that tests the effects of dimensional publicness. The results are presented in exhibit 4. Since we decided to develop factor-based measures for differences in core technology across

---

### Exhibit 3
Unrestricted Models

<table>
<thead>
<tr>
<th>Variable</th>
<th>Articles</th>
<th>Patents</th>
<th>Hiring</th>
<th>Firing</th>
<th>Equipment</th>
<th>Publication</th>
<th>Circulation</th>
<th>Lab Agreements</th>
<th>External Agreements</th>
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<tr>
<td>Controls</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
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<td>-0.00025</td>
<td>-0.00111*</td>
<td>-0.00097</td>
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<td>0.00063</td>
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<td>0.05087***</td>
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<td>0.00398*</td>
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</tr>
<tr>
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<td>Publication</td>
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<td>-0.00448</td>
<td>0.02496**</td>
<td>0.02768**</td>
<td>0.07380*</td>
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</tr>
<tr>
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<td>0.00181</td>
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<td>0.02030</td>
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<td>465</td>
<td>547</td>
<td>515</td>
<td>565</td>
<td>532</td>
<td>492</td>
<td>485</td>
<td>485</td>
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<td>0.027</td>
<td>0.013</td>
<td>0.023</td>
<td>0.057</td>
<td>0.105</td>
</tr>
</tbody>
</table>

* Statistically significant at the 10% level  
** Statistically significant at the 5% level  
*** Statistically significant at the 1% level

Given that each model is estimated separately, the presence of missing values for different variables in each model leads to

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Exhibit 4
Chow F-test for Sector and Dimensional Publicness Variables

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>WITH FACTOR VARIATES Sector Dimensional</th>
<th>WITHOUT FACTORS Sector Dimensional</th>
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</thead>
<tbody>
<tr>
<td>Outputs</td>
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<td></td>
</tr>
<tr>
<td>Articles</td>
<td>32.307*** 6.694*** 28.660*** 6.915***</td>
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<tr>
<td>Patents</td>
<td>1.225 2.487** 0.676 2.119**</td>
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<tr>
<td>Bureaucracy</td>
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<td></td>
</tr>
<tr>
<td>Hiring</td>
<td>6.000*** 0.651 6.812*** 0.546</td>
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<tr>
<td>Firing</td>
<td>10.862*** 2.932*** 13.671*** 2.871***</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>1.586 1.564 2.052 1.715</td>
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<tr>
<td>Publish</td>
<td>0.436 1.383 0.397 1.404</td>
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<tr>
<td>Circulation</td>
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<td>Buffers</td>
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<tr>
<td>Lab agree.</td>
<td>0.470 1.097 0.494 0.866</td>
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<tr>
<td>Ext. contact</td>
<td>2.457* 3.720*** 1.700 3.999***</td>
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</table>

* Statistically significant at the 10% level
** Statistically significant at the 5% level
*** Statistically significant at the 1% level

Exhibit 5
Sample Selection Analysis

<table>
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<th>Dependent Variable</th>
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<td></td>
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<td>Outputs</td>
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<td>2.60</td>
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<tr>
<td>Patents</td>
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<td>Hiring</td>
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</tr>
<tr>
<td>Firing</td>
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<tr>
<td>Equipment</td>
<td>11.08</td>
</tr>
<tr>
<td>Publish</td>
<td>3.06</td>
</tr>
<tr>
<td>Circulation</td>
<td>7.39</td>
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<td>Buffers</td>
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<tr>
<td>Lab agreements</td>
<td>7.13</td>
</tr>
<tr>
<td>External contacts</td>
<td>7.13</td>
</tr>
</tbody>
</table>

*n = 676 since TOTPER was missing for 57 cases.
differing sample sizes. With effective sample sizes running from 84 percent to 69 percent of the total sample of questionnaires, tests for potential selection bias resulting from incomplete survey responses were considered. A total of 733 cases responded. The size variable measuring the total number of employees at a lab is missing in 57 cases, leaving a mail survey sample of 676 cases. Analysis determined whether selection bias problems exist due to missing value coding for specific variables. For each of the nine estimated models, cases were coded zero when all variables had values or one when at least one variable contained a missing value, thus forcing exclusion of that case. A logistics model including the organizational size variable and the three dummy variables modeling core publicness then was used to describe the probabilities of selection (Judge et al. 1985). The results presented in exhibit 5 suggest that there were no major problems of selection bias due to incomplete responses, at least with respect to size or sector.

In exhibit 4, each coefficient from the Chow F-test can be considered as an independent contribution to the equation. Thus the variance contributed by the (significant) coefficients is an increment to that contributed by the others, not a reflection of statistical redundancy. These results indicate that dimensional publicness, as operationalized by seven variables, does in certain circumstances provide additional explanation beyond that derived from the core model alone. While the results vary somewhat depending on whether the factor variates—the controls of organizational technology and mission—are introduced, the differences are not dramatic.

Not only does dimensional publicness add significant and unique variance to the explanation of laboratory output focus (as measured by percentage of activity devoted to, respectively, patents and scientific articles), but in the case of patents, significant coefficients are derived for dimensional publicness even in the absence of significant coefficients for core type. Arguably, the importance of dimensional publicness with respect to patent output might pertain to recent public policy changes geared at accelerating the transfer of technology not only from government but also from university and cooperative R&D laboratories.

Neither core nor dimensional publicness provides a powerful, comprehensive explanation of bureaucratization (as measured by the items assessing the time required to meet an activity request). However, both core and dimensional publicness account for bureaucratization of the sort that one associates most closely with political authority and government structure—that related to
personnel. Apparently the imprimatur of civil service regulations is deeply stamped; moreover, the personnel procedures and accompanying red tape involved in political authority is not circumscribed by legal status (core type). This seems intuitively correct in that many legal constraints imposed by businesses working under government contract (or tied to government by some other administrative apparatus) are similar to the constraints the government imposes on its own agencies. The regulations involving equal employment opportunity and affirmative action come to mind, but worker health and safety regulations also are brought to bear with government "strings." Interestingly, only the firing variable is significant in the case of dimensional publicness, perhaps indicating that at least some job security and workers' prerogatives found in government are more easily transported to public (but nongovernment) organizations.

The contribution of dimensional publicness is particularly important with respect to one of the buffer variables, the percentage of time the laboratory director devotes to external relations. Again, this relationship is not just an increment to core type; core type is not related significantly to external relations, except to a modest degree and with the organizational technology/mission variables introduced into the equation.

In sum, both core and dimensional publicness make unique and significant contributions to an explanation of fundamental organizational activities and characteristics related to composition of output, bureaucratization and red tape, and external focus. The notion that public and private organizations are alike only in unimportant respects (Allison 1979) seems to be as mistaken as the notion that all differences found between public and private organizations are attributable to misspecified models (Meyer and Williams 1977).

In considering these results, particularly given the context of the model presented in exhibit 1, a possible threat comes from the potential for reciprocal causality and simultaneity among the dependent variables. In order to consider the effects of these, a three-stage least squares version of our model was estimated. Several important points should be made about this type of analysis before presenting the results. First, the number of consistent observations for which all variables are represented was 345 or approximately 51 percent of the total sample. Tests for selection problems were run again, comparing the entire sample with the subsample of 345 cases. Neither organizational size (Chi-square of 1.35 based on a sample of 676) nor institutional context (university, industry, government) as measured by three dummy

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variables (Chi-squares of 1.35, 0.01, and 0.01 respectively) were statistically significant in explaining selection (i.e., no missing values in any of the 345 cases versus at least one missing value for 331 cases). Second, the simultaneous estimation of the model focuses attention on those variables that reflect reciprocal causality, here the red tape variables and buffer variables, not those associated with publicness or institutional context.

Therefore, in order to focus our attention on the effects of alternative specifications of publicness, three versions of the system model were estimated: one that included both core and dimensional representations of publicness, the unrestricted model; one that used only a dimensional representation; and one that used only the core representation. The logic behind this approach was to replicate the reasoning that was used in carrying out the Chow test above, but here based on the overall system of equations, incorporating simultaneity. The results are presented in exhibit 6.

**Exhibit 6**

**Third Stage Least Squares Estimation Results**

<table>
<thead>
<tr>
<th>Model</th>
<th>System Weighted Mean Square Error</th>
<th>System Weighted R-square</th>
<th>Degrees of Freedom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrestricted Without</td>
<td>2.894</td>
<td>0.172</td>
<td>3074</td>
</tr>
<tr>
<td>Sector</td>
<td>3.827</td>
<td>0.169</td>
<td>3074</td>
</tr>
<tr>
<td>Dimensional</td>
<td>38.034</td>
<td>0.078</td>
<td>3343</td>
</tr>
</tbody>
</table>

The results suggest that the use of dimensional variables may in fact be more significant than core type when considering the issues of reciprocal causality and simultaneity. These findings strongly suggest the importance of the dimensional publicness concept and, unlike some other findings, imply that dimensional publicness provides a more powerful explanation, not just a complementary one, than core publicness. The testing of reciprocal and simultaneous effects pits the two explanations against one another in the most stringent terms. In doing so, the magnitude of the coefficient for the dimensional concept suggests that it is more elemental even than effects derived from core type. While this may be surprising given the expectations found in the public administration and public organization theory literature, there is at least one reason to believe that a dimensional approach gives a more rudimentary causal explanation. Core type is an attribute.
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variable that is loaded with implications about attendant behavior but that uses indirect assumptions and little direct grounding to get from attribute to behavior. This is what Bozeman (1987) has referred to as the causal problem in comparative public-private studies, that is, differences between public and private organizations are observed, causes are suggested, but there is no testing of the causal reasoning because the observations have little or no empirical correspondence to the ad hoc theory that is imposed.

The dimensional explanation, as operationalized here, is based not on attribute but on behavior, communications with government, implied influence, and dependence on government resources. It seems reasonable that an explanation that is more grounded in behaviors is in a sense more basic than one that is grounded in attributes and makes once- or twice-removed assumptions about the implications of those attributes in terms of behaviors.

CONCLUSIONS

The central finding from this study is that the core and dimensional approaches are not mutually exclusive alternatives but are instead useful and even complementary alternatives. Formal legal status (core type) has important independent effects that do not vanish with a more fully specified model. But the insights provided by the dimensional concept of publicness are equally important and supplement the broad judgments accruing from the core approach.

The findings with respect to the bureaucratic/red tape variables are particularly instructive. Extending previous findings (Loveless 1985; Bozeman et al. 1992) about the different origins of red tape in government and business organizations, red tape also seems to vary according to extent of external political authority and type of red tape. Red tape pertaining to personnel is particularly sensitive to political authority, consistent with the extensive findings about the importance of formal rules and procedures in public personnel management (e.g., Fottler and Townsend 1977). The evidence indicates that dimensional publicness and core publicness are in some respects independent explanations, and each has pervasive effects.

What does this imply for future research strategies? The most obvious implication is that neither a dimensional nor a core explanation alone is likely to prove as powerful as both together. At least until additional findings have been produced from studies employing both the core and dimensional models, efforts to

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combine the two are particularly welcome. This will enable more sophisticated models that will begin not only to more effectively distinguish public from private organizations but also the impact of direct and indirect, internally originating and externally originating political influences.

Future research might consider also the impact of organizational function or mission vis-à-vis publicness. This study examines a set of technology-intensive organizations, R&D laboratories. This focus provides advantages as well as disadvantages. One advantage of examining organizations with a similar mission is that the homogeneity of mission serves essentially as a control. Previous studies comparing public and private organizations with different functions tended to obscure the unique contribution of both function and publicness. If private insurance companies differ from public welfare agencies, how much of the difference is attributable to publicness and how much to function? Clearly, the preferred design is to examine organizations from stratified sample matching function and publicness variables—for instance, a simultaneous examination of public and private schools, public and private welfare organizations, public and private research organizations, or public and private sanitation organizations. While such matched samples have been employed in a few cases (for example, Coursey and Bozeman 1990), strong limitations are related to the expense of gathering such extensive data. There is also the conceptual problem of the comparability of certain functions, such as, Do private security firms compare to police departments? If not, is there any suitable comparison? What is the public equivalent, if any, to manufacturing?

It is not clear how far the findings about R&D organizations can be extended to organizations with different missions, but similar findings (Bretschneider 1990; Coursey and Bozeman 1990) for organizations with quite different missions lends some encouragement. Moreover, R&D organizations seem to be a particularly useful focus because of the inherent variety of these organizations' morphologies and institutional settings (McKelvey 1982; McKelvey and Aldrich 1983). Moreover, with organizations so heterogeneous in structure, environment, and institutional setting, the observed effects of publicness are especially noteworthy.
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APPENDIX A
Maximum Likelihood Estimation of Factor Model

Significance Tests Based on 697 Observations:

Test of H0: no common factors.
V5 HA: at least one common factor.
Chi-square = 1576.444 DF = 28 Prob > Chi**2 = 0.0001

Test of H0: 3 factors are sufficient.
V5 HA: more factors are needed.
Chi-square = 27.777 DF = 7 Prob > Chi**2 = 0.0002

Eigenvalues of the weighted reduced correlation matrix
Total = 13.0057 Average = 1.62571

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<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>Eigenvalue</td>
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<td>Difference</td>
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<td>5.185562</td>
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<td>Proportion</td>
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<td>Cumulative</td>
<td>0.4872</td>
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<td>1.0168</td>
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<table>
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<td>Physics</td>
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<td>Earth science</td>
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<td>Weighted</td>
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<tr>
<td>Unweighted</td>
<td>2.026267</td>
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<td>0.445814</td>
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