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Abstract

Using a sample of 35 university departments, this study relates aspects of research and teaching effectiveness in university departments to contextual and structural contingencies. Three contextual measures (paradigm development, student emphasis, resource availability) and two structural measures (academic control, bureaucratic control) serve as independent variables. The contextual variables are found to be better predictors of effectiveness than the structural variables. Implications for developing and testing structural contingency theories as well as programmes for university reforms are discussed.

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Introduction

This study relates aspects of research and teaching effectiveness in university departments to contextual and structural contingencies. The study is part of a research programme attempting to apply the Aston concepts and measures (Pugh et al. 1963, 1968, 1969) to university organizations (Bresser 1979, 1984). The research is one of the few attempts to relate measures of organizational effectiveness to structural and contextual variables based on the Aston methodology, and is the first attempt to explore such relationships in university organizations.

Structural contingency theories suggest that organizational environments and structures can influence organizational effectiveness in significant and direct ways. In particular, they emphasize the need to match organizational designs with internal and external environments (contexts) to encourage high levels of organizational effectiveness (Child 1974a, 1977). However, the empirical evidence supporting structural contingency theories is limited, with only weak and inconsistent relationships being found between measures of environments and structures, and between behaviours and structures (Gerwin 1981; Starbuck and Nystrom 1981). Similarly, organizational environments and structures have only shown weak and inconsistent relationships with indicators of organizational effectiveness (Child 1975; Pennings 1975).

Researchers cite many reasons for this lack of findings. Some have emphasized the absence of a commonly agreed upon theoretical scheme leading, for example, to conceptual confusion with regard to the distinctions between external environments and organizational technologies (Pennings 1975).

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Others have attributed disparate findings to methodologically different perspectives. For instance, results based on perceptual measures have usually disagreed with those based on objective measures (Payne and Pugh 1976), and the emphasis on cross-sectional studies has limited possibilities for causal inferences (Pugh and Hickson 1976; Starbuck 1981). Child (1977) has questioned the relevance of matching organizational designs to contingencies at all. When organizations pursue strategies which provide them with some degree of monopoly or with a protected market niche, they can control environmental contingencies or, at least temporarily, ignore design-contingency matches.

These explanations highlight limitations, but do not falsify the contingency approach as a useful research paradigm. Contingency theories may have been defined too broadly in the past (Blackburn 1982). Rather than assuming that similar contextual or structural dimensions and contingency relationships are relevant for all organizations (Pugh et al. 1968, 1969), contingency theories may have to be further refined to incorporate the specific contingencies faced by different organizational types. For example, with respect to contexts, Donaldson and Werner (1976) and Hinings et al. (1976) showed that different variables are needed to accurately describe specific organizational settings. Similarly, several investigations suggested that different structural profiles exist across different types of organizations (Blackburn 1982; Bresser 1984; Holdaway et al. 1975). Further, effectiveness criteria also vary across different types of organizations (Cameron 1978; Pennings 1975). It follows that more refined contingency theories may be needed to study different and specific types of organizations.

This study relates contexts and structures to aspects of organizational effectiveness for a specific organizational type, namely university departments. Hypotheses explaining effectiveness are developed and then tested in a sample of 35 West German university departments.

Effectiveness of University Organizations

Strasser et al. (1981) proposed a continuum of models for evaluating organizational effectiveness characterized on the one end by a pure goal model and on the other by a pure system model. Following the Aston framework (Pugh et al. 1963), this study adopts a model close to the 'system' end of such a continuum. However, the specific effectiveness criteria are derived from the announced goals of the political groups involved in the reform of the German university system (Bresser 1979).

A wide variety of effectiveness criteria have been suggested for evaluating universities (Cameron 1978; Gross 1968; Weick 1976). Within the West German system of higher education, where all universities are public institutions, the diversity of possible university purposes and goals is reflected in the views held by different political interest groups. Since the system

expanded rapidly during the 1960s and required extensive internal adjustments, different political groups emerged with many, often conflicting reform goals. For example, a conservative group of professors and politicians favoured an expansion of the system without changing much of its traditional structure (Mikat and Schelsky 1966). Liberals recommended an expansion together with the introduction of more competitive elements within the system, for instance, by founding private universities (Engels 1974; Maitre 1973). Leftist professors, students, and politicians pressed the university to be more responsive to societal issues and problems, and they asked for democratized decision-making structures which would give each group (professors, assistants, students) one-third of the seats in all decision-making organs of the university (Schumm 1969). In spite of this diversity, these political groups also shared some common goals. A consensus existed concerning a need to improve university capacities so that more research could be completed, and more people could obtain a university education (Mikat and Schelsky 1966; Engels 1974; Schumm 1969).

This consensus suggested a choice of effectiveness indicators to assess a university department's formal capacities within the domains of research and teaching. The measures used are objective rather than perceptual indicators, and thus are compatible with the Aston measures of context and structure. With the exception of two publication measures, the criteria are average scores over two to five semesters, thereby reducing the effects of an exceptional semester (Child 1974b). A minimum of two semesters allows the inclusion of relatively young departments. The maximum of five semesters was imposed so that measurements were not extended back to a time when the contextual and structural attributes might have been significantly different from those measured in the research. The following are short operational definitions.

Four variables measure a department's capacities to perform research. *Book publications* is the mean number of books published by the three most recently employed professors who were obtaining their first professorial appointments. (In Germany, all professorships are tenured.) This focus highlights the department's current research emphasis, and avoids including professors whose publication productivity is higher simply because they have spent more time in the system. A department with a high score on this measure has recruited faculty members who have demonstrated high productivity with regard to book publications. Presumably, such a department has a higher capacity to produce book publications. *Article publications* measures the average number of published articles for the same newly appointed professors. Within the German context, similar measures of book and article publications for evaluating the universities' research effectiveness were recommended by Bolsenkötter (1978) and Spiegel-Rösing (1975). The *sabbatical-index* is the mean number of faculty members taking a sabbatical per semester relative to the size of eligible faculty members. The variable measures a department's formal capacity to facilitate full-time research by its faculty members and was

proposed as a basis for effectiveness evaluations by Bolsenkötter (1978). The *habilitation-index* measures the average number of habilitations completed per semester relative to the number of completed Ph.D.'s. An habilitation thesis is the normal formal qualification required for a professorship in Germany, and is written after a researcher has obtained the Ph.D. Since habilitation candidates are usually recruited from a department's Ph.D. graduates, higher scores on this variable indicate a greater departmental capacity to qualify junior faculty for professorial appointments.

Four indicators reflect a department's capacity to educate and process students. The *dissertation-index* is the average number of students completing a Ph.D. relative to the average number of students completing graduate (master's) studies. A similar indicator was demonstrated to have discriminatory power among several effectiveness measures tested in an OECD/CERI experiment at six German universities (Mertens 1978). A *graduate-faculty ratio* is calculated as the mean number of students completing their graduate studies per faculty member. *Average semesters of study* measures the mean number of study semesters needed before graduation from a department. The large number of semesters needed by students to graduate has been a topic of much controversy in the German reform debates (Dallinger et al. 1978). *Surplus semesters of study* is the difference between the average semesters of study needed to graduate and the normal number of semesters specified by a department in its curriculum. High scores on the first two measures indicate capacities to graduate highly educated students. Low scores on the last two variables indicate capacities to process students through educational programmes efficiently.

From a systems perspective, the measures reflect departmental capacities to generate research and to educate students. They can serve to explore contingencies which may increase or decrease system capacities as special aspects of organizational effectiveness. The contingency framework proposed by the Aston researchers (Child 1974a; Pugh et al. 1963) suggested that organizational contexts, structures, and activities are among the major determinants of organizational effectiveness. This study defines measures of context and structure, and develops predictions for relationships between context, structure and effectiveness.

Context and Effectiveness

Eleven variables are used (Bresser 1984) to represent six contextual dimensions as defined by the Aston group (Pugh et al. 1969). The specific dimensions represented include size, charter, operations technology, origin and history, dependence, and location. In addition, the level of paradigm development is included as a new contextual dimension specifically relevant for distinguishing university departments.

Paradigm Development

According to Kuhn (1970), the term paradigm refers to the values, beliefs, and techniques which are shared by members of a scientific community. The level of paradigm development has been used successfully to distinguish different scientific disciplines. Empirical studies have reported differences in the activities and attitudes of researchers working in fields with higher as opposed to lower levels of paradigm development (Lodahl and Gordon 1972; Neumann 1977; Pfeffer et al. 1976). In general, members of fields with higher levels of paradigm development (e.g. physicists) showed attitudes and activities reflecting much consensus over theories, research goals, methodologies, and curricula. However, in fields with lower levels of paradigm development (e.g. sociology), beliefs about these issues were rarely shared and conflict rather than consensus prevailed. Thus, well-developed paradigms function much like ideologies, binding people together, helping them to understand their worlds, and providing them with guidelines for appropriate behaviour (Bresser 1984).

In addition to distinguishing disciplines on the basis of the attitudes and activities of their members, the paradigm concept may help to explain differences in the institutional contexts within which scientific communities work. University departments in high paradigm fields may operate in more favourable contexts than departments representing low paradigm fields. For example, Lodahl and Gordon (1973a) and Pfeffer et al. (1976) reported that high paradigm fields had comparatively few problems in acquiring research funds, presumably because the higher levels of consensus in such disciplines facilitated the evaluation of research proposals. Similarly, Bresser (1979, 1984) demonstrated that departments in higher paradigm fields attracted more financial resources and technical support and they had to process fewer students than departments in lower paradigm fields.

The level of paradigm development could also influence organizational structures. Lodahl and Gordon (1973b) and Beyer and Lodahl (1976) found that social science departments, representing lower levels of paradigm development, were more strongly controlled by their universities' central administrations than physical science departments with more highly developed paradigms. They suggested that the lack of consensus typical for low paradigm fields might account for this difference. Bresser (1984) used similar reasoning to explain why departments in fields with lower levels of paradigm development emphasized academic control techniques such as self-coordination, whereas departments from higher paradigm fields emphasized more routinized bureaucratic controls.

Since scientific fields have different levels of consensus concerning research problems and curricula, and these are associated with differences in attitudes and activities among researchers, evaluations of effectiveness are also likely to differ across fields. Members of low and high paradigm fields may not only define effectiveness differently but also attribute dissimilar meanings to the

same criteria. For example, a poor performer in terms of the number of article publications expected in a high paradigm field may be considered a good performer according to the norms of a low paradigm field. Thus the level of paradigm development is expected to predict differences in effectiveness as discussed below.

An article is a shorter form of scientific communication than a book. If articles are the main form of communication, then high consensus has to exist among researchers as to what problems are important, what methodologies should be used, and how results should be interpreted. Without consensus, scientific progress could not be adequately communicated in succinct articles and books would be preferred. Due to the lack of consensus, researchers in low paradigm fields usually must define, explain, and justify their problems. Further, they have to explain and defend the methodologies used, and elaborate on possible interpretations of the findings. Therefore, to communicate effectively, researchers from low paradigm fields tend to publish relatively more books, whereas researchers from high paradigm fields use articles as their dominant form of publication (Neumann 1977). Thus departments representing fields with higher levels of paradigm development are predicted to have lower book publication and higher article publication scores than departments representing disciplines with lower levels of paradigm development.

Scholars from low paradigm fields with their diverse belief systems and communication problems may find it attractive to take sabbatical leaves and conduct research at other universities where they can find more colleagues sharing and supporting their particular world views. In contrast, scientists in high paradigm fields are likely to deemphasize sabbatical leaves since whether they are at home or elsewhere, they are surrounded by people with similar paradigmatic beliefs (Wilkes 1976). Therefore, departments from low paradigm fields are predicted to have higher sabbatical-index scores than departments from high paradigm fields.

Completing the habilitation demonstrates a capacity to do advanced research and qualifies a person for a professorial appointment. During the university reform debates, the habilitation was criticized as an antiquated initiation procedure inhibiting scientific progress (Bresser 1982). Since the reorganization of the university system in the 1970s, some professors have been appointed without completing an habilitation but it is still usually required. As the relative absence of conflicts in fields with well developed paradigms facilitates agreement on curricula, high paradigm fields are expected to make more use of the habilitation, and to have higher habilitation-index scores.

Agreement on curricula may also explain why fields with well developed paradigms are likely to have more Ph.D. graduates. For example, the value of a Ph.D. in physical science fields is high, since in attaining this degree a student must demonstrate a capacity to utilize and apply established research methods, and these skills are valued in the laboratories of potential employers. In contrast, social science training at the Ph.D. level is less uniform and usually emphasizes the understanding of ideological controversies. Consequently, the

value of such a Ph.D. is itself often controversial. Therefore, the Ph.D. is considered more often as a standard qualification in fields with highly developed paradigms, and departments from such fields are expected to have relatively high dissertation-index scores.

Wilkes (1976) defined research breadth as the intensity of contacts, publications, and activities outside a researcher's field. He reported higher research breadth for low paradigm fields. This reflects the lower levels of consensus within such fields, and may indicate that some lower paradigm fields are more generally practice-oriented than fields with higher paradigm development. For example, theories developed in the fields of sociology, jurisprudence, or business administration often deal with similar issues and borrow from other disciplines in order to develop practical guidelines for many professions. In contrast, theories developed in physics or chemistry are more uniquely focussed, and are usually relevant to a limited number of neighbouring disciplines and professions. Fields with broader and more general applicability may be more in demand because they offer graduates a wider variety of job opportunities. In fact, for the departments investigated here, lower paradigm fields have significantly higher student enrolments (Bresser 1979, 1984). The need to educate and process more students in departments from low paradigm fields leads one to expect higher graduate-faculty ratios than in high paradigm departments.

Due to a high consensus on curriculum matters, high paradigm fields have developed longer sequences of prerequisite courses than low paradigm fields (Salancik et al. 1980). This suggests that the average number of study semesters should be higher in departments representing higher rather than lower levels of paradigm development. In contrast, the high consensus on curriculum matters in fields with highly developed paradigms should ensure that the normal graduation periods published in a department's curriculum are accurate so that surplus study semesters should be comparatively low.

The predicted relationships between a department's level of paradigm development and the effectiveness indicators are summarized in the first line of Table 1. A positive sign indicates that high paradigm fields are expected to have a comparatively higher score on the criterion variable. A negative sign indicates that such scores are expected to be comparatively lower for high paradigm fields.

In this study, the level of *paradigm development* is measured by affiliation to a field. Physics and chemistry departments represent higher levels of paradigm development, and law and business administration departments lower levels of paradigm development. In previous studies, social sciences such as sociology or the political sciences have been used to represent disciplines with lower levels of paradigm development. In Germany this approach is not possible, because these social sciences usually are combined with other fields to form large umbrella-departments. In contrast, as the fields of law and business administration are organized as distinct departments, these were chosen to represent lower levels of paradigm development. This is consistent with other

Table 1
Hypothesized relationships

	Book Publications	Article Publications	Sabbatical Index	Habilitation Index	Dissertation Index	Graduate-Fac. Ratio	Average Semesters	Surplus Semesters
Paradigm development	−	+	−	+	+	−	+	−
Student emphasis	−	−	+	−	−	+	+	+
Resource availability	+	+	+	+	+	+	+	+
Academic control	−	−	+	−	+	+	+	+
Bureaucratic control						−	−	−

studies, which evaluated law and business administration as having lower levels of paradigm development than physics and chemistry (Kort 1976; Salancik et al. 1980).

Aston Dimensions of Context

Four different aspects of a department's size are measured: (1) the *number of employees*; (2) the *number of full-time students*; (3) the *financial resources* available within a budgetary year; and (4) the number of *teaching programmes* offered during an academic year. Charter is represented by a *student-faculty ratio*. Three variables measure technology in terms of the means and operations used in teaching and examination processes: *technical support* is the mean number of employees with technical support functions per faculty member; *percentage of non-lecture courses* is the proportion of teaching programmes which are non-lecture courses; *examinations* measures the number of final tests students take during their last semester before graduating. Origin and history is represented by a department's *age*. *Dependence* counts the number of specialized support functions performed by university service centres outside a department's boundaries. Location is measured by the indicator *geographical dispersion* which is a count of a department's operating sites. For details, see Bresser (1979, 1984).

Bresser (1984) reported that the size variables are highly intercorrelated, and the student-faculty ratio, the technical support span, and dependence (negative) also show significant correlations with the size indicators. These correlations suggest that the contextual variables can be reduced to a smaller number of independent dimensions through factor analysis. After performing a principal component analysis with varimax rotation, a 2-factor solution appeared to be best interpretable and most logical with regard to the variable loadings. This solution is presented in Table 2.

Table 2
Factor Analysis of 11 Contextual Variables (n = 35)

Variable	Factors and Factor Loadings I Student Emphasis	II Resource Availability
Number of employees	.10	.93
Number of students	.76	.46
Financial resources	−.30	.83
Teaching programmes	−.11	.68
Student-faculty ratio	.90	.09
Technical support	−.72	.43
% Non-lecture courses	−.66	.44
Examinations	.77	−.06
Age	.67	.02
Dependence	−.20	−.68
Geographical dispersion	.46	.40
Percentage of total variance	34.2	29.3

The first factor is called *student emphasis* because the variables loading highly (above .66) on this factor indicate the emphasis placed on processing students. For example, a large student enrolment is accompanied by high student-faculty ratios, comparatively little support from technical personnel in teaching and research processes, a large percentage of lecture courses, and an examination technology which focusses on administrative efficiency by concentrating most final examinations in the last semesters before a student's graduation. In addition, such departments tend to be comparatively old. The second factor is labelled *resource availability* because it has high loadings (above .68) on variables depicting a department's relative wealth and independence. The variables loading highly on this factor include: number of employees, financial resources, teaching programmes, and dependence (negative).

Standardized factor scores (mean = 0, standard deviation = 1) are calculated for both factors to represent the Aston concepts of context in this study. The two factors distinguish different aspects of a department's context that are related to its size (students versus resources), but at the same time indicate a potential trade-off determining the relative favourableness characterizing a department's context. A department with high scores on the student emphasis factor faces an unfavourable context in terms of faculty workload and responsiveness to student needs. Large student bodies have to be educated by relatively few faculty members who have little technical support and rely on large lecture courses and an inflexible examination technology to cope with the workload. In contrast, high scores on the resource availability factor indicate that a department operates in a relatively favourable context, with high levels of human and financial resources allowing many teaching programmes and relative independence.

To predict relationships between these contextual dimensions and the effectiveness variables, the literature on the consequences of size provides some clues. Large size has been criticized for creating a poor learning and

research environment in universities (Goodman 1962; Stroup 1966). However, the empirical evidence is more equivocal. In several studies, positive relationships were found between size and research productivity (Hagstrom 1971; Blau 1973). It has been suggested that such positive relationships are more likely if larger academic institutions have high levels of financial resources or many Ph.D. programmes (Blau 1973; Pfeffer et al. 1976).

Positive relationships with research effectiveness variables may be expected if a department has large human and financial resources. It can be predicted that resource availability is positively related to book publications, article publications, the sabbatical, and the habilitation-index (see Table 1). The availability of resources should allow a department to be more selective in choosing faculty, to facilitate sabbatical leaves, and to encourage more junior faculty to complete an habilitation. In contrast, when a department has to educate many students, research activities are likely to be impeded. When a department is highly involved in teaching, it is likely to be less demanding in its recruiting, and in developing the research skills of junior faculty. However, the emphasis on teaching makes it likely that many faculty members seek to obtain sabbaticals. Thus student emphasis can be expected to have negative relationships with book publications, article publications, and the habilitation-index and a positive relationship with the sabbatical-index.

Student emphasis and resource availability are generally expected to have similar relationships with teaching effectiveness. An exception is likely with regard to the dissertation-index. Coping with many students makes it difficult for faculty to devote time to Ph.D. students, but this is facilitated if a department is well endowed with resources. Thus it is predicted that the dissertation-index is negatively correlated with student emphasis and positively with resource availability. A department's relative capacity to graduate students as indicated by the graduate-faculty ratio should be increased by both student emphasis and resource availability. However, as large size based on either students or resources creates complexity, both contextual dimensions are hypothesized to increase average and surplus study semesters.

Structure and Effectiveness

Universities have been described as collegial organizations in which specialized professionals have a high degree of autonomy, and where academic control relies on self-coordination, for example, through faculty committees (Parsons and Platt 1968). Universities have also been described as bureaucratic organizations (Blau 1973; Holdaway et al. 1975) relying on formalized roles and procedures for control. Becker and Gordon (1966) proposed that university structures combined both collegial and bureaucratic characteristics. Empirical evidence presented by Beyer and Lodahl (1976) and Bresser (1984) supports this broader conceptualization.

For this study, 17 structural variables similar to those developed by Pugh et al. (1968) are operationalized. The variables include three specialization measures, a measure of academic self-coordination, a standardization variable, a professionalization measure, an indicator of formal planning, three formalization, three centralization, and four configuration measures. Detailed definitions are given in Bresser (1984) together with a principal component analysis which yielded three independent factors. The first factor, called academic control, includes variables with high positive loadings on the three specialization measures and on several variables indicating complimentary academic coordination and control techniques. For example, in highly differentiated departments, self-coordination through committees may be used to deal with controversial issues resulting from differentiation. Coordination to resolve routine problems may be provided through an administrative staff, as indicated by the high loading found on the dean's span of control. The second factor, bureaucratic control, has positive loadings on four variables traditionally associated with bureaucracy. These include two formalization scales, and two measures of hierarchically centralized decision-making. The third factor, non-workflow proportion, shows high loadings on several configuration measures.

The first factor corresponds to the collegial and the second to the bureaucratic model of university organizations while the third factor has a residual character. Therefore, standardized factor scores for the factors *academic control* and *bureaucratic control* are used as indicators of organizational structure in this study. Departments with high scores on the academic control factor are highly specialized and emphasize both self-coordination and coordination through the dean's office. Departments with high scores on the bureaucratic control factor are subject to hierarchically centralized decision-making, and emphasize formalized administrative controls.

A department's emphasis on academic control may reduce its capacity to perform research. For example, the committee work needed to cope with the coordination problems of a complex department reduces the time that faculty members can spend on research. This may lead to lower research standards and less support for the development of research capacities in junior colleagues. Therefore, it is hypothesized that academic control is negatively related to book publications, article publications, and the habilitation-index (see Table 1). In contrast, a positive relationship is predicted between academic control and the sabbatical-index, as faculty members use sabbatical semesters to escape obligations to support self-coordination efforts, and instead concentrate on neglected research projects.

Academic control probably has a mixed effect on teaching effectiveness. On the one hand, high levels of internal differentiation and self-coordination are likely to increase a department's capacity to provide advanced education. This suggests positive relationships between academic control and the variables 'dissertation-index' and 'graduate-faculty ratio'. On the other hand, more academic control may reduce processing efficiency by allowing differences of

opinion to be raised and discussed by both faculty and students. This may result in more mandatory courses and longer study periods. Thus, positive relationships between academic control and the graduation period variables are expected.

Bureaucratic structures in universities have been criticized for creating a poor learning environment (Goodman 1962; Stroup 1966). Blau (1973) showed that bureaucratic features increased drop-out rates and discouraged students from enrolling in graduate programmes. It is expected that bureaucratic controls reduce departmental capacities to provide advanced education as indicated by the dissertation-index and the graduate-faculty ratio. However, bureaucracy may impose efficiency. Thus, the graduation period measures are predicted to be negatively related to bureaucratic control. Because research activities are usually separated from an institution's administrative bureaucracy (Blau 1973), no relationships are hypothesized between bureaucratic control and the research effectiveness measures (see Table 1).

Sample and Instrumentation

The data was collected from a random sample of 35 West German university departments from 21 universities during the winter-semester 1977/78 (Bresser 1979). The sample was stratified by scientific discipline to account for different levels of paradigm development. It includes 18 departments from two social sciences (law and business administration) and 17 departments from two physical sciences (physics and chemistry). Departmental chairpersons (called deans in the German system) and chief administrators were interviewed on the basis of two standardized questionnaires. Documents and records were acquired to verify the interview data.

Analysis

The t-test is used to test the significance of differences between sample means, and product-moment and partial correlations are used to analyze variable interrelationships. Hierarchical multiple regression analysis and F-tests serve to evaluate the relative predictive power of each predictor variable.

Results

Table 3 shows measures of central tendency and dispersion for the effectiveness variables. A comparison of means for the two subgroups of social and physical science departments indicates significant differences between fields for three research effectiveness variables. Faculty members in social science departments publish more books and fewer articles than those in

physical science departments. They also take more sabbatical leaves than physical scientists.

Comparable differences exist for three indicators of teaching effectiveness. Physical science departments turn out relatively more Ph.D. graduates than social science departments. The social science departments' faculties produce more graduates with master's degrees. Physical science students need more semesters to graduate than social science students.

These results provide support for six relationships predicted between the effectiveness variables and the level of paradigm development. Although the hypothesized differences for the habilitation-index and the surplus semesters are in the expected direction, they are not significant.

Table 4 gives the correlations between the effectiveness variables and the dimensions of context and structure. The results for the total sample show six significant correlations between paradigm development and the effectiveness variables which reflect the differences across fields discussed above. Many of the other significant correlations in the total sample are likely to be mediated by the level of paradigm development because, although not shown in Table 4, similar paradigmatic differences exist for the developed contextual and structural dimensions. For instance, social science departments tend to have higher student emphasis ($p < .001$), lower resource availability ($p < .09$), lower bureaucratic control ($p < .12$), but higher academic control ($p < .12$) scores than the physical science departments (Bresser 1984). These paradigmatic differences suggest that the significance of correlations in the total sample may be spurious and, therefore, any assessment of pairwise relationships between context, structure and effectiveness should be performed separately for the two subgroups of departments. This need to analyze by discipline is apparent in Table 4 where many subgroup correlations deviate from the total sample results.

Within social science departments, article publications, the dissertation-index, and average semesters are virtually unrelated to any aspect of context or structure. Bureaucratic control has a positive relationship with book publications, which was not anticipated (see Table 1). In line with predictions, size (reflected in student emphasis, and, especially, in resource availability) increases the sabbatical-index. Deviating from expectations, the departmental capacity to see junior faculty through to an habilitation suffers as a department has more resource availability. Consistent with expectations, this capacity also suffers as a department emphasizes academic controls. Bureaucratic control is positively related to the habilitation-index. Since the habilitation is a standardized procedure certifying research competence, a positive association with the use of bureaucratic procedures is plausible but not expected.

In accord with our hypotheses, large size, especially as it is reflected in a strong student emphasis, is positively related ($r = .59$) to a social science department's capacity to graduate students with master's degrees. However, graduation may take longer than expected as student emphasis is also associated with surplus semesters ($r = .70$). While increased graduation capacities seem desirable,

Table 3 Means and Standard Deviations of Effectiveness Variables for Groups of Departments

Variables	Total Sample		Social Science Departments		Physical Science Departments	
	Means	Standard Deviations	Means	Standard Deviations	Means	Standard Deviations
1 Book publications (30, 17, 13)[a]	3.03	1.47	3.71***	1.61	2.15***	0.52
2 Article publications (30, 17, 13)	20.39	12.70	14.32**	7.43	28.33**	13.99
3 Sabbatical index (35, 18, 17)	0.059	0.046	0.087***	0.045	0.030***	0.024
4 Habilitation index (35, 18, 17)	0.120	0.097	0.110	0.090	0.131	0.106
5 Dissertation index (30, 16, 14)	0.337	0.287	0.115***	0.033	0.589***	0.231
6 Graduate-faculty ratio (33, 16, 17)	1.98	1.84	3.37***	1.76	0.67***	0.28
7 Average semesters of study (34, 17, 17)	11.27	1.48	10.59**	0.97	11.95**	1.62
8 Surplus semesters of study (34, 17, 17)	2.54	1.24	2.83	0.94	2.24	1.46

[a] The numbers in parenthesis below the variable names indicate the sample size for the total sample and the two subgroups of departments. For some variables, the sample size of 35 (total sample), 18 (social sciences), and 17 (physical sciences) is reduced due to missing values.

***, ** Differences between social and physical science departments are significant at the .001, .01 level (two-tailed tests).

Table 4 Correlations Between Predictor and Effectiveness Variables

	Book Publications (30, 17, 13)[a]	Article Publications (30, 17, 13)	Sabbatical Index (35, 18, 17)	Habilitation Index (35, 18, 17)	Dissertation Index (30, 16, 14)	Graduate-Fac.Ratio (33, 16, 17)	Average Semesters (34, 17, 17)	Surplus Semesters (34, 17 17)
				Total Sample				
Paradigm development†	−.53*	.56*	−.63*	.11	.84*	−.75*	.46*	−.24
Student emphasis	.49*	−.36*	.62*	−.16	−.73*	.81*	−.30*	.40*
Resource availability	−.04	−.18	−.01	−.43*	.36*	−.07	.54*	.52*
Academic control	.15	−.36*	.27	−.46*	−.19	.32*	.14	.48*
Bureaucratic control	.20	.11	−.12	.31*	.14	−.20	.30*	−.10
				Social Science Departments				
Student emphasis	.11	.19	.36	−.24	.08	.59*	.07	.70*
Resource availability	.08	−.03	.44*	−.51*	−.32	.31	.05	.36
Academic control	−.14	−.11	.28	−.57*	−.15	.21	.07	.26
Bureaucratic control	.52*	.04	.06	.51*	.13	−.07	−.15	−.34
				Physical Science Departments				
Student emphasis	.41	.15	−.11	.12	−.44*	−.11	.26	−.01
Resource availability	.16	−.57*	−.11	−.47*	.15	.24	.75*	.79*
Academic control	.38	−.33	−.28	−.33	.16	.07	.60*	.65*
Bureaucratic control	.62*	−.15	.07	.12	−.07	−.24	.41*	.12

[a] See Table 3

* Significant at $p \leq .05$

† Paradigm development is scored as a dummy variable with scores of 1 for physical science departments and scores of 0 for social science departments

their value in the present context may be questionable. For example, to cope with large student numbers and also to reduce surplus semesters, social science departments may lower graduation standards. This increases the graduate-faculty ratios but at the expense of educational quality (Heydebrand 1983). More evidence is needed before a positive relationship between student emphasis and the graduate-faculty ratio can be interpreted as desirable.

Within physical science departments, the sabbatical-index and the graduate-faculty ratio show no significant relationships with any dimension of context or structure. Similar to the social sciences and equally unexpectedly, bureaucratic control is positively correlated with book publications. In contrast to our predictions, resource availability is associated with fewer article publications ($r = -.57$). When the variables constituting the student emphasis factor are examined, it becomes apparent that the number of students ($r = -.52$), the student-faculty ratio ($r = -.72$), and the percentage of non-lecture courses ($r = -.67$) are also significantly and negatively correlated with article publications. These relationships are concealed in Table 4, where the correlation between the student emphasis factor and article publications is insignificant ($r = .15$). This suggests that size, whether measured in terms of student enrolment or resource availability, lowers the standards for article publications which physical science departments adopt when recruiting faculty members.

As in the social science departments, so too in the physical sciences, the habilitation-index is unexpectedly negatively correlated with resource availability. These unexpected results may reflect a peculiarity of the German university system during the 1970s. After the rapid expansion, many doctoral graduates decided to pursue a university career even as the available new faculty positions decreased because of governmental cutbacks (Bresser 1982; Dallinger et al. 1978). As resource availability was reduced, more doctoral graduates may have decided that to continue their university careers, they needed to acquire additional qualifications by completing an habilitation.

In line with expectations, student-emphasis is negatively correlated with the dissertation-index in the physical sciences. Also, resource availability is associated with longer study times as measured by average semesters and surplus semesters ($r = .75, .79$). Although Table 4 shows insignificant correlations between the student emphasis factor and average and surplus semesters, this is misleading. Three variables constituting the student emphasis factor (number of students, student-faculty ratio, percentage of non-lecture courses) also have significant positive relationships with average and surplus semesters. Consequently, it seems to be the size of the department which generates the longer graduation periods for physical science students. The positive correlations between the academic control factor and the two graduation period measures provide further support for this interpretation because the measures of specialization load highly on the academic control factor and are correlated with size. In contrast to our predictions, more bureaucratic physical science departments have more average semesters.

Resource availability and the structural variables are related to the

habilitation-index in the social sciences, and (with one exception) to average and surplus semesters in the physical sciences. Since resource availability also tends to be positively associated with academic and bureaucratic control, it may act as a mediating variable on structure-effectiveness correlations. To explore this, partial correlation coefficients are calculated controlling for resource availability. In the social sciences, the partial correlation between academic control and the habilitation-index becomes insignificant, whereas the partial correlation coefficient between bureaucratic control and the habilitation-index ($r = .58$) remains significant ($p < .01$). In the physical sciences, the partial coefficients between the structural variables and average and surplus semesters are all insignificant.

These results suggest that the contextual dimensions may be better predictors of effectiveness than the structural dimensions. After separating out the effects of resource availability, academic control is not related to effectiveness in either subgroup; for bureaucratic control there are three significant correlations. In contrast, the contextual dimensions show nine significant correlations with effectiveness variables: three for student emphasis and six for resource availability.

The hypothesized relationships between pairs of variables required an examination of correlation coefficients in the two subgroups to control for the mediating effects of paradigm development. While this approach provided a detailed account of variable interrelationships, it does not consider the relative importance of the independent variables in explaining effectiveness. To evaluate the relative predictive power of all the independent variables, including paradigm development, hierarchical multiple regressions are calculated for the total sample (Table 5).

The predictor variables enter the multiple regression equations in the following order: paradigm development is entered first because this contextual dimension has been hypothesized to influence other aspects of an organization's context as well as organizational structures (Bresser 1984; Lodahl and Gordon 1973a, 1973b). Student emphasis and resource availability are entered in step two and three because they represent aspects of the context within which structures develop (Child 1975; Pugh et al. 1969). Academic control is entered in step four, assuming that it is a more important control mode in academic institutions than bureaucratic control (Bresser 1984). Finally, bureaucratic control is included in step five.

The regression results (Table 5) confirm the importance of the level of paradigm development in predicting effectiveness. Differences across fields as indicated by the level of paradigm development account for the most variance in six regression equations; the direction of each relationship can be ascertained from the sign of the appropriate zero-order correlation for the total sample shown in Table 4. Resource availability explains the most variance for the remaining two criteria, negatively affecting the habilitation-index, and positively affecting surplus semesters. In addition, student emphasis has a positive effect on surplus semesters. Resource availability has a negative effect

Table 5 Hierarchical Multiple Regression of Contextual and Structural Variables on Effectiveness Criteria

	Book Publications			Article Publications			Sabbatical Index			Habilitation Index		
	R^2	ΔR^2	F	R^2	ΔR^2	F	R^2	ΔR^2	F	R^2	ΔR^2	F
Paradigm development	.283	.283	12.11**	.309	.309	15.41**	.393	.393	21.06***	.012	.012	.59
Student emphasis	.298	.015	.64	.323	.014	.71	.438	.045	2.45	.025	.013	.60
Resource availability	.304	.006	.28	.504	.181	9.02**	.451	.013	.66	.251	.226	10.77**
Academic control	.332	.028	1.18	.517	.013	.63	.459	.008	.45	.258	.007	.33
Bureaucratic control	.440	.108	4.61*	.519	.002	.09	.459	.000	.01	.391	.133	6.35*
	Dissertation Index			Graduate Faculty Ratio			Average Semesters			Surplus Semesters		
	R^2	ΔR^2	F	R^2	ΔR^2	F	R^2	ΔR^2	F	R^2	ΔR^2	F
Paradigm development	.702	.702	75.70***	.558	.558	48.20***	.215	.215	10.64**	.057	.057	3.14
Student emphasis	.717	.015	1.60	.686	.128	11.08**	.224	.009	.41	.167	.110	6.08*
Resource availability	.750	.033	3.65	.687	.001	.02	.404	.180	8.93**	.448	.281	15.46**
Academic control	.761	.011	1.20	.687	.000	.02	.422	.018	.90	.469	.021	1.13
Bureaucratic control	.777	.016	1.74	.687	.000	.02	.433	.011	.55	.491	.022	1.24

*$p < .05$, **$p < .01$, ***$p < .001$

on article publications, whereas paradigm development has a positive effect. Further, resource availability like paradigm development, has a positive effect on average study semesters. Student emphasis has a positive effect on the graduate-faculty ratio, while paradigm development has a negative one. After paradigm development and the two other contextual dimensions are entered into the equations, the remaining variables are only of secondary importance. In no case does academic control explain a significant amount of variance. Bureaucratic control has positive effects on book publications and the habilitation-index.

Consistent with the correlational analyses, the regression results suggest that contextual variables (paradigm development, resource availability, and student emphasis) are more powerful predictors of effectiveness than structural variables. This order of importance remains confirmed when the order of inclusion into the regression equations is reversed. When bureaucratic control and academic control enter before resource availability, student emphasis, and paradigm development, the three contextual variables still account for significant amounts of variances in twelve cases, and a contextual variable explains the most variance in six instances. The structural variables explain significant amounts of variance in only six cases, and the largest amount of variance is explained by a structural indicator for only two criteria.

Discussion and Conclusion

This exploratory study relates Aston concepts of context and structure (Pugh et al. 1968, 1969) to the effectiveness of university departments in West Germany. The results confirm the usefulness of the Aston programme, when appropriately modified, to explore effectiveness contingencies for particular organizational types. An implication may be that rather than seeking generalizations broadly applicable to many organizations, structural contingency theories might contribute more by refining theories to make them relevant for different organizational types (Blackburn 1982). Such an approach may allow effectiveness issues in particular types of organizations to be better understood and may provide findings with potential relevance for specific organizational designs.

In this study, eight effectiveness measures assess the formal capacities of university departments to perform research and to educate students. The particular criteria chosen reflect the German university reform debate of the 1960s and 1970s. The contextual contingencies considered comprise three dimensions: (1) the level of *paradigm development* which accounts for differences across scientific fields represented by different university departments; (2) the pervasiveness of the teaching function represented by a dimension labelled *student emphasis*; and (3) the relative wealth of a department in terms of personnel and finances, a dimension called *resource availability*. The structural contingencies include *academic control* and

bureaucratic control, two previously developed dimensions (Bresser 1984) which reflect respectively the collegial and bureaucratic features of university organizations (Becker and Gordon 1966).

The findings emphasize the importance of paradigm development for studies focussing on the functioning of university departments. Different levels of consensus with respect to research and teaching issues which distinguish researchers from high and low paradigm fields have been shown to lead to dissimilar attitudes and activities within departments representing different fields (Lodahl and Gordon 1972). The level of paradigm development has also helped explain differences in the organizational contexts and the structures of university departments (Bresser 1984; Lodahl and Gordon 1973a, 1973b). The results of this study indicate that the level of paradigm development also may explain differences associated with measurements of effectiveness. Specifically, significant differences across fields could be explained by the paradigm concept for six effectiveness criteria.

The differences between the social and physical science departments investigated can be summarized as follows: Social science departments tend to score high on book publications, sabbaticals, and graduate-faculty ratios, and low on article publications, dissertations, and average numbers of study semesters. In addition, resource availability is relatively limited, and the emphasis on educating large numbers of students is high. Social science departments also tend to prefer academic controls to bureaucratic controls (Bresser 1984). The characteristics of the physical science departments mirror the social science departments. Physical science departments score high on article publications, dissertations, and average numbers of study semesters. They score low on book publications, sabbaticals, and graduate-faculty ratios. In addition, they enjoy more favourable contextual conditions including relatively more resource availability and relatively fewer demands associated with educating students. They tend to emphasize bureaucratic controls while deemphasizing academic controls.

This study further suggests that, when investigating university departments, the Aston concepts of context can be reduced to two major dimensions. The student emphasis dimension identifies the (relatively unfavourable) contextual conditions which prevail when large numbers of students have to be educated. The resource availability dimension represents the (relatively favourable) conditions which exist when a department is well endowed with resources. These two dimensions which characterize German university departments may well be generalizable to university contexts in other cultures.

When comparing the effectiveness correlates for the groups of social and physical science departments, it is apparent that the contextual and structural dimensions often relate to the effectiveness variables in different ways. In addition, several correlations deviate from the hypothesized pattern. These results emphasize once again that the level of paradigm development may play an important mediating role influencing relationships between context, structure, and effectiveness in ways that are not well understood and not easily

derived from current organization theories. However, there are some noteworthy patterns that may stimulate further research. For example, the results show that as disciplines emphasize particular effectiveness criteria, e.g. physical science departments emphasize article publications, more significant relationships are found between contextual or structural variables and these emphasized criteria. Thus, a strategy for future research might focus first on identifying those effectiveness criteria that are most salient for particular disciplines. The next step would be to consider the contextual and structural contingencies that might affect these important criteria.

A further consistent finding is that regardless of scientific discipline, departmental capacities to perform research or to process students seem to suffer as departmental size increases as measured by either student emphasis or resource availability. For example, there are negative correlations between the habilitation-index and resource availability, and positive correlations between surplus semesters and both resource availability and student emphasis. The only potentially desirable relationships exist for the social sciences where student emphasis and resource availability are positively correlated with the sabbatical-index and the graduate-faculty ratio. Nonetheless, it was explained that these relationships could indicate a response to the problems raised by large student numbers which ignores issues associated with educational quality (Heydebrand 1983).

Another similarity across disciplines is the lack of relationship between structure and effectiveness. After calculating partial coefficients, academic control has no significant correlations with effectiveness variables in either subgroup. Bureaucratic control has no significant relationships with teaching effectiveness variables where negative relationships were expected, but has three unexpected positive relationships with two research effectiveness variables. These relationships suggest that bureaucratic controls may function in some unanticipated ways in university organizations. In contrast, there is a relatively large number of significant correlations between the two contextual dimensions and the effectiveness indicators. The relative importance of the contextual variables is also supported by the regression results. Paradigm development, resource availability, and student emphasis are more powerful predictors of effectiveness than the two structural variables.

How can this order of predictive importance be explained? It could be that for this particular type of organization, contextual conditions are more important determinants of effectiveness than internal structures. Within the public German university system, many contextual elements characterizing a university department (e.g. student enrolment, size of personnel, financial resources) are determined by outside authorities such as government agencies (Bresser 1984), and these decisions clearly influence the capacities and activities of university departments. In contrast, academic or bureaucratic features of a department's formal structures may have only negligible effects on capacities and effectiveness, especially since many teaching and research activities are carried out individually with little central coordination.

Although these findings are preliminary, based on cross-sectional data, and a small sample size, they provoke some speculations concerning possible programmes to reform universities. In Germany, most of the reforms during the 1970s involved changes of university structures. For example, new university laws prescribed democratically structured self-governing boards and redefined many university roles (Dallinger et al. 1978). The findings of this study suggest that this emphasis on structure may not have been a particularly optimal reform strategy for improving university capacities. Instead, they indicate that it might have been more important to change the contexts of university departments, since contextual variables are more strongly related to effectiveness than structural variables.

Hence, the results have implications for university reformers planning future experiments. For example, increased departmental size, whether derived from student emphasis or resource availability, and regardless of discipline, often has unfavourable consequences for effectiveness criteria. Therefore, in general, if the purpose is to improve capacities, it may be worthwhile for reform efforts to keep new departments relatively small, or to break up large departments into smaller units. In addition, future experiments will have to consider the extent to which university reforms should take account of disciplinary differences.

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