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# Economies of atmosphere : the joint impact of scale, scope, and atmosphere on scientific performance in clinical medicine and economics

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# Economies of Atmosphere

# Economies of Atmosphere

The Joint Impact of Scale, Scope, and Atmosphere on Scientific Performance in Clinical Medicine and Economics

## Proefschrift

ter verkrijging van de graad van doctor aan de
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Prof. Dr. J.H.R. van de Poel

Dedicated to my parents
and Greta

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# Preface

"We are not ready to suspect any person of being defective in selfishness" (Adam Smith)

The neoclassical paradigm is a utilitarian and rationalist paradigm. It conceives economic agents as seeking to maximize their utility, and to choose rationally the best means to attain their goals. Recently, these assumptions have been put somewhat in perspective. First of all, there is an increasing body of literature in economics and game theory on altruistic behavior and cooperative strategies in zero-sum game situations showing that agents do not always act selfishly in a narrow sense - certainly not when the time horizon of the parties is extended. The benevolent butcher may abstain from short-weighing; the producer may advertise his products truthfully when he need not; the agent does not cheat even though it may be 'rational economic behavior' to do so; some people care about future generations; some support development aid - not primarily to elicit reciprocal gifts nor adjusted in terms of 'marginal utilities to the recipient'.

In addition, the growing literature on human information processing and prospect theory shows that agents - although their behavior may be purposive - typically do not always take deliberate (or rational) decisions. They do not fasten their seat belts; they continue to smoke twenty years after the Surgeon General's report; they pay stock brokers for costly consultancy although the time series behavior of stock prices in the Dow Jones Index resembles a random walk. Of course, search costs have to be taken in account when the decision is made under budget and time constraints - which is typically the case. Anyone who tries to make fully-informed rational choices would make only a handful of decisions each week, leaving hundreds of important matters unattended. In accounting for search costs and the scarcity of information processing capacity, we rely partially on habits, operational routines, and rules of thumb which consist of fixed rather than flexible, rational responses. As a result, most consumers shop at the same supermarket, even though some other market will have lower prices for some products. We are aware that many of our decisions will be inferior to those a fully informed rational agent would have made. And yet we have no better alternative. Given scarce cognitive resources (and scarce energy and time), to rely, partially, on rules of thumb and other non-choice decision rules may be fully rational.

Some of these non deliberate decision rules are provided to individuals by their culture which affects their mental program and behavior - both at the national and the organizational level. Culture, or as we prefer to call it 'atmosphere', is not the aggregation of individual decisions, but a common value and information system. This, however, does not imply that methodological individualism is not applicable to atmosphere. This investigation focuses on the economies and diseconomies of atmosphere, i.e. the profitable and harmful effect of atmosphere, especially at the level of the firm. The theoretical Section of this study, Section I, is concerned with the economic rationale of atmosphere. As a result, the question is not only whether atmosphere can affect costs and performance, but also why certain aspects of atmosphere would increase or decrease economic efficiency. Definitions of atmosphere and technical efficiency will be given in the first chapter of this book.

The world of deductive reasoning and the empirical world are separated. Consequently, when it can be demonstrated that there is an economic rationale for atmosphere, this does not necessarily imply that there is also empirical evidence for economies of atmosphere. The empirical Sections of this volume (including Methodology and Design, Section II, and, Empirical Studies, Section III) are concerned with demonstrating empirical evidence for the socalled efficient culture hypothesis, i.e. the assumption that economies of atmosphere prevail in certain structures. Since it would be naïve to think that atmosphere is the only facilitator of an organization's efficiency, the economies caused by atmosphere are compared with economies of scale and economies of scope. A special organizational structure has been selected to test the efficient culture hypotheses, i.e. the university research unit. Working within the internal environment of a professional bureaucracy, the university research unit is characterized by a multi-utility function (research, patient care, education), high task uncertainty, decentralization, and mutual monitoring. This is the environment where the central coordinating mechanism is assumed to be atmosphere rather than (bureaucratic) rules or (market) prices. Although the university research unit has primarily been selected for pragmatic reasons, it fits perfectly in the design of the empirical studies which have been conducted within the framework of this study.

Potential readers of this study are confronted by an information choice problem. They know the book contains information but in deciding whether to invest real resources in reading it (i.e. the opportunity cost of the reader's time and possibly the purchase price), they need to know whether the benefits to be derived from the content are likely to exceed the expected costs. As for the opportunity costs of your time, I have tried to present a rich, yet parsimonious, treatment of each topic.

On the benefits side, there are several reasons why the following chapters may be worthy of attention. First of all, the economics of atmosphere is one of the few joint ventures of economics and organizational science, because it deals with the impact of non-economic factors like values and information on economic efficiency. Neoclassical economists, like French chefs with regard to food, have developed stylized models whose ingredients are limited. Just as traditional French cooking does not use seaweed or raw fish, so neoclassical models do not make assumptions derived from neighbouring disciplines. Following George Akerlof, this study disagrees with the rules that limit the nature of the ingredients in economic theory. Since the purpose of scientific theory is to predict and to explain, we believe that it may be fruitful to sacrifice predictive efficiency to a limited extent in order to explain more of the variance of the economic behavior under study, while avoiding overdetermination.

As the saying goes, half a loaf is better than none. Organizational economics has, in general, more explanatory power than other organizational sciences. Organizational theory, for example, excels in descriptive analyses. Subtle as they may be, they are not particularly helpful in understanding economic phenomena, because of a lack of explanatory theory. In addition, the field of organizational behavior is well equipped for establishing validity, but it tends to emphasize measurement rather than theory, so that is not very helpful in understanding performance behavior either. Despite these criticisms, all the above mentioned approaches have appeared to be very useful when brought into action selectively. It is nearly impossible to explore the costs, benefits, and limits of atmosphere, even in a relatively preformal way, without consulting economic theory (chapter 2 and 3). In addition, organizational theory has been very useful in providing a descriptive typology to partition a sample for empirical research (chapter 4). The field of organizational behavior, finally, has been extremely helpful in providing valid measurement instruments to assess atmosphere and scientific performance (chapter 4 and 5).

Second, this is one of the first empirical attempts to compare competitive advantages in the scientific enterprise (Section III). Since the inputs and outputs of university research units can - in principle - be measured, they can be held accountable for the degree to which efficiency is attained. Three sources of efficiency are distinguished in the literature: economies of scale, economies of scope, and economies of atmosphere. As often, the starting point of the study was rather practical. In 1986, the Ministry of Education and Science of the Netherlands commissioned an interdisciplinary team, composed of Bally, Spangenberg, and Starmans, to conduct an investigation into the factors facilitating and inhibiting scientific productivity in Dutch clinical medicine (study I). The central hypothesis of the team was that performance differences between medical research units were related not only to medical inputs, but also to the research infrastructure of which atmosphere represents the informal side. The Ministry

had commissioned special audit panels to evaluate the scientific performance of Dutch medicine and economics. Without the large scale performance evaluations of the Raad voor Advies van het Wetenschapsbeleid (RAWB) and the Verkenningscommissie Economische Wetenschappen (VEW), the empirical studies presented here could not have been conducted.

In order to answer the question whether the findings of the study in clinical medicine (study I) can also be generalized to other disciplines, I conducted a follow-up study on scientific performance in economics in 1987 (study II). Consequently, the etiology of scientific performance in two unrelated scientific disciplines has become the central subject of the empirical part of this book (Section III). Since the main interest is in the determinants of scientific performance, the book does not end with a number of guidelines for improving university research performance in general, although some hints are given along the way. The principal aim of the research project described in Section II and III is the dissection of the network of predictor and criterion variables. Special attention will be given to methodological considerations into the etiology of competitive advantages within the scientific enterprise.

It is incumbent upon me to stress the indispensable role that many have played in the design, execution, and analysis of the present study. First of all, I am very grateful to my thesis advisors. Working with and being coached by Geert Hofstede and Hein Schreuder has been a great privilege. They provided a stimulating learning environment in which I could capture many economies of atmosphere. Without their constructive criticism and rigorous quality control, the present study, I am afraid, would be no more than a collection of poorly organized ideas and statistics.

I am also grateful to Yvonne Bally and Richard Starmans who requested me to join the team which was commissioned by the Ministry of Education and Science. Just as Cees van Dorp, who as a science policy maker has always been a loyal supporter of study I, they have contributed significantly to the present study. In addition, I would like to thank Frans Nijhuis (RL), Bert Breemhaar (IVA), and Arie van Heeringen (RAWB) who supported me in numerous respects, and provided me with many useful suggestions regarding the design and analysis of the data. The assistance of Ward Alfenaar (RL) was indispensable for the statistical analysis of the empirical data, while Mr. van Westen (Informatiebank, RAWB) provided me with indispensable literature on scientometrics and research policy. Of course, my primary tribute goes to the many anonymous scientists who participated in the present study. Without their voluntary cooperation there would have been no data at all to analyze.

Among my colleagues from the Faculty of Economics and Business Administration, I owe a special debt to Harry Juch who has always been an inspiring room mate (even when he deserted to become a management consultant). Furthermore, I would like to thank Maarten Vendrik, Harry Bierings, Geert Woltjer, George Hendrikse, Patrick van Cayseele, Arjen van Witteloostuijn, and Steven Maijoor for being stimulating intellectual sparring partners. Each of them has supplied me with relevant literature for this study. In addition, I owe thanks to Sjoerd Romme and Paul Kunst for their collegiality, and their consummate cooperation in a joint research project which was conducted in a variety of private and public sector organizations. I would also like to thank Mieke van Zutphen who has supplied our research unit with a pleasant atmosphere to work in. Finally, I am grateful to Bob Wilkinson for assistance with the English style. Of course, any remaining errors are entirely the author's responsibility.

Last but not least, I owe a great debt to the working discussions that I have had with Tom Allen and Ed Schein (Massachusetts Institute of Technology), Harry Triandis and Robert Bontempo (University of Illinois), Michael Bond and Kwok Leung (Chinese University of Hong Kong), Gordon Redding (City University of Hong Kong), George Akerlof (Berkeley University), Arjo Klamer (University of Iowa), Paul Adler (Stanford University), Jennifer Bond (National Science Foundation), Masahiro Harimoto (Kyoto University and London School of Economics), and Chen Long (Academica Sinica, Beijng). They have taught me that the game of science is, in principle, international.

Most of the time, writing this book has been an undivided pleasure. When it was not, I could always rely on the support of Greta Noordenbos. Offstage and without being aware of it, she has been the emotional co-author of this book. I would like to dedicate this book to her and to my parents. Without their lifelong support and stimulation, this book would never have been written.

# Introduction

Why are some organizations more efficient than others - even though they use the same production technology and operate under similar industry conditions? Which are the main internal sources of their technical efficiency? Is there an economic rationale for the efficiency function which has recently been attributed to atmosphere, and under which circumstances is it a liability rather than an asset? These are, in a very general sense, the main questions of the present study. Recently, a growing convergence between public and private sector organizations has been observable. On the one hand, it is increasingly recognized that public sector organizations are disciplined by the invisible hand, i.e. the competitive principles derived from the struggle for life at the market place. On the other hand, business enterprises are getting increasingly dependent on governmental regulation and jurisprudence. The present investigation reflects this convergence because the theoretical section of the study mainly focuses on firm behavior in a competitive environment, whereas the empirical section centers on performance differences in the public sector, i.e. university research units. The purpose of this introduction is to preview the main themes of the text and to explain the basic methodological approach.

This book is composed of three Sections. The first Section (chapters 1-3) deals with the costs, benefits, and limits of atmosphere. The second Section (chapters 4-5) focuses on a (descriptive) basis to partition a sample. In addition, it deals with the measurement of atmosphere and scientific performance, and the design of the study. In the third Section (chapter 6-7), results are reported of an empirical study on the determinants of scientific productivity in medicine and economics. The consistency of the results is examined in order to answer the question whether the findings can be generalized to other disciplines. Moreover, some research policy implications are discussed (chapter 8). Finally, the major strengths and shortcomings are discussed and suggestions for continued research are given (chapter 9).

**Section I: Theory**

**Chapter 1** - The first chapter provides a theoretical foundation for the investigation. In general, the criterion for organizing economic transactions is assumed to be cost minimization. After dealing with the newfound respect for corporate culture as an internal source of cost (in)efficiency, it is pointed out that many of the antecedents, mechanisms, and consequences of the cognitive and informal side of organization have already been discussed in the mainstream literature. Integrating the insights of various authors leads to a definition of atmosphere. Essentially, it is defined as a set of shared values, and as a common stock of knowledge. Furthermore, a definition is given of technical efficiency, including production and transaction costs, and the level of performance. The cost and benefits/harms associated with culture are defined as (dis)economies of atmosphere. After giving definitions and examples of economies an overall framework is presented.

**Chapter 2** - The main purpose of the second chapter is to review the implications of economies of atmosphere for our understanding of the national level, the between- and within-industry level, and the business group level. The review is guided by three research questions, i.e. (i) does atmosphere affect economic efficiency? (ii) If so, why should certain aspects of atmosphere increase or decrease economic efficiency? (iii) What are the costs of providing an (in)adequate atmosphere? These questions are also dealt with at the organizational level in the next chapter. They concern the benefits and costs of having an adequate atmosphere, and the economic rationale for the relationship between atmosphere and efficiency.

**Chapter 3** - The third chapter deals with economies of atmosphere at the organizational level. Three views of the firm are discussed: the microeconomic theory of the firm, organizational economics, and the information processing approach of the firm. (i) The microeconomic theory of the firm is a theory of the market rather than a theory of the firm. An intangible and internal resource such as atmosphere is not compatible with the theory of the firm. (ii) Organizational economics centers on the mutual gain from team production. An atmosphere of trust can be a solution to the assurance game in the team approach. Within agency theory atmosphere can be seen as a solution to a managerial problem - the difficulty of imagining all contingencies and specifying them in employment contracts. Although both agency theory and transaction cost economics deal with the complex equilibrium of contractual relations within the firm, only the latter discusses the antecedents and consequences of atmosphere in an explicit manner. The role of atmosphere is analyzed in the peer group and the internal labor market. (iii) While organizational economics focuses on values and information, the information processing approach deals with atmosphere as a common stock of knowledge, i.e. a code, knowledge of specific facts, and

behavioral rules. It shows why an efficiency function can be attributed to atmosphere in terms of an increase in cost efficiency of the firm's responses.

Section I investigates the economic rationale for the attribution of a transaction cost minimization function to atmosphere. However, the economic problem is saving on the sum of transaction and production costs. Consequently, production costs should be considered as well. Neoclassical economics has emphasized scale economics as a mechanism for decreasing production costs. Recently, it has been recognized that under certain conditions economies of scope may contribute to both production and transaction cost minimization. The final sections of chapter 3 define the alternative sources of efficiency in order to enable a systematic comparison between the sources of internal efficiency.

**Section II: Design and Measurement**

The theoretical Section has attempted to show that there is an economic rationale for the existence of atmosphere. The tough question is to find out whether there is empirical support for this proposition. In order to test the hypothesis that amosphere affects internal efficiency, it is necessary to: (i) select organizational units where economies of atmosphere may reasonably be expected; (ii) select instruments for the measurement of atmosphere; (iii) select instruments for the measurement of efficiency; (iv) design controls for internal and external validity.

**Chapter 4** - Organizational theory provides a theoretical basis for partitioning the sample. Chapter 4 focuses on a typology which is based on transaction cost economics, i.e. Ouchi's distinction in markets, bureaucracies, and clans. Building on transaction cost economics, Ouchi has developed a typology which seeks to explain the cooperation between individuals who share partially congruent objectives. Ouchi conjectures that atmosphere is especially efficient in the clan organization. Consequently, his typology provides a useful theoretical basis for the empirical exploration of economies of atmosphere at the micro level.

Organizational behavior researchers have developed a strong measurement tradition. As a result, several instruments for the measurement of organizational climate and culture exist. Climate measures were designed by Litwin and Stringer, Schneider, and Andrews, while Hofstede and co-workers have constructed measures for general values at the national and organizational level. The construct validity of these measures is suggested by empirical studies relating values to performance. Chapter 4 discusses the background and the main dimensions of this measurement tradition. Furthermore, the instruments which will be used in the collection of data are discussed.

**Chapter 5** - A commission of the Netherlands Ministry of Education and Sciences offered the unique opportunity to study (economies of atmosphere in) medical research units of university hospitals. With a time-lag of one year, this study was replicated in departments of economics and business administration. The research performance of clinical medicine and economics has been the subject of national evaluation studies which combined various scientometric indicators and peer reviews. Despite imperfections in the performance measurement, these evaluations provided the best available empirical database for the classification of research units in high and low performers. The empirical studies emphasize a managerial approach to university research. Chapter 5 deals with this approach, and discusses some pros and cons of the qualitative and quantitative performance indicators mentioned above.

In order to check for internal validity, the research units have been matched with regard to their relative research performance within their discipline. In order to demonstrate external validity, the consistency of predictor-criterion relations in study I and II is examined. Chapter 5 discusses the design of these studies. Furthermore, hypotheses are formulated concerning the predictors of research performance. In addition to atmosphere, hypotheses are formulated concerning economies of scale, scope, atmosphere and various managerial factors. A Dutch-language questionnaire has been designed to measure these predictors in research units. The items of this questionnaire are included in Appendix 2.

Note that the empirical studies have focused on a restrictive range of the economies of atmosphere framework. Since measures were only available of general and specific values, no attention has been paid to atmosphere as a stock of common knowledge. Since the evaluation studies of medical and economics research performance have focused primarily on performance measurement, no data were available on costs - certainly not at the unit level. Consequently, the investigation of economies of atmosphere had to be restricted here to the relation between values and research performance in a university environment.

### Section III: Empirical Studies

Two empirical studies were conducted in a chronological order. In order to get an impression of incentives and constraints and the measurement of scientific performance, in-depth interviews were held with research managers in multinational firms, policy makers in governmental research institutes, and high performing research professors in university departments. Although the results of the interviews are not reported in the study, they substantially contributed to our tacit understanding of research management and performance evaluation in the private and public sector. The list of interviewed persons is given in Appendix 1. On the basis of the performance evaluation of the Raad voor Advies Wetenschapsbeleid (RAWB), study

I focuses on the incentives and constraints of scientific performance in clinical science in the Netherlands. The report of study I will be published by Research Policy (North-Holland). The extended version has already been published in the Science Policy Series of the Netherlands Ministry of Education and Science. On the basis of the performance evaluation of the Verkenningscommissie Economische Wetenschappen (VEW), study II centers on facilitating and inhibiting factors in Dutch economics. The reports of study II will be published by Scientometrics (Elsevier Science Publishers).

**Chapter 6** - Economies of atmosphere are explored in clinical departments of university hospitals. Additional hypotheses are tested concerning the competitive advantages of scale, management, control, and communication. Ideally, economies of scope would be investigated as well, but relevant data were not available in the RAWB report. The chapter starts with a discussion of the performance evaluation concerning clinical medicine. Then it focuses on the procedures concerning sampling, data collection, and data analysis - including the Fisher linear discriminant analysis. Finally, the univariate and multivariate results will be discussed, especially regarding the evidence for economies of atmosphere.

**Chapter 7** - This chapter makes an attempt to explain why performance records differ among departments of economics. It is assumed that, in principle, the same set of incentives and constraints influence research effectiveness as in clinical medicine. The findings of the VEW have been used for classifying research units into high and low performers. After collecting data on the organization of research units, univariate and multivariate statistics, including multiple regression analysis, have been applied to explore the research questions regarding competitive advantages in the scientific enterprise. To examine external validity, the findings are compared with large scale performance studies conducted in economics (USA and UK) and accounting (USA).

**Chapter 8** - The previous chapters have reported results concerning the determinants of scientific productivity in these disciplines. Chapter 8 summarizes the main results, and focus on their consistency. When consistency between the findings of study I and II can be observed, despite the considerable variation between the disciplines, this would give confidence in the external validity (generalizability) of the findings to other disciplines. Thus, the findings may give a quantitative basis for quality control in science. After examining the consistency of the findings, a review is given of the strengths and weaknesses of the studies presented here. The main finding is that economies of scale, scope, and atmosphere can be captured by university research units. Scale especially, is an important condition for high performance, although scope and atmosphere may contribute as well when a unit is operating with sufficient critical mass. In addition, the results confirm the importance of recent policy measures, i.e.

decentralization of university research management, and internationalization of Dutch university science.

**Chapter 9** - The final chapter will summarize and discuss some of the main findings of the study against the background of the available data on economies of atmosphere. Then the main strengths and shortcomings of the research project will be discussed. Finally, surggestions are given for continued research. The main conclusions of the investigation are the following: (i) from an empirical perspective, economies of atmosphere have less impact than is generally believed - although there is certainly an economic rationale for the existence of atmosphere from an analytical point of view; (ii) it is the dynamic interplay between atmosphere and other sources of efficiency rather than atmosphere alone which accounts for the variance in technical efficiency between organizations; (iii) economies of scale tend to be more important than economies of atmosphere. Units working without sufficient 'critical mass' may not be able to compensate their scale disadvantage by developing a superior atmosphere.

# SECTION 1. THEORY

# 1

# The Economies of Atmosphere Framework

"A concern for atmosphere evidently makes the supply of a satisfying exchange relation part of the economic problem" (Williamson)

## 1.1. Introduction

This chapter provides a theoretical foundation for the book. After dealing with the recent rediscovery of corporate culture, it is pointed out that many of the antecendents, mechanisms, and consequences of the cognitive and informal side of organization have already been discussed in the mainstream of the organizational theory literature. In contrast to this literature, this book focuses on the economic rather than on the social or psychological consequences of culture. The main research questions of the theoretical part concern the benefits and costs of having an adequate culture, and the economic rationale for informal organization. Combining the insights of various authors yields a definition of culture. Furthermore, a definition is given of economic efficiency including production and transaction costs, and the level of performance. The cost and production advantages associated with culture are defined as economies of atmosphere. Examples and definitions are given of economies and diseconomies of atmosphere. Finally, the economies of atmosphere framework is presented.

While chapters 1-3 of this study deal with the full spectrum of interrelations between dimensions of atmosphere and economic efficiency, the remaining chapters will focus on a limited set, i.e. the relationship between values and performance only. By contrast with the formal modeling apparatus associated with much of the microeconomics literature, the economies of atmosphere framework is of a relatively preformal kind. Inasmuch as subsequent formalization of economies of atmosphere would be feasible, that condition is not necessarily grounds for objection, since the relevant reduced forms are unlikely to be discerned without first explaining the underlying microanalytics.

## 1.2. Rediscovery of Informal Organization

In 1977, a visit by two McKinsey consultants to the leading schools of business in the United States and Europe resulted in a statement which is still current today: "The state of the art is in refreshing disarray, but moving towards a new consensus; some few researchers continue to write about structure (...). But primarily the ferment is around another stream of thoughts that follows from some startling ideas about the limited capacity of decision makers to handle information and reach what we usually think of as rational decisions, and the even lesser likelihood that large collectives (i.e. organizations) will automatically execute the complex strategic design of the rationalists" (Peters and Waterman, 1982: 5).

By this innovative 'stream of thoughts' the authors referred to the literature on informal organization or 'culture', the key variable in their analysis of excellent Fortune 500 companies. Since their description of the consequences of culture in terms of the financial performance of large U.S. companies, many conferences, articles, books, and special issues of journals have proliferated on corporate culture (Administrative Science Quarterly, 1983; Organizational Dynamics, 1983; Frost et al. 1985; Killmann et al., 1985; Schein, 1985; Journal of Management Studies, 1986; Barney, 1986). From a theoretical point of view, the concept of 'corporate culture' appears to be very fruitful. Several scholars have investigated the relationship of culture to other organizational key variables including 'strategy' (Schwartz and Davis, 1981; Fombrun, 1984; Weick, 1985), 'control' (Ouchi, 1979 and 1980), and 'structure' (Wong and Birnbaum, 1988). The relationship with economic efficiency has been explored by Wilkins and Ouchi (1983), Kreps (1984), Crémer (1987), and Camerer and Vepsalainen (1988).

The new stream of thoughts affected not only mainstream management theory, but also common *business practice. Since the publication of Peters* and Waterman's bestseller "In Search of Excellence', managers have been increasingly interested in their company's culture, especially, of course, in its impact on productivity and product quality. In addition, culture is increasingly associated with the success and failure of new product innovations (Gupta et al., 1986), joint ventures, and vertical integrations. Having a 'strong' culture, however, is not necessarily an asset. Since 'it may take ages and cost fortunes' to change a culture (Deal and Kennedy, 1982), it may also be a liability. If the corporate culture is strong and myopic, it will contribute to failure rather than to success (Schein, 1984). Moreover, managers have learned, by trial and error, that corporate culture can be a serious constraint in the implementation of strategic decisions (Lorsch, 1985; Wilkins and Patterson, 1985), especially in the case of mergers and takeovers.

It is often assumed that 'corporate culture' is a new concept doomed to fade away like so many popular management subjects before (Hofstede, 1986: 257). "To name a few: Management By Objectives, the rage of the early fifties, was followed by the Total Marketing Concept, only to be superseded by Long Range Planning. In the early seventies, Strategic Planning emerged as the "Ultimate Answer". Then came Boston Consulting Group Matrices and Experience Curves" (Ansoff and Baker, 1986: 82). Corporate Culture is simply the latest. We believe, however, that culture or related concepts have always been part of the mainstream literature. After all, the antecedents, mechanisms, and consequences of the informal side of institutions have been extensively discussed in classics such as 'Theory of Moral Sentiments' (Smith, 1759), 'De la division du travail social' (Durkheim, 1893), 'Wirtschaft und Gesellschaft' (Weber, 1922), 'The Functions of the Executive' (Barnard, 1938), 'The Changing Culture of a Factory' (Jaques, 1951), 'Administrative Behavior' (Simon, 1954), 'Leadership in Administration' (Selznick, 1957), 'A Comparative Analysis of Complex Organizations' (Etzioni, 1961), and 'Standards for Morale. Cause and Effect in Hospitals' (Revans, 1964). Even though the term 'culture' has not been specifically used, the importance of 'mental programming' has been clearly understood in the organizational behavior literature on 'atmosphere' or 'climate' as well (Schneider, 1985; Glick, 1985). Frequently cited publications include 'Patterns of Aggressive Behavior in Experimentally Created Social Climates' (Lewin, et al., 1939), 'New Patterns of Management' (Likert, 1961), 'Motivation and Organizational Climate' (Litwin and Stringer, 1968), and 'Some Relationships between Job Satisfaction and Organizational Climate' (Schneider and Snyder, 1975).

Consistent with the observations of De Groot (1982) and Lammers (1986) that there is a widespread tendency in the social sciences to sell old wine in new bottles, organizational theorists are still creative in considering new names for culture in organizations. Ouchi (1980), for example, has reserved the name 'clan' for organizations with 'efficient cultures' (Wilkins and Ouchi, 1983), whereas Mintzberg (1983) has extended his well-known organizational 'pentagon' with a sixth configuration: the 'missionary' which is rather similar to Etzioni's 'normative organization' (1961). A more comprehensive review of some of these theoretical antecedents is given in Burrell and Morgan (1979). Their review is written in the spirit of Newton's remark: "If I have seen further it is by standing on the shoulders of giants" - expressing at once a sense of indebtedness to a common heritage, and a recognition of the essentially cooperative and selectively cumulative quality of scientific achievement (Merton, 1982).

### 1.3. Theoretical Research Questions

The emphasis of this book is on culture's consequences rather than on culture per se (cf. Frost, 1985). Moreover, the interest here is in the consequences rather than the antecedents (cf. Schein, 1983) of culture. Consequently, this study is not concerned with the conceivable effect of economic efficiency on culture. This, of course, does not mean that this influence is assumed to be absent. In contrast to the organizational behavior literature which generally deals with the impact of corporate culture on 'emotional well-being' (Ouchi and Johnson, 1978), 'motivation' (Litwin and Stringer, 1968) or 'job satisfaction' (Schneider and Snyder, 1975), the focus here is on the economic rather than the psychological consequences of culture. The research questions which will be explored in the theoretical part of this study, chapters 1-3, are the following (in order of importance):

1. Does culture affect economic efficiency?
2. If so, why should certain aspects of culture increase or decrease economic efficiency?
3. What are the costs of providing an (in)adequate culture?

The key variables of our investigation are 'culture' and 'economic efficiency'. In order to explore the above-mentioned questions in a straightforward manner, it is necessary to define these terms precisely.

### 1.4. Definition of culture

The first thing to be said about culture is that it does not exist. Lewin (1951) and Hofstede (1980) have rightly pointed out that like 'forces' in physics, 'culture' and 'atmosphere' are intangibles. The terms we use to describe them are constructs. A construct is "not directly accessible to observation but inferable from verbal statements and other behaviors and useful in predicting still other observable and measurable verbal and nonverbal behavior" (Levitin, 1973, quoted in Hofstede, 1980: 14). Like all scientific constructs (Lakatos, 1970), 'culture' does not exist in an absolute sense. Rather it is defined into existence for predictive reasons. In the next sections an attempt is made to define this very construct on the basis of the work of Hofstede, Crémer, Polanyi, and Boisot.

#### 1.4.1. Hofstede: Values

'Culture' has been defined in many ways. Let us adopt as a working definition that of Geert Hofstede: "the collective programming of the mind which distinguishes one category of people

from another" (Hofstede, 1980: 25). The key-words of his definition are: (i) collective, (ii) distinctive, (iii) mental programming.

(i) 'Collective' means that a group of people share a mental program
(ii) 'Distinctive' implies that the mental program is shared with some but not with all people.
(iii)'Mental programming' is a process leading to a specific end product, viz. a mental program.

While the first two are self-evident, the third poses a problem. What exactly can a 'mental program' mean? For Hofstede, the core construct for describing mental programs are values. A value is defined as "a broad tendency to prefer certain states of affair over others" (Hofstede, 1980: 19). This definition reserves the word 'value' for mental programs that are relatively unspecific. An example is 'uncertainty avoidance' - a complex of work-related factors found in Hofstede's (1980) IBM study. 'Uncertainty avoidance' can be activated in a variety of situations. For mental programs that are more specific, for example 'safety-orientation in industrial organizations' (Zohar, 1980) or 'customer service orientation in banks' (Schneider et al., 1980), the terms 'attitudes' and 'beliefs' are used. In general, it is assumed that values are at a deeper level than attitudes (Schein, 1985). As a consequence it is harder to change values than attitudes. Attitudes, on the other hand, are better predictor variables than values (despite their greater variability), because attitudes - especially the 'attitude toward the behavior in question' (Fishbein, 1980: 114) - are at a lower level of abstraction, i.e. more specific (Poole, 1985: 96). Instead of the words 'values' versus 'attitudes', the use of the words 'general values' versus 'specific values' is preferred here. In practice, the general values are often used as indices of national culture (e.g. Hofstede's (1980) dimension 'uncertainty avoidance') and organizational culture (e.g. Hofstede's and co-workers (1988) 'results versus process oriented' dimension), while both general values (e.g. Litwin and Stringer's (1968) dimension 'responsibility') and specific values (e.g. the UNESCO (Andrews, 1979) dimension 'research unit working climate') may refer to organizational climate. In general, the time horizon is long when it is a question of culture, and it is believed to be extremely hard to change - especially when deeper levels are affected (Hofstede et al., 1988). As Deal and Kennedy (1982) put it: it takes ages and costs fortunes. As a consequence, it is easier to reinforce the existing values by socialization of organizational members, while new values are more smoothly introduced by personnel selection (Soeters and Schreuder, 1988).

### 1.4.2. Crémer: Common Stock of Knowledge

Though salient, it may be argued that Hofstede's definition of culture as a mental program is not exhaustive. A complementary definition of culture has been given by Jacques Crémer (1987). He defines corporate culture as "the stock of knowledge that is common to the members of the firm

but not to the general population from which they are drawn" (Crémer, 1987: 11). Note that Crémer stresses two of the elements that are also included in Hofstede's definition: culture is (i) collective and (ii) distinctive. However, the focus of Crémer's paper is on culture as a set of knowledge, not at all as a set of values. His starting point is the description of the firm as an information processing apparatus that receives messages from its environment, processes them, and responds by a message or puts some of its physical resources into play (Galbraith, 1974). Within this framework, the acquisition of common knowledge is an investment, and Crémer explores the benefit from this investment. Crémer analyzes culture as a stock of knowledge by decomposing it in the following elements:

1. A common but distinctive language or 'code' (cf. Arrow, 1974a);
2. A common but distinctive knowledge of specific facts - which may be interpreted as a collective, cognitive 'specific skill' (cf. Becker, 1964; Doeringer and Priore, 1971);
3. A common but distinctive competence or adhesion to specific though simple 'rules of action' (Crémer, 1987) or 'routines' (cf. Nelson and Winter, 1982).

All these elements are closely linked to the literatures on 'economics of information' (Arrow, 1984, Galbraith, 1974), 'internal labor markets', (Doeringer and Piore, 1971), and 'organizational capital' (Prescott and Visscher, 1980). The economic literature may be considered as a valuable complement of the anthropological tradition to which Hofstede's work is referring. As a consequence, a mental program may be seen as a combined set of values, code, information, and competence. Values refer to (i) general values (values) and (ii) specific values (attitudes and beliefs). Code refers to the common language. Information refers to the knowledge of specific facts, and competence to the ability of organizational members to apply specific simple rules (routines). The test of the members' tacit knowledge of the written and unwritten rules of the firm is their ability to interpret them and use them in practice (Wittgenstein, 1978). One of the interesting conclusions of Crémer's paper is that adhesion to rules plays the same role as the knowledge of facts, since they jointly contribute to the cost efficiency of the firm's responses within the information processing approach.

### 1.4.3. Polanyi: Tacit Knowledge

An important shortcoming of Crémer's paper is that the author does not specify the nature of knowledge in his cognitive definition of organizational culture. Obviously, the knowledge embodied in the corporate culture of Shell or IBM is not the type of knowledge that can be found in well-known handbooks like Samuelson's 'Economics' (1980) or in the average how-to-do-it pocketbook. Rather it can be compared with the knowledge embodied in a scientific 'paradigm'. In his famous book on 'The Structure of Scientific Revolutions', Thomas Kuhn has written that the

existence of a paradigm "does not depend upon the formulation of rules and assumptions (...). Indeed, the existence of a paradigm need not even imply that any full set of rules exists" (Kuhn, 1970: 44). In addition, Kuhn refers to the late philosopher-scientist Michael Polanyi (1958) who developed a very similar theme, arguing that much of the scientist's success depends upon 'tacit knowledge'. Tacit knowledge is knowledge that is acquired through practice and that cannot be articulated explicitly.

Though Polanyi's treatment of tacit knowledge was meant to provide a useful perspective on the realm of scientific knowledge, economists have recognized the importance of the concept for the study of organizational competence and operational routines (Williamson, 1980; Nelson and Winter, 1982). In business it is a common situation where one is able to do something and at the same time to be unable to explain how it is done. Chester Barnard [1939], for example, observed numerous examples of tacit knowledge in managers who make competent judgments without evidence that they have been engaged in systematic reasoning, and without their being able to report the cognitive processes that took them to their solution.

An example which illustrates the importance of 'tacit knowledge' is given by Polanyi (1958: 52). "The attempt to analyse scientifically the established industrial arts has everywhere led to similar results. Indeed even in the modern industries the indefinable knowledge is still an essential part of technology. I have myself watched in Hungary a new, imported machine for blowing electric lamp bulbs, the exact counterpart of which was operating successfully in Germany, failing for a year to produce a single flawless bulb". Polanyi has shown that characterizing the firm exclusively in technological terms is a bankrupt idea. The productive wealth of the economy is not only embodied in factories and machines, but also in the tacit knowledge and skills stored in members of the firm. As a consequence, the team knowledge embodied in the corporate culture adds value to the capital assets.

That theme is carried forward in Polanyi's discussion of craftsmanship (tacit competence, skill or routine), especially idiosyncratic craftsmanship where individual skills are significant. Individual skills are hard to imitate because the set of rules determining skillful performance are often "not known as such to the person following them" (Polanyi, 1958: 49). According to Polanyi, an art which cannot be specified in detail cannot be transmitted by prescription. Tacit knowledge can only be transmitted by example from master to apprentice, in a learning-by-doing process. Obviously, this restricts the range of diffusion of tacit knowledge to that of personal contacts, and we find accordingly that craftsmanship tends to survive in closely circumscribed local traditions. It follows that an art which has fallen into disuse for the period of a generation is lost altogether. As Polanyi (1958: 53) has put it: "It is pathetic to watch the endless efforts - equipped with microscopy and chemistry, with mathematics and electronics - to reproduce a

single violin of the kind the half literate Stradivarius turned out as a matter of routine more than 200 years ago".

### 1.4.4. Boisot: Uncodified Information

In a recent paper, Max Boisot (1986) has used the concept of 'codification' of information for the analysis of the modern corporation. Although Boisot does not explicitly refer to Polanyi's work, his classification of corporate knowledge into operationally distinct levels is illuminating. Boisot distinguishes three levels of corporate knowledge:

"1. Uncodified knowledge which cannot be put down on paper and can therefore only be transmitted by force of example in face-to-face situations - i.e. the countless 'tricks of trade' available to skilled workers (...)
2. Semi-codified knowledge, part of which can be put down on paper, but which still needs face-to-face situations for its elaboration. It can only be fully transmitted and understood through personal interaction - i.e. the discussions that follow the presentation of a report to the board.
3. Codified knowledge that can be completely set out on paper and transmitted by impersonal means - i.e. company staff rules and regulations" (Boisot, 1986: 146).

In Boisot's terminology, Polanyi's tacit dimension can be conceived as uncodified knowledge, although some elements may be semi-codified or even codifed, e.g. the company philosophy or the statement of corporate objectives. Nelson and Winter (1982) have argued that the (complete) productive knowledge of a firm is unlikely to be codified in any useful way within the firm, and may not be known to any single member of the firm. A large amount of the firm-specific knowledge is learned by doing, and remembered by storage in the corporate culture, including the organizational production routines - the firm's memory. Several authors have noted that this lack of codified production knowledge not only makes outside imitation difficult, but may be a partial explanation for why some firms have difficulty in replicating their own successful plants (Teece, in: Yao, 1988: 67). Referring to causal ambiguity regarding the production process, Rumelt (1987: 146) writes: in the end, "competitors cannot extract the innovator's secrets because even the innovator does not know the causes of success".

To conclude, the knowledge embodied in a culture can be characterized as 'tacit' or 'uncodified' knowledge', while the routines embodied in that culture can be be characterized as a 'tacit competence'. One of the characteristics of tacit knowledge and tacit competence is that they impede their own diffusion (sometimes even within the firm), because they are so hard to imitate. Tacit knowledge and routines can only be learned by doing, in the appropriate face-to-face environment.

### 1.4.5. Definition of culture

Integrating the insights of Hofstede, Crémer, and Polanyi/Boisot, we may define culture as a distinctive mental program. It is common to the members of a group (collective), but not to the general population from which they are drawn (distinctive). The mental program consists of (i) (general and specific) values, (ii) more or less tacit forms of knowledge (the code and knowledge of facts), and (iii) competences (routines or simple rules). In general, the mental program has a tacit nature which refers to the fact that it is (hardly) uncodified. Consequently, it is difficult to imitate.

## 1.5. Definition of Economic Efficiency

Few concepts are more widely used within economics than that of 'efficiency'. It usually means 'not wasteful, or 'doing the best one can with available resources'. However, there are specialized usages, for example the concept of 'efficient markets' in the finance literature, or Leibenstein's (1980) concept of 'X-inefficiency' (New Palgrave, 1987). McGuire et al. (1988) distinguish between three aspects of economic efficiency which are, of course, not completely independent: (i) allocative efficiency, (ii) social efficiency and (iii) technical efficiency. Although reference will sometimes be made to aspects of allocative or 'Pareto efficiency' (it is not possible to make any individual better off without making some other individual worse off) which is a subset of social efficiency (maximize, given the budget constraint, the welfare of the population), this study will focus on technical efficiency.

A definition of technical efficiency may be found in Robert Anthony's lucid treatment of this subject. Anthony (1965) uses the term in a comparative (rather than in an absolute) sense as a criterion for judging the performance of a responsibility or input-output center. We do not ordinarily say that responsibility center X is 75% efficient, but rather that it is more (or less) efficient than center Y (level analysis), or that it is more (or less) efficient than it was in the past (trend analysis). Efficiency is the ratio of outputs (benefits) to inputs (costs), or the amount of output per unit of input. Center X is more efficient than Y either (i) if it uses fewer resources than Y but has the same output (find a minimal cost with the constraint that output is fixed), or (ii) if it uses the same resources as Y and has more output than Y (find a maximum output with the constraint that total cost is fixed). The next sections will center on the concepts of costs (expenditures, inputs) and performance (benefits, outputs).

### 1.5.1. Production and Transaction Costs

At the input-level, we distinguish between costs of production and transaction costs. The neoclassical theory of production begins with specific input information. Adam Smith argued that competition would tend to establish the 'natural prices' of commodities produced, i.e. the prices at which the 'the price of any commodity is neither more nor less than what is sufficient to pay the rent of land, the wages of labour, and the profit of stock employed ... according to their natural rates" (Smith, quoted in: New Palgrave, 1987: 698). Costs of production may be defined as the costs of using the factors of production: a certain amount of land, labor, capital, machines, and raw materials. Defined for a given state of technological knowledge, costs of production determine the production function - "the technical relationship telling the maximum amount of output capable of being produced by each and every set of specified inputs (or factors of production)" (Samuelson, 1980: 501). Like technological know-how, brand reputation, and marketing information, atmosphere is a non-physical resource (Itami, 1984). The cost advantages associated with the possession of these intangible resources will concern both production and transaction costs. Regarding production costs, it is not difficult to conceive that the more information available on optimal production processes, the less the waste of labor, materials and energy. Thus, the existence of reliable information is one of the conditions for effective production cost minimization. Concerning transaction costs minimization, it may be argued that the existence of common professional values of medical and nursing staff of an intensive care unit facilitates mutual adjustment and purposeful behavior. Consequently, the intensive care unit economizes on transaction costs such as the costs associated with coordination and control.

Like production costs, transaction costs are a catch-all term for a heterogeneous assortment of inputs. Transaction costs, however, do not comprise all costs not directly incurred in the physical process of production. They are the ex ante and ex post costs necessary to complete a transaction. The parties to a contract have to find each other, to communicate and to exchange information. The goods must be described, inspected, weighed and measured. Contracts are drawn up, lawyers may be consulted, title is transferred and records have to be kept. In some cases compliance needs to be enforced through legal action and breach of contract may lead to litigation (New Palgrave, 1987: 676). In sum, transaction costs may be viewed as a broad spectrum of institutional costs including those of information, negotiation, drawing up and enforcing contracts, delineating and policing property rights, monitoring performance, coordination, changing institutional arrangements, and excluding nonbuyers from the use of a product or service (New Palgrave, 1987: 56). Transaction costs are often cited as a basic cause for the nonexistence of markets in certain areas (Arrow, 1974a). Although it is highly plausible that economies of atmosphere affect transaction and production costs, the mainstream literature focuses on transaction costs rather than production costs when economies of atmosphere are concerned, while production costs

are emphasized when economies of scale and scope are considered. Except for the framework which will be presented in section 1.6.4., this book will not deviate from this custom - although it is realized that economizing on product expenses and transaction costs is not independent. Consequently, the emphasis of the theoretical part of this investigation is on transaction costs. Production costs will be dealt with in the sections on economies of scale and scope.

### 1.5.2. Level of Economic Performance

At the output-level, we emphasize the level of economic performance. Maximizing the level of economic performance for given inputs is consistent with the profit-maximization hypothesis which is part of the theoretical hard core of Adam Smith's and Alfred Marshall's classical model of the firm. Rumelt (1987) has argued that the appropriate profit concept is that of 'rent' once the source of high profits is located in the firm's resource portfolio rather than in its membership in an industry. Rumelt's rent-earning firm looks much like the successful enterprise of the competitive strategy literature, because it exhibits a high level of performance (profit, growth), and "at its core rest unique specialized resources that cannot be freely expanded or imitated" (1987: 143).

Profit-maximization has been put in perspective by the emergence of the management model of the firm (implying a separation between management and ownership) and the open model of the firm (implying a coalition of stockholders)(Schreuder, 1981: 7-48). An example of an alternative goal which can set by a firm is performance stabilization.

Performance stabilization, i.e. decreasing the variability of economic performance, reflects the risk attitude implying the separation of management from ownership. Alfred Chandler (1977) has pointed out that in making administrative decisions, managers preferred policies that favored the long-term stability and growth of their enterprise to those that maximized current profits. The costs of management failure may be much larger for managers (and workers) than for shareholders, because the latter can diversify their portfolio risk, while the former are in a situation where it is impossible to diversify their human capital (Aoki, 1984a). Under these circumstances, management and workers tend to be more risk-averse than the owners (shareholders). The generation of stable performance levels reflects the risk attitude of the management which seeks to stabilize long-term economic growth at the possible cost of lowering the level of short-term performance (Morita, with Reingold and Shimoruma, 1987). Although, the insurance motive will not be ignored in the next sections, the study will mainly focus on the performance (for example, the profit-) maximization motive. The distinction between technical ('real') and pecuniary economies is particularly useful for the welfare implications of economies of atmosphere. While technical economies of atmosphere result in a real increase of the

performance level, pecuniary economies result in a redistribution of income. For example, in a business group (section 2.6), the pecuniary economies are indicated by performance stability. The next sections will focus on technical rather than on pecuniary economies of atmosphere.

### 1.6. Economies of Atmosphere

We define economies of atmosphere as the impact of culture on technical efficiency. Technical efficiency is indicated by cost minimization or performance mazimization. The concept 'economies of atmosphere' was first introduced by Oliver Williamson (1973; 1975). 'Atmosphere' is the environmental factor in his original formulation of the organizational failure framework (OFF). Within the OFF, atmosphere is a general condition describing the attitudes of economic agents toward the institutional setting of the transaction. Why is atmosphere considered to be important? Standard economics assumes that individuals regard transactions in a strictly neutral, instrumental manner. Subject only to the condition that transactions are technologically separable, each transaction can be priced separately and metered (controlled) independently. Williamson believes that it is more accurate to regard the exchange process itself also as an object of value. He refers to the altruism in Titmuss' (1971) study of blood donors. Titmuss has found that the creation of a market for blood transformed the nature of the transaction, and consequently reduced the altruism embodied in giving blood. According to Williamson, concern for atmosphere tends to raise a comparable system issue. In particular, the influence of metering intensity on work attitudes needs to be assessed with care. Efforts to divide the employment relation into parts and to assess each part separately in strictly calculative, instrumental terms can have counterproductive consequences. Rather than regard transactions in strictly 'quid pro quo' terms, with each account to be settled separately, at least some individuals look instead for a favorable balance among an interrelated set of transactions. Modes of organization which would probably have superior productivity consequences if implemented within a group of pecuniary gain maximizers, may be rejected by a group with a different set of values. As Williamson (1975: 58) has put it: "A concern for atmosphere evidently makes the supply of a satisfying exchange relation part of the economic problem".

Williamson's findings are consistent with Alchian and Demsetz' (1972) well-known treatment of the effects of metering intensity, and Sen's (1983) observation that a worker's involvements are important because it is costly and may be impossible to devise a system of rewards and punishments such that no shirking incentive remains. Every economic system, therefore, tends to rely on the existence of attitudes toward work which supersede the calculation of net gain from each transaction. As Arrow (1968; 1971: 221) has put it: "One of the characteristics of a successful economic system is that the relations of trust and confidence between principal and

agent are sufficiently strong so that the agent will not cheat even though it may be 'rational economic behavior' to do so".

Prior to Williamson's work, the concept of 'atmosphere' had been used within a behavioral context, namely, as an environmental factor in Kurt Lewin's (1951) classic formulation of behavior (B) as a function of tension systems within the person (P) and the pressures emanating from the surrounding environment (E),

$B = f(P,E)$

In seeking to describe the essential dynamics that linked human behavior to generalized environmental stimuli, Lewin (1941: 241) stated: "To characterize properly the psychological field, one has to take into account such specific items as particular goals, stimuli, needs, social relations, as well as more general characteristics of the field as the atmosphere (for instance, the friendly, tense, or hostile atmosphere)". Lewin et al. (1939) studied atmosphere as an 'empirical reality' in an experiment involving the behavioral effects of three different leadership-induced atmospheres. In nearly all cases, behavioral differences could be attributed to differences in the experimentally induced atmosphere rather than to member characteristics. In addition, it was found that previous group history (preceding atmosphere) has an irreversible effect on the perception of leadership in the next game.

Both Lewin and Williamson have explored the effects of atmosphere as an environmental variable. In contrast to Williamson, however, Lewin focussed on the psychological consequences of atmosphere. Williamson's work is more appropriate for the purpose here, because his 'Economics of Atmosphere' (Williamson and Ouchi, 1981: 360) emphasizes the impact of general and specific values on economic efficiency - especially, transaction cost minimization. In comparison with Crémer's treatment of culture, however, Williamson's approach is somewhat incomplete, because it pays no attention to culture as a stock of common code, knowledge, and competence. This study will extend Williamson's concept of atmosphere (values) with the aspects of coding, information and competence. Consequently, atmosphere becomes congruent with the definition of culture as given above (values, information, competence), and the two concepts can be regarded as equivalents.

### 1.6.1. Definition of Economies of Atmosphere

Economies of atmosphere are defined as the joint positive impact of a distinct set of (i) values, (ii) more or less tacit knowledge (codes and information), and (iii) competences on the technical efficiency of a unit. Technical efficiency is indicated by production/transaction cost minimization or performance maximization (for given inputs).

### 1.6.2. Diseconomies of Atmosphere

Atmosphere can be an asset and a liability. We define the harmful effects of atmosphere as diseconomies of atmosphere. Diseconomies of atmosphere may be conceived from a comparative static and a dynamic perspective. The static point of view emphasizes that the decline of costs associated with atmosphere is not infinite. Sooner or later a point is reached at which all opportunities for making further (net) cost reductions through improved atmosphere are exhausted. From a dynamic point of view, Nelson and Winter (1982: 126) have described the trade-off between routines and deliberate choice. "One cannot infer from the fact that an organization functions smoothly and successfully in a particular range of observed environments that it is a rational and 'intelligent' organism that will cope successfully with novel challenges. If anything, one should expect environmental change to make manifest the sacrifice of flexibility that is the price paid for highly effective capabilities of limited scope". If we regard atmosphere as a distinct (limited scope) competence (capability), it would not be very realistic to assume that increasing atmosphere would minimize costs infinitely - especially not in a changing environment. Since corporate culture is conceived as a distinctive competence, the firm's flexibility may be constrained by its limited range of available routines (Teece, 1984). From the dynamic point of view, diseconomies of atmophere exist when atmospheric variables lead to 'myopia' (overlooking important signals) or 'inertia' (when the culture is not timely in adapting to environmental changes). Numerous dysfunctional examples of myopia and inertia can be cited , e.g., Henry Ford's decision to persist in the production of model T, and Xerox's inability to perceive the growing threat of Japanese competition in the 1970s (Lieberman and Montgomery, 1988: 49). Bankruptcy is the ultimate consequence of diseconomies of atmosphere for firms operating in a competitive environment, while inferior performance is generally the consequence of diseconomies for organizations working in the public sector.

### 1.6.3. Definition of Diseconomies of Atmosphere

Diseconomies of atmosphere are defined as the joint negative impact of a distinct set of values, tacit knowledge and tacit competences on the technical efficiency of a unit. From a comparative static point of view, it is emphasized that the decline of costs associated with atmosphere is not infinite: sooner or later a point is reached at which all opportunities for making further cost reductions through improved atmosphere are exhausted. From a dynamic perspective, diseconomies of atmosphere are the negative consequences of the inability to adapt to changing environmental conditions.

### 1.6.4. The Economies of Atmosphere Framework

Now that the salient aspects of culture and economic efficiency have been identified, we are ready to explore the questions about the nature of the relationship between culture and performance, viz:

1. Does culture affect economic efficiency?
2. If so, why should certain aspects of culture increase or decrease economic efficiency?
3. What are the costs of providing an (in)adequate culture?

A matrix can be designed to review the full spectrum of conceivable interrelations between atmospheric dimensions and aspects of economic efficiency in a systematic mode. This matrix is defined as the economies of atmosphere framework. Exhibit 1.1. shows the full spectrum of alternatives. The matrix is not a starting point for an investigation of all conceivable alternatives. Rather it is meant as a simple framework which allows a positioning of the chapters of this book. In particular, the framework shows the limits of the theoretical and empirical analyses which follow. The theoretical chapters, 2 and 3, will mainly focus on the interrelations between dimensions of atmosphere and transaction cost minimization/performance maximization, that is, they will ignore production costs (cells 1, 4, 7, 10, 13). The empirical chapters, 6 and 7, will center on the relationship between values and performance (cells 3 and 6). Obviously, they ignore the information and competence aspects of atmosphere, and cost minimization.

Exhibit 1.1. The Economies of Atmosphere Framework

| | technical efficiency | | |
|---|---|---|---|
| | costs (min) | | performance (max) |
| culture | production | transaction | performance level |
| **values** | | | |
| general values | 1 | 2 | 3 |
| specific values | 4 | 5 | 6 |
| **codes** | | | |
| common language | 7 | 8 | 9 |
| **information** | | | |
| knowledge of facts | 10 | 11 | 12 |
| **competences** | | | |
| simple rules/routines | 13 | 14 | 15 |

### 1.7. External and Internal Economies

The distinction between external and internal economies has been introduced by Marshall. "We may divide the economies arising from an increase in the scale of production of any kind of goods, into two classes - firstly, those dependent on the general development of the industry; and secondly, those dependent on the resources of the individual houses of business engaged in it, on their organization and the efficiency of their management. We may call the former external economies, and the latter internal economies" (Marshall, 1949, in: Schreuder, 1981: 51).

In this study, the economies of atmosphere framework will especially be used to explore the impact of culture on technical efficiency at the firm level. We will center on internal economies rather than on external economies of atmosphere. The firm, however, operates within an industrial and a societal context. Moreover, it can operate independently and as a member of a

business group. In attempting to articulate the economics of atmosphere in the firm, it is important to recognize the external context in which it emerges. As Fombrun (1984: 204) has put it: "Understanding the nature of culture at various levels of analysis is crucial if we are to properly position the concept of corporate culture as a unique and worthwhile level of analysis". Fombrun distinguishes three levels: the national, industry, and firm level. The next chapter will concentrate on the relationship between culture and economic efficiency at the national level, the industry level, and the business group level. These relations will be referred to as external economies. The subsequent chapter will deal with internal economies of atmosphere, i.e., the impact of atmospheric variables on performance at the firm level. At each level of analysis, the three research questions mentioned above will be explored.

### 1.8. Concluding Remarks

This chapter has provided a theoretical foundation for the rest of the text. Following the positioning of the concept of 'atmosphere' in the mainstream literature, definitions have been given of the relevant dimensions. They include atmosphere, technical efficiency, production and transaction costs, level of performance, and (dis)economies of atmosphere. Finally, a matrix has been designed which shows the full spectrum of conceivable relations. Note that the matrix is not meant as a starting point for the investigation of all relations (cells 1-15). Rather it shows the limits of the theoretical analyses which will follow (ignore production costs) and the empirical research which will be reported in Section III of this book (focus on cells 3 and 6).

The subsequent theoretical chapters extend the analysis to consider external and internal economies of atmosphere. External economies consider the competitive advantages of atmosphere at the national level, the (within- and between) industry level, and at the level of the business group. Internal economies are discussed with respect to the (within) firm level.

# 2

# External Economies of Atmosphere

## 2.1. Introduction

The main purpose of this chapter is to review the implications of economies of atmosphere for our understanding of the national level, the between industry and within industry level, and the business group level. The review is guided by the three research questions concerning costs and benefits of atmosphere.

First, at the national level the focus is on the Japanese management style as a competitive advantage. Furthermore, the literature is reviewed regarding the Confucian hypothesis which suggests a correlation between national values and economic growth. Second, at the between industry level, attention will be paid to Meade's distinction between 'unpaid factors' and 'creations of atmosphere'. Third, comparative static analysis at the within industry (or between firm) level show that atmosphere is especially important as a distinctive competence, while high switching costs explain diseconomies of atmosphere. Comparative dynamic analysis at the within industry level emphasizes the importance of atmosphere in the theory of contestable markets, particularly where tacit knowledge or uncertain imitability is concerned. Fourth, when atmosphere is considered at the business group level, the emphasis is on mutual insurance rather than on profit maximization. While the profit maximization motive results in a higher level of performance as compared to the costs, the mutual insurance motive primarily results in a higher stability of performance. Consequently, atmosphere at the business group level is not associated with (technical) economies of atmosphere.

## 2.2. Economies of Atmosphere at the national level

Culture is a key-variable at the national level of analysis. Several authors have attributed the recent discovery for corporate culture in the management literature to the decline of U.S. competitiveness in the world economy in the 1970s (Kirkbride, 1987), and the economic success of Japan in 'beating the Americans at their own game, played with different management rules' (Hofstede, 1986: 253). The charge that 'Japan Inc.' was Number one

influenced management writers who argued that the U.S. could learn from Japan (Pascale and Athos, 1981), and by reorientation could regain its former pre-eminence (Ouchi, 1981).

Several differences in performance between Japanese and American organizations have been observed. According to Robert Kaplan (1983), Japanese manufacturers produce higher quality goods with fewer workers and lower inventory levels than comparable U.S. firms. While Ford Motor Company's better plants turn out an average of two engines a day per employee using 777 square feet of plant space, the average Toyota plant turns out nine engines a day per employee, using only 454 square feet of plant space per engine. While Ford's plants have up to three weeks of backup inventory and use over 200 labor classifications, Toyota has only one hour of backup inventory and has only seven labor classifications.

### 2.2.1. Japanese Management Style

Numerous explantions have been given for the economic success of Japanese firms: protection from the market, tax advantages, subsidies, long working days, company unions, long term contracts, etc. In addition, the high productivity of Japanese enterprises is often explained by the unique features of Japanese management style which are rooted in the traditional Japanese society (Ouchi, 1981; Itawa, 1982; Itami (with Roehl), 1987; Morita with Rheingold and Shimoruma, 1987). Key and Miller (1984) identify three factors characteristic of Japanese management: long-term planning, lifetime employment and collective responsibility. Long term planning encourages making long-range investments which are crucial for the future of the company (Morita with Rheingold and Shimoruma, 1987). Lifetime employment is consistent with extensive on-the-job training, since bilateral investments in specific skills are less likely to be lost with turnover. Moreover, lifetime employment stimulates trust relations between firm members. When people frequently move from one company to another, the situation arises that "if you trust your colleague today, he may be your competitor tomorrow" (Ibid.: 175). This is not particularly helpful for collective action. Collective responsibility is related to company unions, firm loyalty, participative management, and to an emphasis on teamwork, coooperation, and consensual decision making (Takatera and Harimoto, 1987). The worker's (including the management's) mission is to contribute to the company's welfare.

The Japanese management style, however, should be put in perspective. Econometric analyses, for example, have shown that the difference in the prevalence of long-run employment between Japan and the United States is smaller than popularly believed (Tachibanaki, 1984). Lifetime employment in Japan is only assured for the better educated male employees of the large firms. In addition, Takatera and Harimoto (1987) have pointed out that the strength of Japanese

business is the coexistence of cooperative and competitive relations. Aoki (1984b), finally, made an economic analysis of the Japanese firm. In his introduction, Aoki begins with the observation that Japan's economic success has given rise to the Japanese myth. Rather than attributing the specific features of Japanese firms to national culture, he looks for an economic rationale to explain the internal structure of the Japanese firm. Agency theory, transaction cost economics, and game theory are especially helpful in the analysis. We will deal with some of these issues in the next chapter on internal economies.

### 2.2.2. The Confucian Hypothesis

The hypothesis concerning the impact of non-Western management styles on the level of economic performance may well be generalized to other South East Asian NICs (newly industrialized countries) such as South Korea, Taiwan, Hong Kong, and Singapore. "The East Asia group has outperformed the rest of the world in GDP annual average growth rate for two decades and has dramatically outstripped other areas in export growth" (Hicks and Redding, 1983: 25). World bank data on the average annual growth rate of per capita GNP confirm the East Asian lead. Together the five 'Dragons', as these countries are sometimes called, head the list with average annual sustained-growth percentages over a 20-year period of 7.6% for Singapore, 7.2% for Taiwan, 6.6% for South Korea, 6.1% for Hong Kong, and 4.7% for Japan (Hofstede and Bond, 1988: 5).

Hicks and Redding (1983) believe that the key to the economic growth of South East Asia is national culture. In particular, they emphasize the role of the Confucian ethic. In the spirit of Weber's [1920] classic, 'The Protestantic Ethic and the Spirit of Capitalism', (which is, however, not mentioned in their paper), the authors argue that there is a relationship between ethical principles and economic growth. They quote Kahn (1979) who states that the Confucian ethic has two aspects: (i) the creation of dedicated, motivated, responsible, and well-educated individuals, and (ii) the enhanced sense of commitment, and loyalty to institutions - facilitated by the protection against being fired. Kahn believes that both aspects of the Confucian ethic will result in all Confucian societies having at least potentially higher growth rates than other societies. Although Kahn supports his contention with arguments which explain the impact of Confucian values on East Asian modernization and industrialization, he fails to explain the age-long coexistence of Confucian ethics and lack of economic growth in South East Asia. Moreover, the Confucian hypothesis was not really tested by empirical research.

Recently, an interesting correlation between values and economic growth has been revealed. Michael Bond constructed a survey of general Chinese values which was administered to university students in 22 countries around the world. An ecological factor analysis was run on

the means for the 40 scale items and revealed four cultural dimensions. In the search for validity, country scores on these four factors were correlated with those derived from a Western survey of work-related values (Hofstede, 1980). Three of the factors from the Chinese Value Survey correlated at high levels with three of Hofstede's four. The fourth factor, called 'Confucian work dynamism' (CWD), was unrelated to any of Hofstede's, but correlated .70 ($p<.001$) with annual economic growth from 1965 to 1984. CWD was made up of values such as persistence and thrift on the one side (positive signs), and values concerning respect for traditions, and reciprocity on the other side (negative signs). Four of the five Dragons - Hong Kong, Taiwan, Japan, and South Korea - hold top positions on the CWD scale. The next highest scores are found for Brazil, India, Thailand, and Singapore. These results may be interpreted in light of the recent speculation on the Confucian hypothesis. The data tend to support the conjecture that Confucian ethics is at least partially responsible for the East Asian economic miracle (Hofstede and Bond, 1988). They will also help focus the discussion, because only certain of the Confucian values are predictive of economic growth. The authors suggest that the values 'thrift' and 'persistence' are assets to economic growth. "The value of 'thrift' leads to savings, which means availability of capital for reinvestment" (Hofstede and Bond, 1988: 18), while "persistence suggests a general tenacity in the pursuit of whatever goals a person selects for himself or herself, including economic goals" (Ibid.). The negative importance of values such as 'respect for tradition' and 'reciprocity' are also believed to facilitate economic growth in South East Asia. "The 'reciprocation of greetings, favors, and gifts' is a social activity more concerned with good manners than with performance. Too much 'respect for tradition' impedes innovation; part of the secret of the Five Dragon's economic success is the ease with which they have accepted Western technological innovations" (Ibid.).

While the authors argue that culture (as a set of dominant values) is a necessary condition for economic growth, they contend that culture alone is not sufficient for such growth to occur. Other necessary conditions are the existence of a market and a political context that allows development. "The first condition explains why the growth of the Five Dragons started only after 1955, when for the first time in history the conditions for a truly global market were fulfilled. The supportive political context was fulfilled in all five dragons, although in quite different ways, with the role of government varying from active support to laissez-faire" (Ibid.).

In general, the emphasis of the cross-cultural research is on establishing validity and generalizability rather than on explanation and prediction (cf. Hofstede and Bond, 1984; Bosland, 1985; Triandis and Bontempo, et al., 1987). Since Hofstede and Bond emphasize validity and explanation in their recent contribution, their paper may be conceived as an

innovative attempt to understand national culture as a critical variable in the explanation of economic growth.

### 2.2.3. Interim Conclusions

Regarding the three research questions, the preceding sections permit the following conclusions to be derived:

1. Little is known about economies of atmosphere at the national level. The existing cross-national studies, however, tend to give an affirmative answer to the question: does atmosphere affect economic efficiency? The focus is on differences in general value systems and their economic consequences, especially in terms of annual growth levels. At the national level, economies of atmosphere (in the case of South East Asia) can be pointed out.
2. Why should certain aspects of atmosphere increase or decrease economic efficiency? In the case of CWD, it is argued that the value 'thrift' leading to high saving quotas (capital for new investments) can be conceived as an important asset to economic growth, while the negative importance of 'respect for tradition' facilitates economic growth, because too much respect for tradition impedes technological innovation. More generally, it is argued that certain values are stimulating or inhibitive for economic growth in particular time periods and economic conditions.
3. Concerning costs, it can only be said that the costs of an inadequate culture is less growth in particular time periods. The costs of providing an adequate culture have not been considered at the national level.This may be explained by the fact that national culture is extremely stable. Since no alternatives for having a national culture exist, considering the costs of having a national culture may not be a very fruitful enterprise. In that sense there is also no alternative for industry or organizational culture - you always have one. The only alternative is another culture. However, the smaller a unit of analysis (e.g. a firm instead of a national state), the easier a change of culture over time may be, since change is relatively easier to implement.

## 2.3. Economies of Atmosphere at the Industry level

The next sections distinguish between the between-industry level (2.3) and the within-industry (or between-firm) level (2.4). To understand the relationship between atmosphere and performance, it may be stated that atmosphere has been conceived as a 'public good' at the between-industry level, whereas it is mainly conceived as a 'private good' in the strategic management literature on the competitive behavior of firms within an industry.

### 2.3.1. Between-Industry Level

Although little research has been done on the nature of an industry culture, it is well documented that the motion picture industry has norms and values that differ markedly from those of the banking industry (Fombrun, 1984). Similarly, the textile industry is different from the automobile industry, the health industry, or the telecommunications industry - both in terms of norms, career patterns, and the individuals attracted to it. The nature of an industry culture is dependent on several dimensions, e.g. the nature of the product, the industry life cycle stage, the nature of the technology, the market structure, the degree of governmental protection, and the legislative structure. Few economists have dealt with the relationship between atmosphere and performance at the industry level. One of the most influential papers (Meade, 1952) has focused on atmosphere as a public good.

#### 2.3.1.1. Unpaid Factors and Creations of Atmosphere

In 1952 Meade published a paper called 'External Economies and Diseconomies in a Competitive Situation'. It has become an important contribution to the theory of external consumption effects. Because this theory is extensively covered in the literature (Schreuder, 1981), it will be discussed only briefly here. The concept of externalities was introduced by Marshall in 1910. A externality or external economy is a favorable (consumption) effect on one or more industries or firms that comes from the action of a different industry or firm. An external economy shifts the cost or utility curve of each industry or firm it helps, and such an externally caused shift is distinguished from any internal movement along the affected industry or firm's own cost curve. An external diseconomy is defined in the same way, except that it refers to the external harm that is done to others. Smoke nuisance and water pollution are familiar examples of such external diseconomies (Samuelson, 1980: 449). It is frequently accepted among economists that in the production sphere these (technological) externalities result from services (and disservices) rendered without compensation (free) by one producer to another market participant, and that these externalities are a reason for the failure of perfect competition to lead to an optimum situation (Nijkamp, 1977: 43). External (dis)economies shift the cost or utility curve of each individual they help or harm. Moreover, whenever there are externalities, a strong case can be made for supplanting complete individualism by some collective action (Samuelson, 1980: 450). Externalities are an important concept in economics, especially in the theory of public finance, for their "general role in connection with free pricing to be nonoptimal , thereby creating a prima facie case for zoning, government controls, effluent taxes and penalties, and planning" (Ibid.).

Meade contributed to the theory of externalities with his distinction between two types of technological externalities: (i) unpaid factors (of production) and (ii) creations of atmosphere. An example of unpaid factors is given in the story about the bee-master and the corn-grower. "...if all of us in a neighborhood keep bees, I may find that I gain more wandering bees from your nearby acres when total Q of the honey industry rises. On the other hand, when total honey Q is small, I find that some of my bees wander uselessly off to neighboring cornland and my neighboring corn-grower has few bees that might in return wander back to me" (Samuelson, 1984: 449). Since the utility functions of the honey-master and the corn-grower are interdependent, 'constant returns to scale' can only be expected for the society as a whole (all industries) - not for the single industries.

Meade gives the following example of a 'creation of atmosphere' (cf. Schreuder, 1981: 70): "If due to forestry the climate in a region improves, all farmers will take advantage of it". Thus, given perfect competition there are constant returns to scale for all single industries, while there are 'increasing returns to scale' for society as a whole (Ibid.). As Meade has put it: "Both a factor of production and an atmosphere are conditions which affect the output of a certain industry. But the atmosphere is a fixed condition of production which remains unchanged for all producers in the industry in question without anyone else doing something about it, however large or small - within limits - the scale of operations of the industry is. On the other hand, the factor of production is an aid to production which is fixed in amount, and which is therefore available on a smaller scale to each producer in the industry if the number of producers increases, unless someone does something to increase the total supply of the factor" (Meade, in: Schreuder, ibid.). Consequently, unpaid factors (of production) can be conceived as 'private goods' which are sources of conflicts of interests. Creations of atmosphere have the character of a 'public good' which is (by definition) characterized by jointness of supply and consumption, and non-jointness of production (Samuelson, 1984).

#### 2.3.1.2. Atmosphere as a Public Good

Apparently, the above-mentioned forestry example refers to physical atmosphere (climate)- not to culture or atmosphere as earlier defined. Nevertheless, evidence suggests that in some cases the non-physical atmosphere may - within limits - have a comparable impact on industry performance.

An example of culture as a public good is the Swiss bank reputation reflecting the current professional values within that industry. Within the Swiss bank industry, the reputation is a public good, because it favors all Swiss banks. If some Swiss bankers were accused of helping large drug dealers to launder illicitly earned money, this would certainly affect the Swiss bank

reputation in a negative way. Consequently, all Swiss banks would be affected - including the 'innocent' banks. There is jointness of consumption of the spoiled reputation. Thus, decreasing returns would be expected for the industry as a whole.

Culture is also a public good in industries with an elaborated internal labor market when they are contrasted with those that buy human resources at the spot market. Since the internal labor market facilitates employees' firm loyalty, productivity losses and turnover costs for the firm are reduced. An example of a creation of intangible atmosphere is the knowledge transfer caused by the mobility of workers in the microelectronics industry to the telecommunications industry. The costs of their specific skills (on-the-job training) are borne by the former industry while the benefits are also consumed by the latter industry.

Obviously, atmosphere as a public good will not be particularly helpful for single firms in their competition with rivals within their industry. Consequently, the strategic management literature, the focus of discussion in section 2.4., has emphasized atmosphere as a private good.

### 2.3.2. Interim Conclusions

1. First of all, the literature suggests that atmosphere may affect economic efficiency at the industry level. However, diseconomies of atmosphere may also exist. Little is known about the net effect.

2. Why should certain aspects of atmosphere increase or decrease economic efficiency? Attention has been paid to 'creations of atmosphere' which are contrasted to 'unpaid factors of production'. Creations of (physical and intangible) atmosphere are public goods leading to constant returns to scale for the single industries, and increasing returns to scale for the society as a whole. Unpaid factors are private goods leading to constant returns to scale for the society as a whole (i.e. the two industries), and to increasing returns to scale at the level of single industries. Insofar as the intangible atmosphere (i.e. reputation) can be conceived as a public good or bad, general rather than specific values (or distinctive competences) are stressed.

3. There is jointness of consumption, and non-jointness of production concerning creations of atmosphere. Consequently, costs are not necessarily born by the industry consuming the public good.

## 2.4. Within-Industry Level: Comparative Static Analysis

Essentially, the within-industry level is similar to the between-firm level. This has been the source of confusion contained in the so-called (handbook) 'theory of the firm' (such as Koutsoyiannis, 1979) which is a microeconomic theory of the competitive dynamics within the industry rather than a theory on Marshall's internal economies. The analysis of economies of atmosphere at the within-industry or rather the between firm level, focuses on the strategic literature about distinctive competence. Switching costs and the failure to ignore sunk costs demonstrate the existence of diseconomies of atmosphere.

### 2.4.1. Distinctive Competence

Obviously, the collective dimension of atmosphere is stressed when atmosphere is referred to as a 'public good'. However, according to the definition above, atmosphere is collective and distinctive. When the latter dimension is emphasized, atmosphere can be considered as a 'private good'. In contrast to welfare economics, the strategic management literature has always emphasized the distinctive dimension of atmosphere because of the competitive advantages it offers for individual firms (Porter, 1980).

Selznick (1957) was one of the first scholars to point out that intangible assets, such as the identity of a company and a distinctive technological or managerial know-how, matter. Selznick makes the distinction between an 'organization' and an 'institution'. An organization is a technical instrument for mobilizing human energies and directing them toward given aims, while an institution is an organic product of social needs and pressures. "As an organization acquires a self, a distinctive identity, it becomes an institution. This involves the taking on of values, ways of acting and believing that are deemed important for their own sake. From then on self-maintenance becomes more than bare organizational survival; it becomes a struggle to preserve the uniqueness of the group in the face of problems and altered circumstances" (Selznick 1957: 21). Since "organizations become institutions as they are infused with values" (Ibid.: 40), the emphasis is on the embodiment of distinctive (i.e. specific) values in an organizational structure through the elaboration of commitments. The emergence of organizational identity reflects an irreversible element of choice. The acceptance by the management of irreversible commitments - by which it readily limits its own freedom - is the process by which the identity of an organization is set.

### 2.4.2. Failure to Ignore Sunk Costs

Apparently, having a distinctive identity or reputation is an asset because it distinguishes the firm and its product from other firms within the industry. The firm has a 'face' in the anonymous market of numerous buyers and sellers, so that it can profile itself. Product differentiation strategies are dependent on the firm's ability to develop the distinctive skills required for the development of a product that is recognized as distinctive in the market place. However, there are also costs associated with irreversible commitments and skills. In the development of a narrow repertoire of distinctive skills, the firm sacrifices flexibility. Selznick (Ibid.: 54) gives the following example:

"The first boats made by Gar Wood were high quality craft, made of the finest materials by master boat builders. Later, the company decided to mass-produce a comparatively low-cost speed boat for wide distribution. It developed that the entire organization found itself incapable to cope with the effort to shift commitments. Workmen and shop supervisors alike continued to be preoccupied with high cost quality craftsmanship. Members of the selling staff, too, could not shift emphasis from 'snob appeal' to price appeal. The quality commitment was so strong that an entirely new division - operating in a separate plant hundred miles away and therefore recruiting from a different labor market - had to be created to do the job successfully."

The example shows that the existence of a strong quality orientation impedes the attempts of the management to implement diversification within the plant. The attempts to reorganize the existing competence failed. The company structure became multi-divisional to avoid diseconomies of atmosphere. Essentially, the development of distinctive competence or 'asset dedication' - so that once committed, investment decisions involve some degree of irreversibility - reflects the sunk cost principle. "Costs are sunk when they cannot be eliminated even by ending production, e.g. costs that cannot be recovered by exit from the market" (Yao, 1988: 62). The existence of sunk costs (irreversible investments), however, does not explain the relative immobility of the firm. Teece (1984: 106) has argued that a firm's flexibility is constrained not only by irreversible investments, but also by its limited range of available routines. "If a firm has only a limited range of repertoires, its range of strategic choices is correspondingly limited." Since the range is limited, strategy will emphasize the exploitation of those distinctive assets which are socially efficient. That is, the assets must result in products which provide a sufficient increment in value over pre-existing substitute products to justify the costs of the irreversible investment (Rumelt, 1987: 144).

Thus, the firm may be 'locked' into a specific set of irreversible, fixed assets inhibiting the ability of the firm to respond to environmental changes or competitive threats (incumbent

inertia). In their discussion of strategic first-mover advantages, Lieberman and Montgomery (1988) have focused attention on 'incumbent inertia'. Even though incumbent inertia may lead to organizational decline, it is often a rational, profit-maximizing response. For example, it can be rationalized that most U.S. steel producers continued investing in open-hearth furnace technology even after it had become clear that basic oxygen furnaces were superior. As the authors put it: "A firm with heavy sunk costs in fixed plant or marketing channels that ultimately prove sub-optimal may find it rational to 'harvest' these investments rather than attempt to transform itself radically" (Lieberman and Montgomery, 1988: 48). Consequently, the appropriate choice between adaptation and harvesting from initial investments depends on how costly it is to convert the firm's existing assets to alternative uses. Obviously, the existence of high switching costs will lock the firm in the existing atmosphere. In other words, the switching (reinvestment) costs may effectively prevent the mobility of the firm to a more profitable atmosphere.

Economic theory implies that only incremental costs and benefits should affect decisions. This is the sunk cost fallacy: sunk costs are irrelevant for current decisions, since they are history. But do (non-economist) organizational members ignore sunk cost in their everyday decisions? Using prospect theory, Kahneman and Tversky (1974) have found empirical evidence for the sunk cost effect, i.e. that paying for the right to use a good or service will increase the rate at which the good will be utilized, ceteris paribus. For example, betting on longshots increases during the course of a racing day implying that betters have not adapted to their losses. Similar behavior is well known to anyone who plays poker. Finally, there are many examples of the government failing to ignore sunk costs. Thaler (1980) reports that, despite hazards which might emerge during the course of construction, there is hardly any example of a dam whose construction was halted or interrupted temporarily once the physical construction processes actually began. In the same spirit, firms may fail to ignore sunk costs with regard to atmosphere. In the cognitive accounting system of a firm, the existence of sunk costs may play a critical role in the decision not to switch to an alternative atmosphere, because it has taken ages and has cost fortunes to create the present atmosphere. The failure to ignore sunk costs may indicate that the sunk (investment) costs have become psychological switching (reinvestment) costs (personal communication M. Vendrik).

### 2.4.4. Interim Conclusions

What can be learned from strategic management literature is that atmosphere (including distinctive values and competences) is a two-edged sword. On the one hand, a distinctive atmosphere - especially a distinctive competence - may be conceived as a 'competitive advantage' (Porter, 1980) within the industry. On the other hand, a distinctive atmosphere is

an irreversible investment which locks the firm into a particular course of action. Consequently, the firm may be unable to reorganize. The former is a case of 'economies of atmosphere' showing that atmosphere has benefits in terms of profit-maximization or cost-minimization, whereas the latter is a (dynamic) case of 'diseconomies of atmosphere' demonstrating that switching costs are associated with the supply of an appropriate atmosphere.

### 2.5. Within-Industry Level: Comparative Dynamic Analysis

The competition between firms within an industry can be analyzed from both a comparative static and a comparative dynamic point of view. While the static analysis is concerned with cross-section interfirm differences in efficiency, the theory of uncertain imitability is an attempt to explain sustaining supra-normal efficiency levels. The dynamic perspective is important. After all, the firms which are successful today can be bankrupt tomorrow. The tacit dimension of atmosphere appears to be especially relevant at the between-firm level, because the fact that the distinctive competence is uncodified effectively prevents unwanted spillovers. In contrast to the static analysis, first-mover advantages become relevant too in the dynamic multi-stage perspective. Of course, the definition of dynamic analysis presented here can also be interpreted as 'quasi-static' or as the 'analysis of moving static equilibria', but this does not really affect the conclusions which may be derived from the next section.

#### 2.5.1. Contestable Markets and the Theory of Uncertain Imitability

While the preceding section has emphasized distinctiveness in value orientations and competences, this section will focus on another dimension in our definition of atmosphere, viz. the tacit dimension of atmosphere.

Recently, Barney (1986) related corporate culture to the origin and persistence of interfirm differences in financial performance. From a dynamic perspective, Barney has argued that it is not enough for a corporate culture to be valuable (to add economic value) and rare (uncommon, distinctive). In order to be the source of sustained competitive advantage, the culture has also to be imperfectly imitable.

In microeconomics, the financial performance of firms is divided in three categories: normal performance, above normal performance, and below normal performance. Normal economic performance is that rate of return on a firm's investment just enough to keep a firm's assets engaged in their current activities (survival). Technically, a normal return is the expected rate of return in perfectly competitive markets in the long run. Superior financial

performance is a rate of return greater than normal return and indicates that the firm is prospering (excellent company). Firms that obtain below normal financial performance for a relatively long period of time are not expected to survive (bankruptcy constraint). Superior financial performance can be either temporary or sustained. The neoclassical argument runs as follows "Under conditions of free entry, where no one firm has any particular advantages of location, skill, or resources specialized to this industry, one can expect in the long run that such free entry of would-be competitors will compete away any excess profits earned by existing firms in the industry" (Samuelson, 1980: 451).

Obviously, distinctive values, information sets, and distinctive competences are intangible firm assets which may initially encourage supranormal performance. Especially when the firm is timely, first-mover advantages can be exploited and monopoly rents can be earned (Lieberman and Montgomery, 1988). In the long term, however, these advantages are rewarded not by supranormal profits but by survival. Other firms, enviously observing their rival's success, will seek to obtain the same level of performance by duplicating whatever they perceive as success factors. If they succeed, imitation increases the competition facing the initially successful firm, reduces margins, and decreases the level of financial performance. Increased competition through imitation of values and competences will continue until all firms obtain approximately normal economic returns. Thus, given certain imitability of firm skills the market would be 'perfectly contestable' (Baumol, Panzar, and Willig, 1982), i.e. accessible to potential entrants with essentially free entry and costless exit. Consequently, sustainable above normal performance would not exist.

Nevertheless, we do observe excellent companies that make excess rents over a long time horizon. Assuming that these observations are not just statistical artifacts, Lippman and Rumelt (1982) have proposed the theory of imperfect imitability to account for such outcomes. The authors assume that there is a basic ambiguity concerning the causal connections between firm's actions and results. As a consequence, the factors responsible for performance differentials will resist precise identification. Under such conditions the uncertainty attaching to entry and imitative attempts persists, and complete homogeneity (leading to competitive pricing) is unattainable. Lippman and Rumelt have suggested that high rents, ceteris paribus, may well signal the presence of very successful competitors who are difficult to imitate, and thereby impede (costly) entry attempts. The firm earning entrepreneurial rent looks much like the excellent company of the strategy literature. It exhibits a high profit rate and substantial discretion in the allocation of its profit stream. Moreover, at its core rest unique specialized resources that cannot freely be expanded (Rumelt, 1987: 142-143). Since, management is far from an exact science, the ambiguity surrounding the linkage between action and performance in large firms virtually guarantees the existence of substantial uncertain

imitability. Demsetz has argued that these inputs are undervalued because competitors fail to recognize them: "It is not easy to ascertain just why GM and IBM perform better than their competitors. The complexity of these firms defies easy analysis, so that the inputs responsible for their success may be undervalued by the market for some time" (in: Lippman and Rumelt, 1982: 420).

The issue, however, is more than one of information sharing, since "it may never be possible to produce a finite unambiguous list of the factors of production responsible for the success of such firms" (Ibid.). Moreover, frequent transactions between people give rise to unique transaction-specific skills that are tacit or 'unspecifiable'. Here we find dedicated factors of production that are immobile not only because they are unique (distinctive), but also because their replication is a difficult and uncertain endeavor. Uncertainty in the identification and imitation of production functions explains the persistence of interfirm differences in efficiency. This uncertain imitability is a direct consequence of the tacit dimension of intangible firm assets.

### 2.5.2. Economies of Atmosphere as a Barrier to Imitation

Due to the tacit dimension, a valuable and distinctive atmosphere (distinctive values, competences) inhibits a contestable market which is subject of 'hit and run' entry. The concept of entry barriers has been developed within the structure-conduct-performance paradigm in industrial economics. The most notable early developers of the 'structuralist' paradigm were Edward Mason at Harvard during the 1930s and Joe Bain at Berkeley during the 1950s. The essence of strategic management in the structuralist framework is to shield the firm, to the maximum extent legally possible, from competitive forces (Teece, 1984). The principal focus was not one of how to select antitrust policies to increase consumer welfare by enhancing competition, but rather how to maximize rents (and, if necessary, reduce consumer welfare) by restricting competition. Consequently, 'isolating mechanisms' such as patents, trade secrets and tacit knowledge (Rumelt, 1987) rather than regulatory policies were stressed. The principal weapon in the business war is the erection of various forms of entry barriers.

Recently, Porter (1980) listed seven different barriers to entry at the between-industry level: economies of scale, product differentiation, capital requirements, switching costs, access to distribution channels, government policy, and a grouping which may be referred to as 'barriers to imitation' (Yao, 1988). Although not included in the list, economies of atmosphere can be classified as an effective barrier to imitation as well, since the values and tacit competences included in the firm's atmosphere resist imitation and prevent spillover effects. Even if the success factor were recognized by the other firm, the routine "may involve so much

idiosyncratic and difficult-to-unravel tacit knowledge that even if the organization tried to replicate itself, success would be highly problematic, and imitation from a distance would be completely impossible" (Teece, 1984: 107). As a result of imperfect imitability, atmosphere can function as an 'entry barrier' (when the focus is on entry to an industry), and as a 'mobility barrier' (when the focus is on entry to another strategic group within the industry).

### 2.5.3. Atmosphere as a Durable First-Mover Advantage

First-mover advantages arise endogenously within a multi-stage process. Lieberman and Montgomery (1988: 41) define first-mover advantages in terms of the ability of firms to earn positive economic rents, i.e. rents in excess of the cost of capital. "In the first stage some asymmetry is generated, enabling one particular firm to gain a head start over rivals. This first-mover opportunity may occur because the firm possesses some unique resources or foresight, or simply because of luck. Once this mechanism is generated a variety of mechanisms may enable the firm to exploit its position; these mechanisms enhance the magnitude or durability of first-mover rents".

It will be apparent that the early entrant firm can only exploit cost advantages if its distinctive competence and the associated learning curve (unit production costs falling with cumulative output) can be kept proprietary. Interfirm-diffusion of competence diminishes first-mover advantages. Moreover, there is a strong incentive to imitate existing innovations, since imitation costs are lower than innovation costs in most industries. Mansfield (1985) found that process technology leaks more slowly than product technology. Lieberman and Montgomery have argued that organizational innovations are very slow to diffuse, and hence may convey a more durable first-mover advantage than product or process innovation. "Chandler (1977) describes managerial innovations that enabled producers to exploit newly available scale economies in manufacturing and distribution in the late nineteenth century. Many of these firms - e.g. American Tobacco, Campbell Soup, Quaker Oats, Procter and Gamble - still retain dominant positions in their industries" (Lieberman and Montgomery, 1988: 44). If an innovative atmosphere is the unique resource contributing to the first-mover advantage, it may well be conceived as a durable one, because the tacit nature of atmosphere effectively impedes the interfirm spillovers which destroy the rents on existing innovations.

### 2.5.4. Market Imperfections for Human Capital

What does require attention is the need for the market for (collective) human capital to be imperfect, before economies of atmosphere can become a mobility barrier. If this market were perfectly efficient, uncertain imitable skills and routines could be purchased in the same way as any other factor of production. Head hunters and corporate acquisitions provide the mechanisms by which the market for experience may be said to operate. This market is clearly active, and reasonably effective at disseminating firm specific knowledge. In the case of collective tacit knowledge, however, the market for experience breaks down. Moreover, in the case of 'organizational capital' (Prescott and Visscher, 1980), the knowledge possessed by individual employees may not in itself prove very useful, since individuals may only reach their full potential as part of a specific team. Moreover, they may only be productive if employed in conjunction with equipment which has been developed within their firm which would, perhaps, not be readily reproducible by competitors. Hall and Howell (1985) have argued that this non-transferability becomes more subtle where learning by doing is only relevant within organizations reflecting a particular ethos. As a result, a Dutch company which hires a Japanese manager, in the hope of reproducing Japanese performance, is not expected to be very successful.

### 2.5.5. Interim Conclusions

With regard to the research questions, the preceding sections permit the following conclusions to be derived on the industry level.

1. First of all, the literature shows that atmosphere may affect economic efficiency. However, there are limits to the cost advantages associated with atmosphere. Moreover, diseconomies of atmosphere may also exist - especially when atmosphere is conceived from a dynamic point of view.

2. Why should certain aspects of culture increase or decrease economic efficiency? The answer to this question varies. At the between-industry level, attention has been paid to 'creations of atmosphere' which are contrasted with 'unpaid factors of production'. While creations of (physical and intangible) atmosphere are public goods leading to increasing returns to scale for the society as a whole, unpaid factors are private goods leading to increasing returns to scale for the single industries. In so far as the intangible atmosphere (i.e. reputation) can be conceived as a public good, general rather than specific values (or distinctive competences) are stressed.

From a within-industry or between firm perspective, the essential aspect of atmosphere is its distinctiveness. If the culture is distinctive (rare) and valuable from an economic point of view, it may explain interfirm differences in efficiency. The static analysis, however, cannot explain the existence of sustainable above normal rents. From a comparative dynamic perspective, the theory of uncertain imitability shows how atmosphere as an entry barrier impedes rapid imitation to reduce the entrepreneurial rent to normal levels, and prevents the development of a contestable market with free entry for potential hit and run competitors. Thus, atmosphere functions as a quasi-property right where appropriability is low. What does require attention, however, is the condition that the market for organizational capital is imperfect before economies of atmosphere can become an entry or mobility barrier.

3. Much attention has been paid to the costs of supplying an appropriate atmosphere. The existence of sunk costs and especially switching costs explains why atmosphere (irreversible commitment) affects the flexibility of the firm, especially when valuable irreversible commitments are concerned. While the exploitation of economies of atmosphere may lead to prosperity, diseconomies of atmosphere facilitate inertia and organizational decline. The cost of supplying atmosphere is the sacrifice of organizational flexibility. In the terminology of Nelson and Winter (1982), organizational routines are a suppression of deliberate choice. When risk is concerned (probability distribution known), routines may be a rational procedure for decision making. However, in the case of uncertainty (probability distribution unknown), routines may have counterproductive consequences.

### 2.6. Economies of Atmosphere at the Business Group Level

The preceding sections have dealt with the industry or market level (external economies). The concern with external versus internal economies does not only reflect Marshall's dichotomy. Since Coase's (1937) famous observation that markets and firms are alternative organizational mechanisms for supporting transactions, the literature has been mainly concerned with two institutions: the market mechanism (competitive pricing) and the firm's internal organization. The comparative efficiency of markets and hierarchies has been analyzed by Oliver Williamson (1975). Resource allocation in a market economy is implemented through the market by the price system, and within the firm under the direction of the manager. The division of labor between these two modes is determined by their comparative efficiency as alternative instruments for completing a related set of transactions.

Recently, Goto (1982: 61) argued that there is an alternative between market and hierarchy, i.e. the interfirm relationship called the 'business group' in the context of a market economy. Japan provides a typical example of an economy within which business groups play an

important role. These ('Zaibatsu' or 'Keiretsu') groups are extremely relevant when economies of atmosphere are considered, because "their coordination is secured by a set of tacit, informal rules that emerge through a long history of exchange of information and recognition of interdependence, substantiated by financial linkages and interlocking directorates" (Ibid.). The member firms are linked together through shared competence and shared values. Their collectivism is effectively reinforced by institutional and financial ties such as cross-stockholdings, loans, CEO meetings, and interlocking directorships.

There are various reasons why firms decide to form (or join) a business group:

(i) risk sharing. In an industry where the level of technology is high, firms may have the incentive to establish a joint subsidiary with other firms to spread the risks associated with the new venture.

(ii) capitalizing on new technology. The R&D unit of a food industry may discover chemicals that can be developed as a medicine. The firm has three alternatives: (i) manufacturing the new product, (ii) selling the information, (iii) cooperating with another firm. The firm will not be inclined to sell the information, because "the reward for an innovation captured through the selling of technology alone is significantly smaller than that realized through the selling of the product embodying this innovation" (Von Hippel, quoted in: Goto, 1982: 67). Lacking distribution networks and an established brand name, the food processing firm will tend to choose to set up a joint subsidiary with a pharmaceutical firm to capitalize on this new discovery, rather than attempt to develop it into a new product and manufacture and sell it alone.

(iii) information sharing. The market mechanism may not be an effective device to trade information because of the characteristics of information as a public good and the related difficulty of preventing diffusion or excluding nonbuyers from its use. Under these conditions, information costs may be decreased by sharing the information with certain other firms.

(iv) transaction of intermediate goods. In the intermediate goods market, buyers' demands tend to vary over detailed specifications. The number of suppliers and buyers of a specific product is exceedingly small so that bargaining costs may be high. Uncertainty and transaction costs associated with transactions through the market can be reduced by integrating vertically, and thus internalizing the intermediate goods market. However, the coordination of various vertical stages of production is difficult and inhibitively costly. Moreover, firms may find it difficult to raise the capital necessary to integrate vertically. Under these circumstances, market and hierarchy are no efficient alternatives. Firms can secure intermediate goods at lower cost and

with less uncertainty by forming groups rather than by procuring them through the market or integrating vertically.

(v) efficient capital allocation. Its external relation to the firm places the capital market at a serious information disadvantage. Although the general office of the multidivisional firm organization has superior properties in this respect, the M-form has its own drawbacks as a means to allocate capital, because it is able to assign cash flows to only a fairly narrow range of alternatives at any point in time (Williamson, 1975). The business group may provide an efficient alternative. By joining the group and investing in member firms of the same groups, firms can secure more broad investment opportunities than multidivisional firms that allocate funds only to their own divisions.

Obviously, the members of a business group have a competitive advantage in comparison with the firms 'outside' at the expense of foregoing the opportunities of competitive behavior towards member firms. The firm is extremely vulnerable to free riding behavior, and opportunism of other members in his group. Since moral hazard will effectively destroy the rents associated with group membership, the business group construction can only be exploited in an atmosphere of mutual trust. Thus, the sharing of a general value system can be conceived as a condition for the exploitation of group membership.

### 2.6.1. Transaction Cost-Minimization versus Mutual Insurance

Consistent with the transaction cost approach, Goto (1982:61) has attributed the formation of Japanese business groups to a desire for cost-minimization."From the standpoint of the firm, by joining or forming a group, it can economize on the transaction costs that it would have incurred if the transaction has been done through the market, and at the same time, it can avoid the scale diseconomies or control loss which would have occurred if it had expanded internally and performed that transaction within the firm. If the net benefit of forming or joining a group exceeds that of implementing transactions within the firm or through the market, the firm has the incentive to form or to join a group" (Ibid.). Consequently, the business group is conceived as an institutional device designed to cope with market failure and organizational inefficiencies.

Although Goto's hypothesis is plausible, empirical research has demonstrated that firms affiliated with (intermarket) business groups are not per se profit-maximizers. As well as having a lower return on investment (ROI) rate, member firms tend to show a somewhat slower growth rate than independent firms. However, there is clear evidence that the variability of performance (both the rate of profits and the growth rate) of the member firms is smaller than that of the independent firms. Reviewing the research on business groups,

Nakatani (1984) attributes this tendency to the risk attitude of the management which seeks to stabilize corporate performance at the expense of returns on investment. One of the essential functions of the capital market is to allocate risks efficiently among different investors in the economy. But if the capital market is imperfect due to the separation of management and ownership, management is in a position to worry about the business risks. In contrast to Goto (1982), Nagatani (1984) conceives firm grouping as a solution to the problem of the non-existence of insurance markets for entrepreneurial risks.

Since (intermarket) business groups can be compared with owing a full diversified portfolio of business, Nagatani (1984) emphasizes the risk sharing in business groups. The logic of risk sharing is straightforward: when some firms are having a bad year, others will be having a good year; thus, the overall sales and profits of the business groups will be relatively stable over time if member firms help one another in times of serious business hardship. When a financial difficulty arises, the member bank usually renders assistance, sometimes at a far greater cost and risk than normal business reciprocity requires. Likewise, in a buyer-seller relationship, the buyer will accept a somewhat higher price if the seller is in the same group and is facing business difficulties. In the reverse case, when the buyer is in difficulty, the seller is willing to sell at a below market price. This sort of business reciprocity shelters the group from the competitive market forces to which independent firms are exposed. The reciprocity may be taken to imply an implicit 'mutual insurance scheme' in which member firms are insurers and insured at the same time.

Financial research in portfolio theory suggests that the expected rate of return of business groups - like fully diversified portfolio of firms - is a market rate of return. On the average, business groups can expect to perform no better than a well-managed, fully diversified portfolio of stocks (Barney and Ouchi, 1986). While economies of atmosphere are captured by firms with a valuable, distinctive competence and sustained by uncertain imitability, empirical research suggests that the membership of (intermarket) business groups affect the stability rather than the level of the performance, i.e. the net effect of business group membership is not cost-mimimization or profit-maximization, but a redistribution of income between member firms. From this perspective, it might be speculated that pecuniary rather than technical economies of atmosphere dominate with respect to the business group. Assuming that membership of a business group reduces the risks of bankruptcy, it may be argued that uncertainty avoidance and a wider spread of risks rather than performance stabilization as a goal in itself are the main motives for the members. Thus, by reducing the risk of bankruptcy, membership may equally affect the average performance level in the long run.

### 2.6.2. Interim Conclusions

Regarding the three research questions given in chapter 1, the preceding sections permit the following conclusions to be derived:

1. Although the theory suggests that transaction costs are minimized by forming or joining a business group, empirical research has suggested that business group membership reduces the variability in performance rather than the level of performance. Member firms even tend to show lower return on investments and slower growth rates than independent firms. Comparing performance levels, the current empirical answer to the question whether the atmosphere of business groups affects the technical efficiency of member firms is negative. Since there is a positive effect of membership of a business group, i.e. performance stability caused by redistribution of income between member firms, it might be speculated that (at least in the short term) pecuniary rather than technical economies of atmosphere dominate with respect to the business group.
2. Research question two (why should certain aspects of culture increase or decrease economic efficiency?) is only applicable when the answer on the previous question is affirmative.
3. What are the costs of supplying an appropriate atmosphere in the business group? Obviously, an investment has to be made to learn the tacit rules of the group. Since the information sharing with other group members makes each of them extremely vulnerable towards moral hazard, an initial investment in trust is a necessary condition to benefit from business group membership advantages.

## 2.7. Concluding Remarks

This chapter has extended the analysis of the previous chapter by considering external economies of atmosphere. Research questions with regard to costs and benefits of atmosphere have been explored at the national level, the between industry level, the within industry level, and the business group level. The specific items of the interim conclusions will not be repeated here. Rather some general remarks will be made regarding the research questions. This chapter permits the following conclusions to be derived from the preceding sections.

1. Although atmosphere is not a factor of production like capital and labor, it may be conceived as a productive factor because it affects economic efficiency. Economies and diseconomies of atmosphere appear to exist at the national and industry level. At the business group level, pecuniary rather than technical (real) economies of atmosphere seem to be captured.
2. The economic rationale for economies of atmosphere is dependent of the level of aggregation. At the national level, general values like loyalty and thriftiness feature prominently. At the

(intra-)industry level, distinctive competences play a major role. The values of reciprocity and mutual risk sharing are important at the business group level.

3. Generally, the only alternative for atmosphere is another atmosphere. It is apparent that switching costs are associated with the creation of an alternative atmosphere. When atmosphere is a public good, a cost is made by the industry creating atmosphere that other industries do not have to bear themselves. The costs associated with atmosphere - in terms of sacrificing innovation and flexibility - may be so high that the whole industry will be driven out of business. Economies of atmosphere as a private good may be regarded as a durable competitive advantage, especially in exploiting first-mover advantages, and to prevent entry of hit and run competitors by the barrier of imperfect imitability.

# 3

# Internal Economies of Atmosphere

"One of the characteristics of a successful economic system is that the relations of trust and confidence between principal and agent are sufficiently strong so that the agent will not cheat even though it may be 'rational economic behavior' to do so" (Arrow).

## 3.1. Introduction

This chapter deals with economies of atmosphere at the organizational level. Three views of the firm are discussed: the microeconomic theory of the firm, the organizational economics approach to the firm, and the information processing approach of the firm.

(i) The microeconomic theory of the firm emphasizes tangible rather than intangible resources. It is, moreover, a theory of the market rather than a theory of the firm. Consequently, an intangible organizational resource such as atmosphere is not really compatible with the theory of the firm.

(ii) Three central paradigms of organizational economics will be discussed here: team theory (TT), agency theory (AT), and transaction cost economics (TCE). This chapter will particularly focus on the latter paradigm, since only TCE explicitly discusses antecedents and consequences of *atmosphere*. Team theory centers on the exploitation of a mutual gain by interpersonal cooperation. However, the mere technical possibility of a mutual gain does not guarantee that the cooperation needed to secure that mutual gain will actually be forthcoming. The temptation to shirk may inhibit cooperation. More typical is the game in which each player would prefer to be cooperative, if he knew that the other party was going to cooperate (also without being forced to). An atmosphere where team members have trust in the consummate cooperation of the other party may be conceived as a possible solution to the so-called Assurance Game in the team organization.

Within the contractual perspective (AT and TCE) atmosphere may be conceived as a solution to a managerial problem - the difficulty of imagining all contingencies and specifying them in employment contracts. Particularly, atmosphere may be conceived as a means to complete incomplete contracts by providing guiding focal principles. There is, however, an optimal span of

atmosphere as implicit contracting. Although both AT and TCE deal with the complex equilibrium of contractual relations within the firm, only the latter discusses the antecedents and consequences of atmosphere in an explicit manner. The role of atmosphere is analyzed in the peer group and the internal labor market. The internal labor market is a governance structure where an *ex ante* large number condition is transformed into an ex post small number bidding situation as a consequence of human asset specificity. Specific skills have to be embedded in a protective governance structure lest productive values be sacrificed if the employment relationship is unwittingly severed. Where asset specificity is great, employee and employer are effectively 'locked into the transaction', and special efforts will be made to design an atmosphere of fairness, i.e. an exchange relationship that has good continuity properties. Incomplete contracting offers the opportunity to economize on bounded rationality.

(iii) While the team approach focuses on values and information, the information processing approach deals with atmosphere as a common stock of knowledge, i.e. common codes, knowledge of specific facts, and behavioral rules. It shows why an efficiency function can be attributed to atmosphere in terms of an increase in cost efficiency of the firm's responses.

In general, the criterion for organizing economic transactions is assumed to be cost minimization. The theoretical part of this study attempts to show that there is an economic rationale for the attribution of a transaction cost minimization function to atmosphere. Since the mainstream literature on atmosphere (TCE) focuses on transaction costs (in the production process), the review presented here has neglected production costs. The economic problem, however, is not to save on transaction costs, but to save on the sum of transaction and production costs. Consequently, production costs should be considered as well. Neoclassical economics has emphasized scale economies as a mechanism for decreasing production costs. Recently, it has been recognized that under certain conditions economies of scope may contribute to both production and transaction cost minimization. Economies of scope, scale, and atmosphere are complements rather than substitutes. The final sections of this chapter define the alternative sources of efficiency in order to enable a systematic comparison between sources of technical efficiency.

### 3.2. Microeconomic and Complementary Theories of the Firm

The microeconomic theory of the firm is, in principle, the most exact and appropriate theory to deal with internal economies of atmosphere. However, microeconomic theory hardly touches upon the internal organization. What has been developed as a 'theory of the firm' can be characterized more adequately as a theory of the market. In the theory of the firm, the firm is no more than a combined decision criterion, traditionally profit maximization (economic criterion) and a production function (technical criterion). The construct called 'the firm' receives its information

from the markets, and adjusts its market behavior in accordance with the assumed decision criterion. The theory of the firm examines the effects of applying this criterion in different markets. By simultaneously examining the behavior of the various parties involved, microeconomics attempts to explain and predict the resulting market phenomena such as supply, demand, and prices. While treating the firm as a production function (Koutsoyiannis, 1979) or a technological black box (Leibenstein, 1987), the theory of the firm is silent on the internal processes which have led to the firm's response to changing market conditions (Schreuder, 1983; Hendrikse and Schreuder, 1987). Recent developments in economics have generated complementary theories of the firm (Putterman, 1987). Those will be dealt with in the next sections of this chapter.

Itami (1984) describes three views of the firm: (i) the firm as a physical transformation agent, (ii) the firm as an input mix of human resources, (iii) the firm as an information processing apparatus.

(i) The firm as a physical transformation and market exchange agent takes inputs from the environment and produces certain outputs which are then sold to the outside parties in the market place. The members of the firm perform operating activites in the production process. The firm itself is a technological black box. Into this box go labor and capital and out come products. The mechanism is driven by profit maximization, and governed by the law of diminishing returns, that is, an increase in some varying inputs relative to other fixed inputs will, in a given state of technology, make total output increase; but after a point the extra output resulting from the same additions is likely to become less and less (Samuelson, 1980). In standard price theory, the firm is a primitive atom of the economy - a singleminded agent interacting with similarly singleminded consumers and factor suppliers in the market economy. This is the (ideal typical) view which is central in the microeconomic theory of the firm. With the firm as atom or technological black box, the price system appears to be the exclusive mechanism of resource allocation and economic coordination. Prices as sufficient statistics are the efficient units of information.

Today it is increasingly recognized that whether better characterizations of microeconomic reality are provided by ordinary price theory or the developing economics of organization depends upon the questions in which we are interested (Putterman, 1987). Thus, they are complements rather than substitutes. Once the focus of attention shifts to the firm itself, the complex of interacting agents, resources, information, and routines presents itself as a means of organizing economic activities in its own right. Economic theory describes the price system itself as a spontaneous coordination mechanism imparting rationality and consistency to individual agents' behavior in the market. The firm is one such agent responding to price signals in

formulating its internal plans. However, the principals and agents within the firm do not directly respond to price signals when determining their behavior. Instead, they operate within a decision-making structure and a given atmosphere. In a simple model, the signals given to intrafirm agents and determining their behavior can be thought of as commands, which serve as the analogue of price signals in the market. More subtle models will replace the concept of external command with one of internalized (psychological) structures motivating agents to perform the required task, making such behaviors rational from their own standpoints. Atmosphere may appropriately be conceived as an internalized structure which transmits the appropriate signals in the latter model.

(ii) Organizational economics focuses on three paradigms. One of them, team theory, stresses the problem of cooperation between agents with heterogeneous interests. The organization of cooperative economic activity we call the firm is regarded as an input mix of human resources, composed of people with various skills, traits, tastes, and objectives. Itami's second view of the firm further includes agency theory and transaction cost economics. What these approaches share is a common interest in the firm-market relationship, and the internal nature of the firm. In addition, all the approaches are (at least partially) concerned with the problem of agency, i.e. how one actor (e.g. the owner of an asset) induces another actor (e.g. the manager of that asset) to behave in ways consistent with his or her interests. Finally, the paradigms are concerned with the contrasts between internal organization and market, yet there is considerable difference in the emphasis placed upon these modes of coordination. With this caveat in mind, Putterman (1987: 5-14) summarizes some of the main differences between markets and firms:

- Agents interact as 'free' individuals and as 'equals' in markets, but under organizational directives and in accordance with their station in a hierarchy in firms;
- Intrafirm relations are long-term and exchange is relational, whereas pure market relationship are short term and anonymous;
- Whereas 'history does not matter' for pure market exchange, intrafirm relations and firm structures are significantly historical in character. As Putterman put it: "Put differently, the firm is a social institution which has developed, and which likewise can effect changes in its specific norms, 'culture', and routines only over time" (Ibid: 9);
- while markets are often measured against the ideal of perfect competition, the enterprise is a team whithin which the attenuation of competition and the promotion of cooperation may be a requirement for technical efficiency.

(iii) The firm as an information processing apparatus engages in information processing and information exchanging activities. According to Itami, this is the other side of the operating activities in the production process. Operating activities consist not only of physical

transformation processes, but also, inevitably, of information processing within the firm, and information exchange with the environment. The third view is promoted by information economics (Arrow, 1985), and organizational theory (Galbraith, 1974).

The microeconomic view of the firm emphasizes monetary and physical capital - thus, excluding atmosphere which is not a tangible factor of production like capital or labor. The second and third view regard the intangible resources intrinsically connected with the people working in the firm as important assets as well. Examples of such 'invisible resources', in Itami's terms, are technological skills, marketing savvy, production routines, brand reputation, and organizational culture. The next sections of this chapter focus on the relationship between atmosphere and efficiency as conceived by the second and third concept of the firm. The second approach mainly deals with atmosphere as the value system of a firm, whereas the information processing approach deals with atmosphere as a common stock of knowledge. With regard to the economic problem, it may be said that the microeconomic theory of the firm emphasizes minimization of production costs, and the complementary paradigms center on minimization of transaction costs.

### 3.3. Team Theory: Mutual Gain of Team Production and the Assurance Game

Alchian and Demsetz (1972) consider team organization as a special kind of 'market' within which resources compete for assignment to particular uses. The long-term nature of relations among agents allows the team to enjoy certain advantages as a resource allocating mechanism. It is argued that efficient team production with heterogeneous resources is a result not of having better resources, but in taking advantage of the richer knowledge of factor inputs. As Putterman (1987: 10) has expressed: "While competition for scarce resources is assumed to allocate inputs to their most productive uses in the market, since the most productive user would also (rationally) be the highest bidder, the market process assures optimal resource allocation only to the extent that the characteristics of the inputs are known to market participants. If, on the other hand, the special qualities of inputs as they work independently and in interaction with sets of complementary inputs can be known best through use, and/or information about input qualities is poorly communicated across markets (...) allocation of resources by an organization controlling them over a period of time may lead to superior resource utilization".

Economies are realized in team production activity in which joint use of inputs yield a larger output than the sum of the products of the separately used inputs. Interdependence of agents' productivities creates special conditions under which output may be maximized, e.g. one agent's productivity enhances another's. However, the mere technical possibility of a mutual gain (Marschak and Radner, 1972) does not guarantee that the interpersonal cooperation needed to secure that mutual gain will actually be forthcoming. First of all, the persons presented with the

technical possibility are susceptible to moral hazards - they are vulnerable to free rider temptations, or they are simply unscrupulous opportunists. Only in a non-zero sum game with repeated games and an infinite time horizon (Axelrod, 1984), may mutual gains by voluntary cooperation be realized. Leibenstein's (1987) treatment of team production as a Prisoner's Dilemma is exemplary for this type of situation. Quite different is the Assurance Game in which "each player would prefer to do the cooperative thing, even if the other party could not enforce that, if he knew that the other party was going to cooperate (also without being enforced). Here the stumbling block to cooperation is not the temptation to shirk or generally to act selfishly. The obstacle to cooperation is the lack of confidence, or assurance, that the other party is going to cooperate because he or she is confident of the first party's cooperation" (Phelps, 1985: 128). When the venture is an Assurance game, the mutual gain of team production is dependent of the ability to trust and to believe that the partner can be trusted. Apparently, an atmosphere of trust and fairness may be helpful in effective team production by offering a partial solution (complementary to imperfect monitoring) to the Assurance Game. With respect to the issue of control, the team approach is consistent with agency theory and transaction cost economics which have focused on the problem of unforeseen contingencies, and the fundamental issues of adverse selection and moral hazard.

### 3.4. Agency Theory: The Firm as a Nexus of Contracts

The team approach of the firm is consistent with agency theory and with transaction costs economics. The advocates of these paradigms exploring transaction costs, however, set out on two very different expeditions. Agency theory, guided by the notion of 'moral hazard' and 'adverse selection', headed off in the direction of insurance and risk, and ventured into generalized principal-agent relationships. AT conceives the firm as a legal fiction which serves as a nexus for the bundle of long term contractual relations with the owners of human and financial resources as well as business partners. In a sense, the behavior of the organization is like the equilibrium behavior of a market with the individual agent as the elementary unit of analysis. "The behavior of the organization is the equilibrium behavior of a complex contractual system made up of maximizing agents with diverse and conflicting objectives" (Jensen, 1983: 327). Of course, whether one chooses the 'technological black box' or the 'nexus of contracts' definition of an organization depends on the question at hand. However, when using the black box metaphor, it is important to remember that it is a convenient abstraction. Jensen has argued that the danger in its use arises because it encourages the tendency to personalize organizations by attributing motivations and preferences to what is in fact a complex equilibrium system. Essentially, AT is a label for a number of theories that are based on a neoclassical economic paradigm. It deals with the separation of decision (management) and risk-bearing function (ownership), and with the economic relationship between two or more parties, e.g. arrangements between employer and

employee. The paradigm specifies the phenomenon of contracting under conditions of uncertainty, implicating information assymetries between principal and agent. The firm is a collection of contracts between internal and external participants or stakeholders, and these contracts structure relations of accountability between stakeholders, especially by the design of incentives schemes (Van de Poel, 1985). Since there is a multitude of explicit and implicit contractual relationships with respect to the firm, the behavior of the firm is the outcome of a complex equilibrium process. As Jensen and Meckling (1976: 311) put it: "The agency paradigm implies the view that individual behavior in organizations depends on the nature of contracts between individuals and the allocation of (property and decision) rights that follows from their execution. The specification of individual rights determines how costs and benefits are allocated among the participants".

### 3.4.1. Incomplete Contracts and Focal Principles

From a contractual perspective, which is common to AT and TCE, the atmosphere of a firm can be seen as a solution to a managerial problem, i.e. the difficulty of imagining all contingencies and specifying them in employment contracts. Given the managerial problem, the most efficient contracting mode is incomplete contracting , which means that parties to a contract will be cognizant of prospective distortions and the need to realign incentives and to craft governance structures that fill gaps, correct errors, and adapt more effectively to unanticipated disturbances. From this perspective, atmosphere may be conceived as the unwritten aspect of contracts among managers, employees, stockholders, and directors who constitute a firm. The tacitly known values and rules within the firm can administer incomplete contracts between the internal and external participants. As Camerer and Vepsalainen (1988: 115) put it: "Corporate culture solves the problem by specifying broad, tacitly understood rules - 'the ways we do things around here' - for appropriate action under unspecified contingencies". Since written contracts *fail because it is too expensive to make them complete, corporate culture* - consisting of tacitly known rules of behavior which are broad but clear enough to specify optimal employee action in the face of unanticipated contingencies - may be an adequate substitute.

In terms of Schelling (1963, 1984) the incomplete contract is completed by focal principles such as tradition, simplicity, and equity. Since it might be costly to specify every time what has to be done once an unforeseen contingency has arisen, "what is necessary is to coordinate predictions, to read the same message in the common situation, to identify the one course of action that their expectations of each other converge upon. They must 'mutually recognize' some unique signal that coordinates their expectations of each other. We cannot be sure they will meet, nor would all couples read the same signal, but the chances are certainly a great deal better than if they pursued a random course of action (Schelling, 1963: 54). In this world where nearly all

decisions have to be made under uncertainty, the importance of atmosphere emerges. The value of atmosphere is derived in reducing uncertainty and ambiguity - in guiding cooperative behavior in situations where many courses of action are possible. The rules of behavior help employees fill in the gaps between the formal contract and actual contingencies, because they can dictate the choice of a specific focal point in a wide variety of situations (Hendrikse, 1988).

Camerer and Vepsalainen have given two examples of Schelling's focal principles. (i) In densely populated Japan, 'save space' is an appropriate focal principle for guiding manufacturing activity. This focal principle may lead to low-inventory 'just in time' scheduling, and quality control which creates fewer defects, and saves on repair costs. (ii) The focal principle in Western job shops is 'a fair pay for a day's work' - workers should be rewarded on the basis of their effort. Workers' mistakes are absorbed by buffer inventories and production quotas are established. According to the authors both focal principles help workers to respond to unforeseen contingencies, but they may differ in long-run competitive advantage (Ibid.: 120).

### 3.4.2. Optimal Span of Implicit Contract

Kreps (1984) has argued that the reason for (dis)economies of atmosphere is the combination of incomplete contracting and a focus principle, which reduces the range of contingencies with which the implicit contract must deal. An original extension to considerations of the 'optimal size of a firm' is his concept of the optimal span of the implicit contract. "Of course, insofar as the implicit contract permits greater transactional efficiency, an expansion in the span of contract will be beneficial. But weighted against this is the problem that as the span of contract is increased, the range of contingencies that the contract must cover also must increase. And then either it will be harder for participants to determine, ex post, whether the contract was applied faithfully, or the contract will be applied to contingencies for which it is not well suited" (Ibid.: 45). At some point, the benefits from increasing the span of contract are outweighed by the inefficiencies engendered by the fact that the corporate culture is applied in contingencies to which it will be less and less appropriate. Hendrikse (1988) has argued that this argument is consistent with the welfare analysis in the literature on product differentiation stating that there is a tradeoff between innovation (increasing the span of implicit contracting in order to prevent myopia and excess inertia) and standardization (keeping the same clear focal principle) in order to have all noses pointed in one direction, i.e. facilitating teamwork and effective decision making (Farell and Saloner, 1985). At the firm level, Kreps' argument is supported by Nelson and Winter (1982) who conceive organizational routines as a suppression of deliberate choice, i.e. rational decision making. The costs associated with an investment in atmosphere (standardization) become sunk costs once the focal principles have established. From that moment, the relevant costs are re-investment costs caused by the transition to an alternative

atmosphere (innovation). The rational decision maker will only make these transition costs in the expectation that they will be outweighed by the benefits of the new atmosphere.

### 3.4.3 Interim Conclusions

Regarding the research questions stated in chapter 1, the preceding sections yield the following conclusions:

1. Although TT does not explicitly discuss atmosphere, there certainly is a role for economies of atmosphere. Whether the technical possibilities of a mutual gain in team production will be realized is dependent of the solution of the assurance dilemma. Atmosphere may be conceived as a partial solution to the uncertainty about the voluntary cooperativeness of the other party.

2. It may be argued that internal economies of atmosphere are consistent with the contracting perspective, because they include focal principles which guide cooperative behavior. The focal principles complete incomplete contracts in a world where comprehensive ex ante contracting is constrained by unforeseen contingencies.
3. Costs are undoubtedly associated with developing focal principles, because it takes time to learn to read the same message in a common situation. However, these costs are unavoidable in the organization of cooperative economic activity, because the history of a firm plays a decisive role in the formation of that firm's culture. The relevant costs are not the sunk costs associated with the standardization of atmosphere, but the transition costs, i..e. the reinvesting costs which have to be considered when an alternative focal principle is to be developed (innovation). In real life situations, however, sunk costs can matter, because firms may fail to ignore historical investment costs. e.g. because they function as psychological switching costs.

Finally, the literature points out that there are limits of atmosphere from a static point of view, because there is an optimum span of the implicit contracting. At some point, the benefits from increasing the span of the implicit contract are outweighed by the inefficiencies engendered by the fact that the culture is being applied to contingencies to which it is not well suited. From this moment it is worthwhile innovating, that is, moving into a new focal equilibrium.

### 3.5. Transaction Cost Economics: The Firm as a Governance Structure

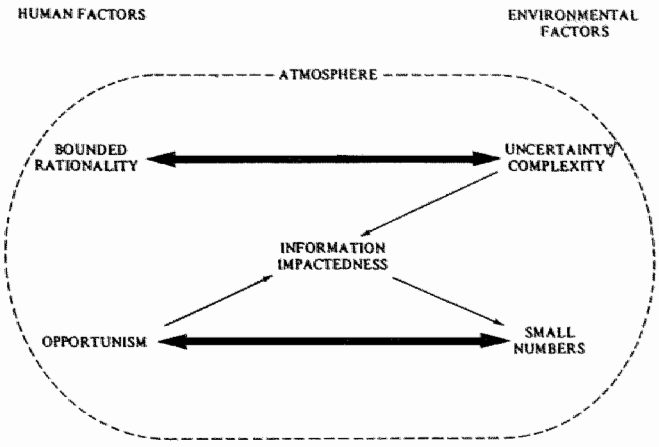
While AT is defined by several neoclassical authors such as Jensen and Meckling (1976), Fama (1980), Fama and Jensen (1983a-b), TCE is mainly defined by Williamson (1975; 1979; 1981; 1985). TCE is very similar to AT in that both work out of a managerial-discretion setup. They also adopt an efficient-contracting orientation to economic organization. Both TCE and AT take issue with the neoclassical theory of the firm whereby the firm is regarded as a production function, to which a profit-maximization objective has been ascribed. In addition, both approaches have elaborated a microanalytic theory of contracts at the intrafirm level.

In contrast to AT and TT, TCE explicitly deals with the concept of 'atmosphere'. According to TCE, the essence of the firm lies in teamwork which involves the nexus of long-term contracts, because it creates dependencies calling for contractual restraints. Emphasizing the transaction as unit of analysis, TCE deals with fundamental aspects of industrial organization. The classic transaction cost problem was posed by Ronald Coase in 1937: when do firms produce to their own need (integrate backward, forward, or laterally), and when do they procure in the market? Coase argued that transaction cost differences between markets and hierarchies were responsible for the decision to use markets for some transactions and hierarchical forms of organization for others. Coase has stated that if all costs of transactions are zero, the use of resources will be similar no matter how production and exchange activities are arranged. Not only would economic organization be randomly determined, there actually would not be any hierarchy. Consequently, the existence of organizations would be inconsistent with economic theory. Coase's observation is supported by Arrow's famous analysis of the limits of organization. Arrow (1974: 33) states that "organizations are a means of achieving the benefits of collective action in situations where the price system fails".

#### 3.5.1. The Organizational Failure Framework

Williamson (1975) starts with the observation that a large number of organizational issues can be usefully addressed in efficiency terms if transaction costs are taken into account. This is accomplished by making the transaction rather than the commodity the basic unit of analysis, and by assessing governance structures in terms of their capacities to economize on transaction costs. Williamson's organizational failures framework (OFF) attempts to identify and link the various factors involved in determining the choice between market and hierarchy.

Exhibit 3.1. The Organizational Failures Framework




The OFF makes assumptions about human nature (bounded rationality and opportunism) and about the state of the world (uncertainty/small versus large number condition). Most of all, it points out the importance of the following three relations: (i) the pairing of bounded rationality with uncertainty, (ii) the joining of opportunism with small number conditions, and (iii) a derivate condition referred to as as 'information impactedness'. The last factor mentioned in the original formulation of the organizational failure framework is atmosphere, which is a general condition describing the attitudes of economic agents toward the institutional setting of the transaction.

The principle of bounded rationality refers to the fact that the capacity of individuals for formulating and solving complex problems is very small compared with the size of the problems whose solutions are required for rational economic behavior in the real world (Simon, 1961). Human behavior is intentionally rational, but only limitedly so. Thus, economic behavior is essentially 'purposive' (Schelling, 1978). Bounded rationality refers to neurophysiological limits on the one hand, and language limits on the other. The former take the form of limits on the capability of individuals to receive, store, retrieve, and process information without error. Language limits circumscribe the ability of individuals to articulate their knowledge by the use of symbols. The classic example is given in Polanyi's (1958) treatment of 'tacit knowledge'. Bounded rationality is, of course, only a problem under conditions where uncertainty or environmental complexity is high. Under these conditions, comprehensive *ex ante* contracting becomes impossible.

Opportunism refers to the attitude towards realizing individual gains through dishonesty in transactions. It is an extreme variety of self-interest seeking, i.e. self-interest seeking with guile. Opportunism can appear in a precontractual stage during original negotiations (e.g. adverse selection), during contract execution (e.g. moral hazard), and during all contract renewal stages. Strategic behavior is involved in all cases, especially regarding information inequalities, strategic manipulation of information, and misrepresentation of intentions. An example of opportunistic behavior is 'shirking' - the act of seeking to avoid performance of contractual duty. Shirking is originally couched in terms of a utility-maximizing employee's labor-leisure tradeoff (Alchian and Demsetz, 1972). The theory of shirking assumes that individuals might shirk contractual responsibilities if benefits exceeded the costs. The classical explanation for shirking behavior is given by Staten and Umbeck (1982: 1023): "Given a time constraint, an individual will allocate his labor to equate the gains from income with the gains from leisure at the margin. If labor rewards are not perfectly correlated with productive effort, then the incentive to produce is diminished - shirking results". The authors assume that shirking intensity is dependent on the costs of monitoring. "If shirking could be costlessly detected, neither party to a contract would have an incentive to shirk, since the full costs of shirking could be brought to bear on the guilty party through renegotiations of the terms of trade. However, if detecting shirking through some monitoring mechanism is costly, the guilty party will not generally be forced to bear the full costs of his behavior" (Ibid). In addition, it is argued that "Monitoring will be undertaken so long as the marginal gains from reduced shirking equal or exceed the marginal costs of detecting" (ibid). It is concluded that "less-than perfect monitoring implies some shirking incentives remain" (Ibid).

Williamson does not state that all economic agents necessarily behave this way. The assumption is that some agents show opportunistic behavior, and that it is very costly to sort out those who do from those who do not. For an opportunistic problem to be posed, a further necessity is that a small numbers bargaining condition prevails. In circumstances where a large number of bidders exist and with perfect monitoring, (perfect) competition will obtain and fair returns will be realized. Where such market conditions break down, the self-policing benefits of competition are no longer assured and concern with opportunism is accordingly warranted.

What happens when bounded rationality and opportunism are joined? This is the world with which TCE is concerned: planning here is necessarily incomplete because of bounded rationality, while promise predictably breaks down because of opportunism. In the nonzero transaction cost world, efficiency emerges under the imperative: organize transactions so as to economize on bounded rationality, while simultaneously safeguarding against the hazards of opportunism (Williamson, 1975).

Information impactedness appears in conjunction with changing conditions (uncertainty). It is the inability of all the interested parties to be costlessly informed of the changes which have occurred (bounded rationality), and the (opportunistic) inclination of some of the parties to withhold or distort the information to which they have preferential access, e.g. by exploitation of first-mover advantages. Information impactedness is a dynamic concept, because uncertainty and opportunism give rise to a small numbers bargaining result.

### 3.5.2. Atmosphere in the OFF

The last factor mentioned in the original formulation of the organization failure framework is 'atmosphere' which is a general condition describing the attitudes of economic agents toward the institutional setting of the transaction. According to Williamson, standard economic theory assumes that individuals regard transactions in a strictly neutral, instrumental manner. Subject only to the condition that transactions are technologically separable, each transaction can be priced separately and controlled independently. The piece wage is one of the reward systems based upon this very assumption. However, it may be more accurate to regard the exchange process itself as an object of value. Williamson refers to the matter of altruism in a study of blood donors (Titmuss, 1971). It appeared that the creation of a market for blood has transformed the nature of the transaction and decreased the altruism embodied in giving blood. Concern for atmosphere tends to raise a comparable system issue. It is conjectured that transactions which affect conceptions of self-esteem and well-being are especially important. Consequently, the influence of control intensity on work attitudes needs to be assessed with care. Efforts to divide the employment relation into parts and assess each part separately in strictly calculative, instrumental terms can have counterproductive consequences. Rather than regard transactions in strictly quid pro quo terms, with each account to be settled separately, at least some individuals look instead for a favorable balance among an interrelated set of transactions.

Alternative models of organization may differ in atmospheric respect. Market exchange tends predominantly to encourage calculative relations in a transaction. By contrast, internal organization is often better placed to make allowance for reciprocal, moral involvements among the parties. Moral involvement resembles reciprocal altruism in that there is a donation made for which nothing is immediately received in return (Gouldner, 1960). It is reciprocal altruism rather than true altruism (Becker, 1976), because there is another side to the transaction: the expectation of reciprocity in the future. Recognition that alternative modes of economic organization give rise to different exchange relations, and that these relations are valued by economic agents requires that organizational effectiveness is viewed more broadly than the usual efficiency calculus would dictate. Thus, modes of organization which would have superior productivity consequences if implemented within a group of pecuniary gain maximizers, may be

rejected by groups with different values. Consequently, a concern for atmosphere makes the supply of a satisfying exchange relation part of the economic problem.

Whereas technological interactions effects play a prominent role in economics, attitudinal interactions are commonly neglected. An example is the impact of control (meter) intensity where this is easy to control on the attitudes of agents concerning difficult to measure performance behaviors (Alchain and Demsetz, 1972). The authors refer to indiscretions in a university environment, discussed below. Suboptimality will result if the fiction of independence is maintained when in fact 'attitudinal spillovers' (Williamson, 1975) exist - especially when an employment relationship is involved. Generally, a reduction in monitoring gives rise to an increase in opportunism. Monitoring the employment relation, however, needs to be done with special care, because progressively increasing the intensity of surveillance can elicit resentment, and have counterproductive results, e.g. work-to-rule. As Sen (1977) has pointed out, atmosphere is important for economic efficiency, because it is costly and may be impossible to devise a system of supervision with rewards and punishments such that everyone has the incentive to exert himself. While less than perfect monitoring implies that some shirking incentive remains, running an organization on incentives for short term personal gain may be counterproductive. Every economic system therefore has to rely on the existence of work-related values which supersede the calculation of net gain from each transaction. As Arrow (1968) put it, "one of the characteristics of a successful economic system is that the relations of trust and confidence between principal and agent are sufficiently strong so that the agent will not cheat even though it may be 'rational economic behavior' to do so".

Williamson assumes that the requisite degree of cooperation between parties to a transaction arises not from a pre-existing harmony of interests, but from active efforts to craft mutual safeguards and harmonizing structures between coalitions (Cyert and March, 1963), i.e. parties whose interests are often opposed. In the end, the team is better off with team spirit and loyalty, because of the reduced shirking, not because of some feature inherent in loyalty or spirit as such (Alchian and Demsetz, 1972). Williamson, Wachter, and Harris (1975) distinguish two contrasting attitudes toward cooperation: consummate and perfunctory cooperation. Consummate cooperation is an affirmative job attitude - including the use of judgement, filling gaps, and taking initiative. It involves working in a fully functional, undistorted mode. Efforts are not purposefully withheld, neither is behavior of unknowingly inapt kind undertaken. In contrast, perfunctory cooperation is a job attitude which appeals more to the letter than to the spirit of the employment contract. The contract obligates employees to perform only a set of duties in accordance with minimum standards, and does not assure their striving to achieve optimum standards. It is not difficult to imagine that consummate cooperation is associated with higher productivity rates than perfunctory cooperation (Peters and Waterman, 1982).

Consummate cooperation, however, is a very delicate force - which may easily be disrupted (debunked) by an intensive metering atmosphere. A classical example is given by Alchian and Demsetz (1972) who refer to office telephones, paper, and mail for personal use by university members beyond strict university productivity. Extending metering with regard to such (costly to meter) indiscretions will presumably elicit resentment. As a consequence, all cooperative attitudes will be impaired with the result that tasks such as teaching or research, which can be metered only with difficulty and for which consummate cooperation is required, will be discharged in a highly perfunctory, i.e. ineffective way. Alchian and Demsetz' example shows that a less intensive effort to control costly to meter issues might yield system gains, especially in professional bureaucracies where monitoring is far from perfect. Perhaps the organization should be become less 'efficient' in order to become more 'effective'. The neglect of attitudinal spillovers is encouraged by an insensitivity to atmosphere. Atmosphere explains why individuals abstain from maximizing their expected utility in circumstances where the pressures are weak. It is central to the problem of work motivation and voluntary cooperation, the importance of which for increasing production performance or minimizing 'X-inefficiency' (Leibenstein, 1980) can hardly be ignored.

### 3.5.3. Efficiency attributes of the Peer Group

Williamson (1975) reserves the term 'atmosphere' for those transactions for which attitudinal spillovers are thought to be especially strong, in particular those in the governance structure called the peer group. Peer groups are small groups which involve collective and usually cooperative activity. Workers are compensated on the basis of the average product of the group. They do not entail coordination. They are characterized by the joining of a non-marginal productivity sharing rule with democratic decision making (Williamson, 1979, 1981). They have an advantage over the market to the extent that they are better able to limit membership in an ex ante discriminating way (adverse selection problem), and check ex post manifestations of moral hazard, especially when tasks are integrated. Members of peer groups or 'clans' (Ouchi, 1980) not only know the requisite attributes to look for in admitting a new member (better screening devices) but are able, as a byproduct of their working relations, mutually to monitor each other virtually automatically - at little incremental monitoring expense. As a result, the organization of transactions in the peer group is consistent with the efficiency imperative to economize on bounded rationality, while safeguarding against the hazards of opportunism.

Generally, a transformation of involvement, from a calculative to a reciprocal mode, is the result of the shift from the market to the peer group, especially if the metering of transactions among the members of the group is consciously suppressed and kept on an informal basis. Although the simple hierarchy, a governance structure dominated by centralization, has superior bounded

rationality properties, the peer group is not always replaced by the simple hierarchy - even when public goods are concerned which result in the free rider problem (Buchanan, 1971). The reason is that the peer group affords valued involvement relations that are upset, in some degree, by hierarchy. Moreover, atmosphere as an idiosyncratic stock of knowledge is apt to be superior to market organization in screening and experience rating respects, and in matching workers to workers (teambuilding). Hence the 'organizational capital' (Prescott and Visscher, 1980) of the team economizes on bounded rationality. Of course, the productivity loss which is inherent in the peer group form is only acceptable to the members, provided that survival is not threatened. Since individuals differ in their preferences for exchange relations, effectiveness may be increased by supplying a mixture of structures which vary in the intensity of metering, thereby allowing individuals to match themselves to organizations in accordance with their involvement-productivity tradeoffs (Williamson, 1975).

### 3.5.4. Benefits and Limits of Atmosphere

Adam Smith [1776] pronounced that it is not from the benevolence of the butcher that we expect our dinner but from his own self interest. Typically, neoclassical economists are concerned with market equilibria in which individual actors behave selfishly under the Walrasian postulate of perfect information and foresight. As a result, nonselfish values incorporated in fairness, trust, altruism and cooperation (in the absence of enforcement) pose serious anomalies for economic theory. But recently, an increasing number of authors have argued that the price system and the principle of reciprocity are essentially complementary (Arrow, 1974; Phelps, 1975) and that trust, i.e. confidence in each other's voluntary compliance, can be extremely efficient (McKean, 1975; Noreen, 1988). It saves a lot of trouble to have a fair degree of reliance on other people's word even or perhaps especially in business situations (Macaulay, 1963; McKean, 1975). While Akerlof (1979) showed the costs of dishonesty, Titmuss (1971) dealt with Kantian altruism in voluntary blood markets, and Arrow (1971) focused on the welfare economics of professional behavior in medical care, TCE has emphasized that consummate cooperation and reciprocal trust oil the wheels of the implicit contract. Like the bulk of an iceberg, an enormous portion of mutual understanding is invisible in the contract, since it would be extremely expensive to write every aspect of an agreement - the precise degree of craftsmanship in every task, the exact quality of materials, or the precise nature of every dimension of performance (McKean, 1975). Without a minimal amount of trust, the outcome of each transaction would be very uncertain, while the costs of writing complete contracts would be excessive. Consequently, an atmosphere of trust may be conceived as an important institutional source of economic structure (Zucker, 1986).

There are, however, also important limitations to the extent to which the general values mentioned above will actually be efficient. According to Collard (1978), spontaneous cooperation

turns out to be more likely (i) the smaller the number of players, (ii) the greater the advantage of cooperation, and (iii) the greater the marginal impact of the individual. Conditions (i) and (iii) are interdependent and are related to the question of increasing returns. To some limited degree this lends support to Schumacher's thesis that 'small is beautiful'. Even if people are only moderately cooperative, there is a far greater chance of voluntary cooperation in a small than in a large community. Collard (1978) refers to the fact of human nature, that (wo)men's loyalties are not to society at large but to particular groups or clubs. (Wo)men are generally only capable of limited altruism, directed towards a small circle of family and friends. While small groups are managed effectively through loyalty and trust, the sentiment of altruism tends to lose its practical effectiveness as we attempt to extend it to more distant individuals, that is, when the number of players is large (Buchanan, 1985). In Becker's (1976) terminology, there is altruism in the family, and selfishness in the marketplace.

By contrast, numerous authors have given examples of large firms which capture economies of atmosphere. For example, Fortune-500 companies such as IBM, MacDonalds, 3M Company, and Procter and Gamble (Peters and Waterman, 1982), and Japanese multinationals such as Mitsubishi, Sony and Toyota Motor Company (Ouchi, 1981; Aoki, 1984a; Itami, 1984; Morita with Rheingold and Shimomura, 1987). It may be argued that Japanese employees are more collectivistic (Hofstede, 1980), and hence their consummate cooperation is less constrained by a large number condition. But what about the relationship between atmosphere and performance in U.S. firms with such large numbers of pecuniary gain maximizers? In the spirit of TCE, the literature on internal labor markets (Doeringer and Piore, 1971; Okun, 1981) provides an economic rationale for the relation between atmosphere and efficiency in the large firm. In Williamson's terms, the internal labor market demonstrates the importance of asset specificity in the fundamental transition of the precontractual situation with a large number of buyers and sellers to the contractual execution stage where a bilateral monopolistic situation prevails.

### 3.5.5. Efficiency Attributes of the Internal Labor Market

The effect of large numbers is, on the one hand, that the individual has no decisive influence on the system, and is unable to appropriate the collective gain that would obtain were he voluntarily to forgo individual self-interest seeking (Olson, 1965). Hence, there is no incentive for consummate cooperation for large firm employees. On the other hand, it may be argued that the large firm has a higher tolerance for perfunctory performance, since the contribution of each individual in the large firm is small in relation to the whole, so that the average effect of opportunistic individual behavior will be insubstantial. The latter argument, however, is not very adequate, since if all individuals shirk, the effect will be substantial. Does this imply that the concept of atmosphere is only viable under small number conditions? The literature on the internal labor markets operating in large firms shows that this is not necessarily the case, because an atmosphere of fair values which are structurally embedded in rules, may increase productivity by reducing labor mobility and increasing stability. This atmosphere, however, is part of the governance structure called internal labor market in order to protect valuable human assets.

The classical description of the internal labor market (ILM) is provided by Doeringer and Piore (1971). They define the internal labor market as an administrative unit within which the pricing and allocation of labor is governed by a set of administrative rules and procedures. The rules governing internal labor allocation and pricing accord certain rights and privileges to the ILM forces which are not available to workers in the external labor market. For example, the employees have 'property rights' to jobs filled internally, and continuity of employment is protected from external competition. The utility of the ILM as a theoretical construct depends upon the rigidity of rules which define the boundaries of ILMs, and which govern pricing and allocation within them. If these rules are not rigid and respond freely to variations in economic conditions, their independent economic role will be minimal. If, however, the rules are rigid, they will interrupt or transform economic influences causing the ILM to respond to dynamic economic events in a manner not readily predictable from conventional economic theory, e.g. relatively stable wages and turn-over rates under different business cycles. Doeringer and Piore discovered three sources of constrained flexibility: (i) skill specificity, (ii) on-the-job training, and (iii) custom. They will be dealt with in the next sections.

### 3.5.5.1. General and Specific Skills

Becker (1964) has made the classic distinction between specific and general training. Specific training is defined as training that has no effect on the productivity of trainees that would be useful in other firms. As a consequence, costs are associated with turnover - both for the employee and the present employer, because both parties make an investment in specific human capital. General training increases the marginal productivity of trainees by exactly the same amount in the firms providing the training as in other firms. Thus, turnover will have no impact on productivity. According to Doeringer and Piore (1971), training is more or less specific according to the type of skill it provides. They distinguish general and specific skills with the latter skill in particular important for the analysis of the ILM. Skill specificity refers to the inability of workers to transfer their skills to alternative employment, and thus requires that the firm functions as an insurance institution. As skills become more specific, it becomes increasingly difficult for the worker to utilize elsewhere the enterprise specific training he receives. This, undoubtedly, reduces the incentive for him to invest in such training, while simultaneously increasing the incentive for the employer to make such investment. Labor becomes a quasi-fixed factor of production, and management incurs costs if a worker leaves and must be replaced. Moreover, skill specificity tends to increase the absolute cost of training because the less prevalent the skill in the labor market, the less frequent provision there is for training in that skill so that economies of scale cannot be realized. Both of these effects encourage the employer to seek to reduce labor turnover, for example by supplying safeguards.

While attributing an efficiency function to the ILM, Doeringer and Piore use an internalization argument which is rather similar to the comparative governance approach of TCE. They assume that ILMs are initiated at the discretion of the management, and that managers seek to minimize labor costs. It follows from the latter assumption that jobs will be awarded to the lowest bidder unless the high price of a competing worker is compensated by high productivity. The competitive market procedure will be replaced by the ILM arrangement if total labor costs, including the costs associated with turnover, are thereby reduced - i.e. where specific skills are concerned.

### 3.5.5.2. On-the-Job Training

The second factor critical in the development of ILMs is on-the-job training. To the extent that skill specificity leads to unrecorded knowledge, it necessitates the process of direct skill transmission from incumbent to successor in the production process. This is the essence of on-the-job training. Such training is more economical than formal instruction in several

respects. Because it is derived from the content of the job, it is confined only to those skills required for the job and involves no excess training. Further, the costs of on-the-job training is reduced by future output which is unavailable when training is conducted outside the plant. On the other hand, on-the-job training frequently involves waste of material, machine damage, reduction in product quality, and sacrifices in the productivity of both the trainee and the instructor.

Skill specificity and on-the-job training place a tremendous amount of power in the hand of the experienced labor force, i.e. the power to threaten turnover which may be very costly for the employer, or to refuse to transfer their specific skills to the newcomers, thus wrecking the learning-by-doing process. Besides, the employee may perform in a perfunctory manner in the knowledge that consummate cooperation is necessary to do the job. Informal training requires an attitude of consummate cooperation in the experienced workman. Where skills are specific, the tacit knowledge of the experienced work force is indispensable to training. Allocative and pricing rules which respond freely to variations in the supply of trained labor may, inadvertently, create an incentive for workers to frustrate the training process whenever possible. A certain degree of wage rigidity and job security is therefore necessary for on-the-job training to operate at all, especially in plants where interaction among workers is an important part of the production process. In Okun's (1981) terminology, the employment relation is more efficiently governed by an 'invisible handshake' than by the invisible hand. In these firms, an atmosphere of fairness may be a necessary condition for high productivity. For instance, a common way to promote the transmission of specific skills is seniority. In the case of strict seniority, jobs are allocated to workers in the order in which they entered the internal market. Because senior workers are guaranteed precedence in employment and promotion over those with less seniority, competition between workers decreases, and senior workers are cooperative in instructing the 'green hands' which enter the firm after them.

#### 3.5.5.3. Customs in the ILM

According to Doeringer and Piore, custom is the third of the major forces important to the understanding of the ILM. Custom at the workplace is defined as an unwritten, and therefore flexible, set of rules based largely upon past practice. These rules can govern any aspect of the work relationship from discipline to compensation. When employment is stable, the same workers come into regular and repeated contact with each other, resulting in the workers developing an interdependent utility function, and communities being formed within the ILM. Communities of this type tend to generate 'shop law' - a set of unwritten rules governing the actions of their members. Adherence to these idiosyncratic 'rules of fairness' (Kahneman et al.,

1986) tends to be viewed as a moral issue. Often supported by a special arbitration apparatus, the custom provides an internal code which permits idiosyncratic conditions to be communicated, thus economizing on bounded rationality. Moreover, reputation damages and utility losses may be associated with disobedience of customs, so that social customs that are costly for the individual to follow nevertheless persist (Akerlof, 1980). In Sen's (19*) terminology, altruistic behavior is facilitated in the ILM. The care for each other's welfare functions indicate sympathy between workers, while the adherence to customs indicates commitment (non-adherence, it will be recalled, under the right circumstances is of pecuniary advantage to the person who disobeys).

Thus, Doeringer and Piore have demonstrated that an atmosphere of fairness generating consumate cooperation is not necessarily inconsistent with a large number condition. As a matter of fact, the ILM shows a transition from a precontractual (large numbers situation in the external labor market) to a postcontractual (small number bidding situation in the internal labor market) situation as caused by joint investments in specific, non-transferable human capital. The ILM case is consistent with transaction cost economics because *ex post* contractual costs are emphasized, i.e. the costs incurred in subsequently administering, informing, monitoring, and enforcing the contractually promised performance. Williamson labels the transition mentioned above from precontract to postcontract as the fundamental transformation. Options available in the former stage are lost in the latter. As a consequence, the value of some resources becomes dependent on particular unique other parties because a loss of significant substitutability by equivalent resources.

Adherence to work customs is not costless. Where customs are in conflict with economic demands, economic constraints begin to affect profits, wages, and employment. Diseconomies of atmosphere may emerge even where work rules may have initially reflected economic forces, because customs constrain flexibility and make it difficult to change in response to dynamic economic forces. Customs which are suboptimal in their adaptation to the environment are a competitive disadvantage to the firm with bankruptcy as the ultimate sanction.

### 3.5.6. Human Asset Specificity, Atmosphere, and ILM Efficiency

The ILM is the institutional form of Williamson's economics of atmosphere replacing the invisible hand by the invisible handshake in the large firm. Obviously, economies of atmosphere are not relevant in the firm's spot market contractual relations with employees who are only in the possession of general skills. The fundamental transformation, i.e. the transformation of a large number situation in the precontractual stage to a small number bidding situation in the contractual execution stage, is only executed when human asset

specificity exists. Human asset specificity is critical because, once an investment has been made, the buyer and seller of labor are effectively operating in a bilateral exchange relation for a considerable period thereafter. Doeringer and Piore's skill specificity refers to human assets that arise from learning by doing. They are skills that are required in a learning-by-doing fashion and that are imperfectly transferable to other employers. Thus, a non-marketability problem arises for the seller. Specific skills have to be embedded in a protective governance structure lest productive values be sacrificed if the employment relationship is unwittingly severed. Inasmuch as the value of specific human capital in other uses is, by definition, much smaller than the specialized use for which it has been intended, the employee is effectively 'locked into the transaction'. This is symmetrical, in that the employer cannot turn to alternative sources of supply and obtain the item on favorable terms, since the cost of supply from unspecialized human capital is presumably great. Where human asset specificity is great, employer and employee will make special efforts to design an exchange relationship that has good continuity properties. The ILM case explains why the creation of an atmosphere where fairness and reciprocity are emphasized is efficient: as a consequence of human asset specificity, the parties to the contract are 'locked into the transaction'. As a result, there is an incentive for the employer and employee to design an exchange relation that has good continuity properties. Atmosphere is the informal side of the protective governance structure which protects the durable investment in transaction specific assets. Valuable as it may be, however, atmosphere is not a substitute for more structural measures like tenure, seniority, internal promotions, company unions, rigid wage rates, and 'golden parachutes'.

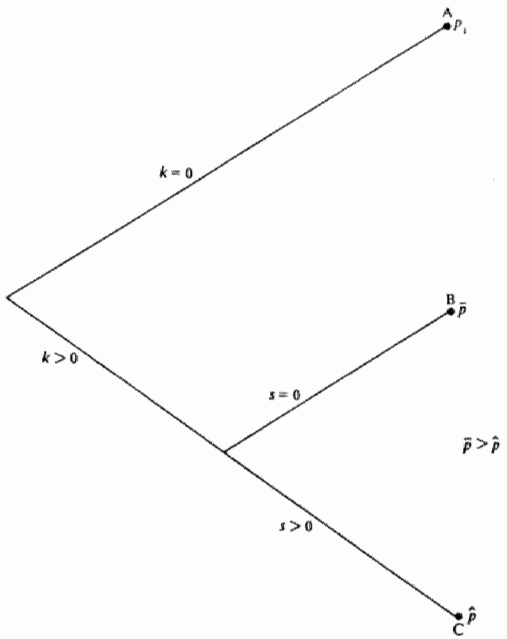
Regarding the efficiency of the ILM, opportunism is attenuated by a wage structure which forecloses individual bargaining, by internal promotion procedures such as the seniority system, and by offering long term employment contracts. These procedures encourage trust relations and consummate cooperation. They stimulate the transfer of specific knowledge within the firm. Moreover, they offer long term monitoring opportunities. The ILM economizes on bounded rationality by writing contracts in general and flexible terms, and supplying the parties with a special arbitration machinery. Rather than attempting to anticipate all bridges that might conceivable be faced, which is excessively costly, bridges are crossed as they appear. But however attractive incomplete contracts are in bounded rationality respects (Llewellyn, 1931; Goldberg, 1963; Macaulay, 1963; MacNeil, 1974; 1978), admitting gaps also poses hazards. Where parties are not indifferent with respect to the manner in which gaps are to be filled, individual bargaining or litigation may result. The firm's specific arbitration apparatus is devised for prevention purposes. It serves to overcome information impactedness, in that the arbitrator is able to explore the facts in greater depth and with greater sensitivity to the idiosyncratic attributes of the enterprise than could judicial proceedings. Furthermore, once it becomes recognized that the arbitrator is able to apprise

himself of the facts in a low cost way, opportunistic misrepresentation of the data is discouraged as well. The arbitration machinery associated with the ILM is apt to be valued not only for efficiency reasons, but also because a greater sense of justice results. Unlike the commercial arbitrator, the firm specific arbitrator not only finds facts, but also pours meaning into the general phrases of a document.

### 3.5.7. Equilibrium of Asset Specificity, Price, and Contractual Safeguard

A simple contractual schema elaborating within the firm the complex equilibrium of contractual relationships, entailing the simultaneous determination of asset specificity, price, and contractual safeguards, is given in exhibit 3.2 (Williamson, 1985: 33). The purpose of this schema is to summarize the previous arguments in a somewhat more general manner.

Exhibit 3.2. A Simple Contractual Schema



Williamson uses k as a measure of transaction specific assets, i.e. general technologies or skills are ones for which k=0, while specific skills are ones for which k>0. Since productive values would be sacrificed if k>0, a bilateral monopoly conditions applies to the latter transaction. Whereas classical market contracting - sharp in by clear agreement, sharp out by clear performance - suffices for transactions of the k=0 kind (MacNeil, 1974), unassisted market governance poses hazards when a k>0 condition exists. As a result, parties have an incentive to devise safeguards (s denotes magnitude of the safeguard) to protect investments in transactions of the latter kind. An s=0 condition is one in which no safeguards are provided, while a decision to provide safeguards is reflected by an s>0 result.

Exhibit 3.2. displays the three contracting outcomes corresponding to such a description. The equilibrium contractual relationship between technology, price, and safeguards are described as follows: "Associated with each node is a price. So as to facilitate comparisons between nodes, assume that suppliers (1) are risk neutral, (2) are prepared to supply under either technology, and (3) will accept any safeguard condition whatsoever as long as an expected breakeven result can be projected. Thus node A is the general purpose technology (k=0) supply relation for which a breakeven price of $p_i$ is projected. The node B contract is supported by transaction-specific assets (k>0) for which no safeguard is offered (s=0). The expected breakeven price here is $\bar{p}$. The node C contract also employs the special purpose technology. But since the buyer at this node provides the supplier with a safeguard (s>0), the breakeven price, $\hat{p}$, at node C is less than $\bar{p}$" (Williamson, 1985: 33). Transactions at node B enjoy no safeguards on which account the projected breakeven supply price is great ($\bar{p}>\hat{p}$). Contractually, such transactions are conceived as unstable. They may revert to node A (in which event the special purpose technology would be replaced by the k=0 technology) or be relocated to node C (by introducing contractual safeguards that would encourage the continued use of the k>0 technology).

### 3.5.8. Reciprocity as a Credible Commitment

The simple schema demonstrates that costs are associated with incentive contracts that do not share risk efficiently (Noreen, 1988). As Williamson put it: "Inasmuch as price and governance are linked, parties to a contract should not expect to have their cake (low price) and eat it too (no safeguard)" (Ibid.: 19). An atmosphere emphasizing reciprocity and mutual risk sharing may be conceived as the informal side of the S>0 condition. Reciprocity and other 'credible commitments' (Williamson, 1983) such as buy-sell agreements, most-favoured-customer clauses, and joint ventures are undertaken in support of alliances and to promote exchange. These commitments involve reciprocal acts to safeguard a relationship, and to protect asset specific investments from holdup. They can serve as means of creating

competitive, economical mutual reliance and self-enforcing contracts. For the purpose of studying economic organizations, the important lesson is that transactions that are subject to ex post opportunism will benefit if appropriate safeguards can be devised ex ante. Rather than reply to pre-emptive opportunism (which is a very primitive response) the parties of firm-specific transactions seek to give and to receive credible commitments (Alchian and Woodward, 1988).

### 3.5.9. Interim Conclusions

Regarding the research questions posed in chapter 1, the following conclusions may be derived from the preceding sections:

1. TCE shows that economies of atmosphere exist at the firm level. When human asset specificity is great, opportunism is attenuated by creating (among others) an atmosphere of fairness, while bounded rationality is economized by incomplete contracting. Atmosphere is, of course, only a partial solution to the managerial problem. In the internal labor market, for instance, it has to be supported by structural measures such as rationalization of the wage structure, an internal promotion procedure, and a special arbitration apparatus.
2. The main antecedent of economies of atmosphere is human asset specificity. Given a world characterized by bounded rationality and opportunism, employer and employee are locked into the transaction when an investment is made in specific human capital. As a result, special efforts will be made to create an atmosphere of fairness, i.e. to design a protective exchange relationship that has good continuity properties. Reciprocity thereby is among one of the possible credible commitments.
3. Credible commitments are given in the expectation that credible commitments will be received and that, as a consequence, the system will function more efficiently and there is more to be consumed by everyone. It is clear that a great deal of time has to be invested in creating such an atmosphere of reciprocal altruism - particularly under large number conditions. Consequently, it is only expected to be done when the parties to the contract are sufficiently locked into the transaction, for instance, when specific technology is required to do the job, and turnover costs are high.

## 3.6. The Firm as an Information Processing Apparatus

The next sections will focus the attention to the information processing view of the firm. Economic theory is founded on the assumption that firms will behave as if they are able to maximize, regardless of how complex their decision problems might be. Consequently, the theory has never investigated the consequences of a genuine gap between human decision making

capacity and the difficulty of a decision problem. In a seminal article, Heiner (1983) has argued for a new approach to the realm of behavior under uncertainty. He proposes that an action will only be added to the repertoire of actions if certain criteria of reliability are satisfied for that action. He argues that given increased uncertainty, the repertoire of actions will be limited. With few actions from which to choose, savings on decision costs can be made, and the individual's behavior will be more predictable. Predictable or 'flexibility constrained' behavior evolves to the extent that uncertainty prevents agents from successfully maximizing. Heiner then suggests that this explains behavior in a surprisingly wide range of applications, including the evolution of social institutions. Uncertainty is the main source of observed regularities in economic behavior, including the predictable behavior of buyers and sellers in financial markets (Kaen and Rosenman, 1986).

Heiner believes that when uncertainty exists, flexibility to react to more information or administer a more complex repertoire of actions will not necessarily enhance an agent's performance. On the contrary, sequential replication games of the basic prisoner's dilemma empirically showed that the worst performance came from the most sophisticated strategy, whereas the simplest strategy was identified as dominant over all the others (Axelrod, 1984) In addition, Simon [1954] showed that decision makers in a variety of contexts systematically restrict the use and acquisition of information compared to the potentially available information. Thus, an agent's overall performance may actually be improved by restricting flexibility to use information or to choose particular actions. Note that restrictions in flexibility or regularities in economic behavior introduces the role of history. This contrasts with economic analyses in which the weight of the past is generally disregarded. For instance, the principal-agent framework, one of the dominant paradigms in the economic theory of organization, assumes that the principal and the agent meet once and sign a contract which is then executed (Crémer, 1987).

### 3.6.1. Economizing on Information

Arrow (1978) discusses uncertainty as a consequence of the role of time in economic affairs. Generally, there is an emphasis on the economic future as against the fleetingness of the present. For example, economic decisions are mostly seen as concerned with decisions on holdings of assets rather than on choices of cash flows. Decisions to hold assets are determined by anticipations of the future. The dominance of the anticipated future has led to an increasing emphasis of uncertainty, as it is recognized that forecasting is uncertain, and that we can never known the future in detail. In contrast to the Arrow-Debreu model (Arrow and Debreu, 1954) implying a set of 'futures markets for all commodities for all future dates', it is recognized that the requirement of perfect foresight cannot hold literally.

Information processing ability is scarce. Moreover, in a decentralized economy, individuals have different information, and each individual is specialized in certain activities and has only general knowledge about other activities. Given the scarcity of information processing ability, agents concentrate on acquiring the information most useful to them, and will crowd out the information which is less useful. Information broadly pertinent to the economy as a whole may have very little predictive power for the future of that agent. Each agent bases his anticipations on all the information at his disposal and this may include a great many facts and observations not available to others. Thus, the agent, as an economizer of information, will make forecasts on information which is not common to the general population. In a decentralized (competitive) economy, he will specialize in idiosyncratic rather than in general knowledge (Arrow, 1974a).

### 3.6.2. Information Processing Approach to Atmosphere

Clearly, atmosphere can be seen as a response to uncertainty, because it is a perfect example of constrained flexibility, especially in the domain of information processing behavior. In his discussion of the cognitive aspects of corporate culture, Crémer (1987) asks the fundamental question: why is corporate culture a factor of efficiency in the internal treatment of information within organizations? His basic thesis is that culture can enable the organization to respond better to the information it receives. Corporate culture is defined as a stock of knowledge that is common to a substantial portion of the employees of the firm, but not to the general population from which they are drawn. It is the portion of specific human capital that is common to many employees of the firm. Organizations have specialized in specific knowledge as a response to the strategic problem of external adaptation (Itami, with Roehl, 1987), whereas their internal integration is promoted by investing in a stock of knowledge which is common to the members of the firm (Crémer, 1987). As mentioned before, Crémer analyzes culture by decomposing it into three elements: (a) a common code, (b) a common knowledge of facts, and (c) a common knowledge of (behavioral) rules. The next sections investigate how these aspects are related to efficiency from an information processing perspective.

### 3.6.3. Common Code

In fact, the first aspect has been extensively discussed by Arrow (1974a). According to Arrow, the functional role of an organization is to take advantage of the superior productivity of joint actions. An organization can acquire more information than any one individual, for it can have each member performing different experiments (specialization). But there is a price to be paid. The information has to be coordinated if it is to be of any use to the firm, i.e.

communication channels have to be created within the firm. If all information received by any member of the organization were transmitted to all others, there would be no gain in information processing costs.The information has to be reduced without loss of value. Much of the information received is irrelevant, so that what is received by one member of the organization is transformed into a much smaller volume for retransmission without losing value for decision making. The firm should develop its own system of 'sufficient statistics'. This need for efficient retransmission explains the utility of an organization for information processing. Since information is scarce, it is optimal to reduce the internal transmission still further. Since internal communication channels can be designed, their structure can be chosen with a view to cost minimization. As Arrow points out, the efficiency of a channel can be increased particularly by the choice of a suitable code.

The code refers to all the known (formal and informal) ways for conveying information. It is efficient to generate a specialized code when some type of information is to be transmitted repeatedly. The code is the common language and becomes the way of looking at the world, because it is the idiosyncratic filter through which all information inputs are processed. Coding has two economic implications: (i) It creates an irreversible capital commitment of the firm; (ii) while coding permits a greater number of individual information sources to be pooled usefully, there are increasing costs of coordination as scale grows.

With regard to the first point, it is necessary to have made an adequate investment of time and effort in order to be able to receive and retransmit signals - comparable with learning a foreign language. Others have found it economical to use a large number of possible codes, and for any newcomer it is necessary to make an initial investment to acquire it. The learning of a (specific) code is both an act of irreversible investment for the employee, and an irreversible capital accumulation for the employer. Such investment, being locked up in individual minds, is irreversible, because it remains in the possession of the individuals. Once the investment has been made, and an information channel acquired, it will be cheaper to keep on using it than to invest in new channels. Once created, organizations develop an identity (Selznick, 1957), because sunk costs have been made, and the (transition) costs of changing the code are nontrivial. Apparently, history matters. The code is determined in accordance with the best expectations at the time of the firm's creation. Since the code is part of the firm's sunk capital, and transistion costs may be high, the code of a given firm will be modified only slowly over time. In order to economize on information costs the code constrains flexibility.

Concerning the second point, the limited computational capacity of the decision maker for acquiring and using information is a fixed factor in information processing, and one may expect certain diminishing returns in response to increases in other information resources, cf. the

'span of control' in management science. In addition, the organization's gains from increasing scale are derived by specialization, that is, by having its members make different experiments. Members will be accumulating different types of skills in information processing, i.e. they learn more in the direction of their activity, and will unlearn elsewhere. Obviously, it is easier to communicate with individuals with whom one has a common code. As a result, communication among them becomes more difficult, and the codes used in their intercommunications have to become more complex. As a function of increasing scale, there is a growing need for codes to be mutually understandable within the organization imposing a uniformity requirement on the behavior of the participants (Arrow, 1974a).

Crémer (1987) describes the firm as an information processing apparatus. It receives messages from its environment, processes them and responds with a message. By analogy with standard definitions of technical efficiency, this response is cost-efficient when a set of decisions of a given quality is taken at the lowest possible costs. The quality of a response is defined by its appropriateness (in serving the interests of the firm) and its speed. Increasing the speed of the response decreases the costs as the decision maker spends less time processing information. A common code influences the appropriateness of response, because the code is specialized, i.e. specific ('to the point') rather than general signals will be given. The presence of a code increases the speed of the response because it carries large amounts of meaning with relatively few symbols. Organizations find blueprints, product number systems, and occupational jargons helpful in increasing the efficiency of their internal communications.

### 3.6.4. Knowledge of Specific Facts

Coding is only one aspect of culture. Culture, it will be recalled, may be regarded as a stock of accumulated information, and thus another aspect of culture is the common knowledge of specific facts. A certain number of facts (including the fact that others know them) are known by most members of the organization. Employees learn about the general background: the objectives of the firm, how the product is conceived and sold. In addition, functional aspects are known throughout the firm, including the location of factories, telephone codes, and the responsibilities of different executives.The presence of a common set of known facts will increase the effectiveness of communications, especially if agents know what the others know. If many facts are known by every recipient, less communication is required. Moreover, only the relevant information is transmitted. Furthermore, common knowledge of facts about the organization enables agents to take more appropriate decisions. It enables them to compute more accurately the benefits and costs of the organization, because they can predict better the reactions of the rest of the organization. Moreover, it allows more specific reactions to environmental messages as the agents have a more subtle understanding of the range of actions

that can be taken. Finally, 'personnel information', which may be part of the common knowledge, facilitates the matching of workers to tasks at which they have a comparative advantage, whereas team information facilitates teambuilding - the matching of workers to workers. Following Alchian and Demsetz (1972) treatment of the team as an alternative allocating mechanism using 'inside' information on input factors of production, Prescott and Visscher (1980) have argued out that personnel and team information are part of the organizational capital, and that a poor match between workers, tasks and team members is, in general, not indifferent to the firm.

### 3.6.5. Rules of Behavior

The third element of Crémer's decomposition of culture is the knowledge of the rules of behavior which employees must agree to follow. These rules can be conducive to greater efficiency if they are at the same time simple and broadly applicable enough. They must serve as guides to decision making under uncertainty. The knowledge of simple rules (and the knowledge that others know them, and will adhere to them) enables the agent to predict the actions of others. Rules make the actions of the different employees of the firm more predictable. An extreme case of the role of simple rules to ease decentralized decisions is given by Arrow (1974a). Military culture stresses obedience. During combat, officers have to make rapid decisions. For coordination purposes, they need to know precisely what their subordinates are doing. Hence, it is better that the latter obey orders even when they have information that shows them to be suboptimal. In this example, simple rules restrict the actions of subordinates and help predict their behavior for coordination purposes. In addition, simple rules facilitate computations because they cut off some branches of the decision tree. As Crémer (1987) illustrates, if the culture emphasizes the smooth running of the production process, a salesman will not have to explore the branches of his decision tree that involve modifying a product extensively in order to please a client.

### 3.6.6. Interim Conclusions

Regarding the research questions, the preceding sections permit the following conclusions to be derived:

1. If atmosphere is conceived as a common stock of knowledge, the information processing approach shows that an efficiency function can be attributed to atmosphere.

2. Why is atmosphere efficient? It is argued that the more developed the common stock of knowledge, the more it will facilitate appropriate and fast responses - by providing easy

access to information, increasing the predictability of the other agent's behavior, and by coordinating the bounded rationality of the different members of the organization. Atmosphere is stronger the greater the stock of knowledge (of a code, facts, and rules) common to the employees, whereas the strength of atmosphere is determined by the degree of common learning within the organization (socialization) and the degree to which personnel selection is focused on special subgroups of the population (standardization of skills).

3. Knowledge may decrease errors (waste), and enhance technical efficiency. Monetary and time resources have to be sacrificed in order to invest in a common stock of knowledge. It pays to do so, but not unlimitedly. When firms overinvest in on-the-job training or select employees with a Ph.D. degree where an ordinary M.A. degree suffices, the production costs are unnecesarily high.

### 3.7. Alternative Sources of Efficiency: Scale and Scope

In general, the criterion for organizing economic transactions is assumed to be cost minimization (Knight, 1921). In addition, Williamson has stated that "the criterion for organizing commercial transactions is asumed to be the strictly instrumental one of cost economizing. Essentially this takes two parts: economizing on production expenses and economizing on transaction costs. In fact, these are not independent and need to be addressed simultaneously" (Williamson, in: Chandler, forthcoming: 34). Elaborating upon TCE, this chapter has attempted to develop a theoretical rationale for the attribution of a transaction cost minimization function to atmosphere. Transaction costs are reduced by economizing on bounded rationality, while simultaneously attenuating opportunism. Williamson has rightly pointed out that the economic problem is not saving on transaction costs, but saving on the sum of transaction and production costs. Consequently, production costs should be considered as well. Neoclassical economics has emphasized an important mechanism which may decrease production costs, i.e. economies of scale (Stiglitz, 1958). Recently, it has been recognized that economies of scope may also contribute to least cost profit maximization (Panzar and Willig, 1975; 1981). Regarding the economic problem, one might say that economies of scale, scope, and atmosphere are complementary rather than substitutes. The following sections define the alternative sources of efficiency in order to enable a systematic comparison to be made with the economies of atmosphere principle.

### 3.7.1. Economies of Scale

Scale economies permit relatively large producers to manufacture and market their products at lower average cost per unit than relatively small producers. The concept is especially important in the field of industrial economics (Scherer, 1971; Shepherd, 1979). The principal basis of scale economies is specialization or the division of labor. In Adam Smith's view [1776], great reductions in production costs were due to three repercussions of the division of labor: an increase in worker dexterity, the saving of time, and the invention of machines enabling one man to do the work of many. In large firms, a richer division of labor is possible than in small firms. The low volume production line sacrifices either specialization or full utilization of specialized resources, and thereby suffers some cost disadvantage. Identical principles apply in the use of machinery. Special machinery can be designed to perform special tasks at considerable savings of time and labor. But the small scale producer may find no advantage in adopting them, because they cannot be scaled down and would, therefore, be idle much of the time, leaving a small number of units of output to bear the full burden of their capital costs.

Another benefit of size arises from reserves. A firm anxious to maintain continuity of production must hold equipment in reserve against machine breakdowns. A firm which is just large enough to use only one specialized machine may be forced to double its capacity if it insists on hedging against breakdown. The larger firm with numerous machines can obtain virtually the same degree of protection by holding only a small proportion of its capacity in reserve. Moreover, the large firm can spread overhead costs over a range of products. In addition, size offers advantages in maintaining capacity sufficient to meet fluctuations in demand, for the larger the number of customers a given production center serves, the more the random peaks and valleys in individual customer demand tend to cancel out, allowing the large firm to maintain less reserve capacity relative to the average level of demand.

From a dynamic point of view, the economies of scale principle is related to the phenomenon of learning curves (Hall and Howell, 1985). When a new product is introduced, the cost per unit at plant level is initially high, but as cumulative output increases, the costs per unit fall in an orderly way, such that the log of the current average cost is related linearly to the log of cumulative output to date. This learning-by-doing phenomenon can have first mover advantage implications, since the firm which gets in first and accumulates experience may be able to maintain a continuing cost advantage over later entrants. Of course, the decline in costs does not continue indefinitely. In nearly all production and distribution operations the realization of scale economies is subject to diminishing returns. Sooner or later a point is reached at which all opportunities for making further cost reductions through increased size are exhausted. The

sources of economies can become causes of diseconomies if they are pushed too far. Thus, excessive specialization has bred such alienation among workers that frequent breakdowns, and careless work result. In addition, it is possible that rising unit costs related to the difficulty of managing an enterprise of increasingly large scale will offset and eventually overwhelm the savings attributable to high volume and distribution.

Two hypotheses in this vein have been advanced. For one, the entrepreneur or the chief executive officer is a fixed, indivisible input. Whenever increasing doses of variable inputs (workers, middle managers, machines) are used in combination with some fixed input, sooner or later diminishing marginal returns take hold. A related hypothesis asserts that as the enterprise increases in size, it becomes more difficult to keep each unit's operations in harmony with those of every other part. The coordination problem results in upward pressure on costs. At some critical point the diseconomies of large scale management overpower economies of scale, and unit costs begin rising with output, giving the long run average total costs curve its familiar U-shape. The downward segment of the 'U' is governed by scale economies, the upward thrust by managerial diseconomies which may be overcome only partially by a system of checks and balances which reduces the probability that important aspects of decisions will be overlooked.

Economies of scale may be real (those which reduce the inputs of factors per unit of output) or pecuniary (those which result from paying a lower price for the inputs purchased by the firm). The latter do not reduce the quantity of inputs, but rather the money costs of the inputs for the particular firms. Real economies are technical (resulting from using more efficient large scale machinery), managerial (resulting from spreading the managerial fixed input over a larger amount of output) and labor economies (arising from the greater specialization of the labor force). The distinction between real and pecuniary is useful for the welfare implications of these economies. Technical economies raise allocative efficiency, whereas pecuniary economies mainly imply a redistribution of income - benefitting large firms at the expense of input suppliers.

Whatever their nature economies of scale, whenever present, do form an important barrier to entry for new firms. In discussing barriers to new competition, the concept of minimum optimal (efficient) economies of scale is especially relevant. It is assumed that for each industry there exists a minimum optimal scale of plant, that is a minimum plant size at which the economies of scale are fully realized. Furthermore, costs are assumed to remain constant beyond the minimum optimal scale. Finally, the minimum optimal scale is the same for all firms, the established ones and the potential entrants, since technology is the same for all. The advantage of the established firms is that they have already reached scales of outputs larger

than the minimum optimal scale, while the entrant will have to establish itself gradually, starting perhaps from suboptimal levels of production. In this event, it must be assumed that the entrant expects eventually to reach the minimum optimal scale, otherwise it would not enter the market. If the actual state of the entrant is equal to or greater than the minimum optimal scale size of plant, there is no barrier to entry (Koutsoyiannis, 1979).

There is no minimum efficient scale for all industries. Chandler (forthcoming) has rightly emphasized that different production technologies have different scale economies. In some industries, such as oil, steel, and aluminum, the cost-curve gradient is steep and the penalties of producing below minimum efficient size are severe. In others, such as soap, cereal, and similar branded packaged products, the gradient is less steep and the penalties of operating below minimum efficient size not as severe.

### 3.7.2. Economies of Scope

Economies of scope exist when for all outputs, $y_1$ and $y_2$, the cost of joint production is less than the cost (c) of producing each output (y) separately. That is, it is the condition for all $y_1$ and $y_2$, (Panzar and Willig, 1975),

$$c\ (y_1, y_2) < c\ (y_1, 0) + c\ (0, y_2).$$

With economies of scope, joint production of two goods by one enterprise is less costly than the combined costs of production of two specialty firms. Whereas economies of scale refer to declining average costs associated with increasing output of a single product function, economies of scope are realized when it is less costly to combine two or more product lines in one firm rather than produce them separately. Examples are department stores which enjoy significant economies of scope in their retailing function by carrying many products and brands, or the common utilization of new distribution systems for the transport of ice, meat, and fruits (Chandler, in: Hendrikse and Schreuder, 1987). In Chandler's forthcoming work on scale and scope economies, he compares the American oil industry and the German chemical industry. "In the same years that Standard Oil was investing in its large refineries to exploit the economies of scale, the German dye makers were maken an even larger investment to exploit fully the economies of scope. The enlarged plants produced literally hundreds of dyes as well as pharmaceuticals from the same raw materials and the same intermediate chemical compounds. The first three enterprises to make such investments to exploit the cost advantages of scale and then those of scope - Bayer, Hoechst, and BASF - were able to reduce the price of a new, synthetic dye, red alizarine, from 270 Marks per kilo in 1869 to nine marks in 1886 and to make comparable price reductions in their other dyes" (Chandler, forthcoming: 42).

In contrast to industrial organization economists such as Scherer, Chandler emphasizes throughput, i.e. the technological advantages of scale cannot be achieved without managerial coordination. Regarding scope in the chemical industry, it is argued that the addition of each dye involved the development of a specialized product - requiring constant supervision to assure the necessary quality - and steadily increase the need for organizational coordination. With regard to distribution, Chandler argues that, just like manufacturers, wholesalers and retailers as well were organized specifically to exploit both economies of scale and scope. Concerning distribution, it is argued that the cost advantages of joint distribution or scope are reduced when products require specialized facilities and skills in marketing and distribution. This is also true for transactions. "If the transactions were complex, however, if the products required specialized knowledge in order to sell, to install, to maintain, and to make the necessary credit arrangements, and if costly specialized facilities were required to distribute the goods, the intermediary had to hire personnel with specialized skills and invest in specialized facilities - skills and facilities that were often applicable only to one particular product line". Obviously, both scale and scope have limits.

Whereas minimizing production costs is the main objective of economies of scale, Teece (1984) has shown that the internalization of economies of scope within one firm can only be explained when both production and transaction costs are taken into account. If the technology displays scope economies, but market transactions can be used to transfer the advantages of joint production to another firm, the production of two goods by two firms will not be more costly than the production of the goods by a multiproduct firm. According to Teece, the organizational implications of scope are only clear when there is a market failure, so that unless production is centralized in only one firm, it is impossible to cash in on the advantages of joint production. One explanation for market failure is to be found in the nature of the commodity sold, especially when the commodity is information. Market exchange may break down because of the problems of disclosing value to buyers in a way that is both convincing and does not destroy the basis for exchange. A very severe information impactedness problem exists, in which the less informed party (the buyer) must be wary of opportunistic representations by the seller. If, moreover, there is insufficient disclosure to assure the buyer that information possesses great value, the 'fundamental paradox' of information arises: its value to the purchaser is not known until he has the information, but then he has in effect acquired it without cost (Arrow, 1971). Teece argues that the multiproduct enterprise is an efficient way of organizing economic activity, if the fundamental paradox of information is not resolved, and if economies of scope are based upon the common and recurrent use of proprietary knowhow or the common and recurrent use of a specialized and indivisible physical asset. In addition, Jones and Hill (1988) have argued that economies of scope are

difficult to realize using the market mechanism, because of transaction difficulties. In a world characterized by bounded rationality and information impactedness, the very fact that inputs are shared or utilized jointly makes contingent claims contracts aimed at realizing economies of scope difficult to draft, monitor, and enforce, particularly because the normal risks associated with opportunism apply.

### 3.7.3. A Comparison

In contrast to the formal modeling approach associated with much of the literature on economies of scale and scope, the economies of atmosphere principle is of a preformal kind. Inasmuch as subsequent formalization would appear to be feasible, that condition is not necessarily grounds for objection. Some problems, of which economies of atmosphere is arguably one, are so complex that they first need to be approached on their own terms. Focus is nevertheless required, and TCE offers one focused perspective on economies of atmosphere. Exhibit 3.3. deals with the similarities and differences between the above mentioned complementary sources of efficiency. By economies, technical rather than pecuniary economies should be understood.

Exhibit 3.3. Sources of Efficiency

| Economies | Basic Principles | Minimize |
|---|---|---|
| scale | *specialization/standardization<br>*spreading fixed inputs over large amount of outputs | production costs |
| scope | * exhausting of common resources by multi-product functions | production costs + transaction costs |
| atmosphere | * human asset specificity<br>* reciprocity<br>* information advantages | transaction costs + production costs* |

* Since the mainstream literature on the economics of atmosphere focuses on transaction costs rather than production costs (TCE), production costs were neglected in this study. This does not imply that atmosphere does not affect production costs. Since atmosphere affects the productive/cooperative attitudes of agents, their job satisfaction, and the appropriateness of their stock of production information, it would be highly implausible if the firm's production costs would be totally unaffected by it. Moreover, economizing on production expenses and economizing on transaction costs are not independent.

### 3.8. Concluding Remarks

This previous sections have identified three views of the firm which may be relevant for exploring economies of atmosphere.

(i) The microeconomic theory of the firm is not particularly helpful, since it is a theory of markets rather than a theory of the firm. In addition, tangible rather than intangible assets are emphasized - at least in the handbook versions of the microeconomic theory of the firm.

(ii) Team theory, agency theory and transaction cost economics are more promising. The main emphasis of this chapter is on TCE, since it has integrated atmosphere as an environmental variable in its central (OFF) framework. Regarding the research questions, the preceding sections yield the following conclusions:

1. It may be argued that the concept of economies of atmosphere is consistent with the economics of organization which is complementary to the microeconomic theory of the firm.

2. An atmosphere of trust and fairness may be helpful in realizing the mutual gain, where this is technically possible, in team production. From a contractual perspective, economies of atmosphere are captured when the focal principles of the firm complete incomplete contracts. In order to be competitive, these focal principles have to be adequate. TCE discusses the peer group atmosphere as a favorable condition for economizing on bounded rationality and attenuating opportunism. In large number conditions, for instance the internal labor market of large firms, human asset specificity is regarded as an antecedent condition for an atmosphere of reciprocity. Atmosphere is efficient when human asset specificity exists, because it offers security to the employer, and economizes on labor and turnover costs from the employer's point of view. Diseconomies of atmosphere are captured when the the optimum span of implicit contract is exceeded. At some point, the benefits from increasing the span of contract are outweighed by the inefficiencies engendered by the fact that the culture is applied in contingencies to which it is not well suited.

3. Costs are positively associated with the development of focal principles. These costs are especially high in formulating and implementing alternative focal principles when the traditional principles prove to be inadequate. The simple contractual schema shows that the costs of providing safeguards are compensated by the lower supply price of human capital. Thus, it costs time and money to provide an atmosphere of mutual risksharing, but it pays to do so.

(iii) The information processing approach of the firm deals with atmosphere as a common code, common knowledge of specific facts, and common knowledge of behavioral rules.

1. Each of these dimensions is believed to affect the cost efficiency of the firm's responses.

2. Why are these dimensions efficient? It is argued that the more developed the common stock of knowledge the more it will facilitate appropriate and fast responses - by providing easy access to information, increasing the predictability of the other agent's behavior, and by coordinating the bounded rationality of the different members of the organization.

3. Costs are associated with atmosphere because it takes joint efforts and time to develop a common stock of knowledge. Diseconomies of atmosphere are captured when an inadequate stock of knowledge has been developed. Since the efficiency of a firm can only be identified as compared to the efficiency of other firms (or to its efficiency in the past, abstracting from technical progress), (dis)economies of atmosphere can only be conceived as a competitive (dis)advantage.

The previous chapters have focused on economies of atmosphere at the industry and the firm level. An attempt has been made to make plausible that an efficiency function can be attributed to atmosphere. Moreover, explanations have been given why economies of atmosphere exist at the industry and the firm level. These are preformal explorations in economic theory suggesting that there is a rationale for economies of atmosphere. Following Aoki (1984), it is believed that it is not necessary to rely exclusively on historical or (descriptive) cultural explanations to understand the economic structure of the Japanese firm, business group strategies, the success of the excellent firm or the internal labour market of large firms, where an economic rationale can be found for the understanding of these economic phenomena.

The world of deductive reasoning is not similar to the empirical world. It is a quite different thing to demonstrate that there is a rationale for economies of atmosphere, and to demonstrate that there is empirical evidence for economies of atmosphere. Thus, the tough question is how to study economies of atmosphere. Since the economic problem is saving on production and transaction costs, empirical studies on the impact of atmosphere on efficiency have to take economies of scale and economies of scope into account as well. (As mentioned before, atmosphere is expected to affect production costs as well, but the theoretical part of this study did not deal with them, since the mainstream TCE literature focuses on transaction costs minimization).

Besides, valid instruments are needed for the measurement of atmosphere and performance. Finally, a selection has to be made of organizational units where economies of atmosphere can reasonably be expected. The next Section (II) of this book deals with the sampling and measurement problem. The subsequent Section (III) reports the results of two empirical studies which deal with the joint and the differential impact of economies of scale, scope, and atmosphere on scientific productivity in clinical medicine and economics.

# SECTION II. DESIGN AND MEASUREMENT

# 4

# Foundations in Organizational Science[1]

## 4.1. Introduction

The first section of this chapter discusses the contribution of organization science in the empirical studies presented here. Researchers in organizational theory (often originating from sociology) and organizational behavior (often originating from psychology) have paid much attention to general and specific values in organizations. Their approach has provided in-depth insights in atmosphere at the organizational level. Several typologies of organization have been developed in organizational theory which enable meaningful comparisons to be made between organizations (Burrell and Morgan, 1979; Lammers, 1986). These typologies may provide a theoretical basis for the partitioning of samples in organization studies. The present chapter will discuss Ouchi's typology (1980). Building on the work of Williamson, Ouchi has developed a typology of markets, bureaucracies, and clans. Following TCE, Ouchi hypothesizes that the probability that economies of atmosphere will be captured is dependent of the organizational form. In a sense, Ouchi has formulated a contingency approach of atmosphere which focuses on the efficiency properties of the clan organization in comparison with the bureaucracy and the market. These organizational forms are, of course, ideal types in the sense of Weber. Consequently, the pure form will seldomly be observed in real life organizations. As a heuristic device, however, his typology may provide a useful basis for the empirical exploration of economies of atmosphere at the micro level.

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[1] Sections discussing the psychometric properties of instruments are partially based on research conducted in cooperation with Triandis and co-workers, University of Illinois (USA), and Hofstede.

Triandis, H.C. and Bontempo, R., Betancourt, H., Bond, M. and Leung, K., Brenes, A., Georgas, J., Hui, C.H., Marin, G., Setiadi, B., Sinha, J.B.P. and Verma, J., Spangenberg, J.F.A., Touzard, H. and de Montmollin, G., The Measurement of the Etic Aspects of Individualism and Collectivism across Cultures, Australian Journal of Psychology, Vol. 38, No. 3, 1986: 257-267.

Hofstede, G.H. and J.F.A. Spangenberg, Measuring Individualism and Collectivism at Occupational and Organizational Levels, in: C. Kacitcibasi (Ed.), Growth and Progress in Cross-Cultural Psychology. Berwyn: Swets North America Inc., and Lisse: Swets and Zeitlinger B.V., 1987: 113-122.

Subsequent sections will discuss the contribution of organizational behavior research in the empirical studies presented here. Coming from a rich measurement tradition (Price and Mueller, 1986), organizational behavior researchers have designed several measures of related concepts of atmosphere, particularly organizational climate and culture. The focus of these concepts is on atmosphere as a set of values rather than as a stock of knowledge. Unfortunately, the psychometric properties of the instruments are not always provided in the literature. More information is provided about their construct validity (which can be identified by testing hypotheses concerning their relation with dependent variables), which proves to be fairly good. Other chapters focus on the psychometrics of the measures, i.e. their internal consistency in the specific samples being investigated, whereas the present chapter will mainly discuss their background, content, and relation with performance in a variety of organizations.

### 4.2. Ouchi: Markets, Bureaucracies, and Clans

The comparative basis for Ouchi's typology is the nature of the transaction. Building on transaction cost economics, Ouchi has developed a typology which seeks to explain cooperation among a collection of individuals who share only partially congruent objectives. When a team of individuals collectively produces a single output, the problem develops of how to distribute the rewards emanating from that output in such a manner that each team member is equitably rewarded. If equitable rewards are not forthcoming, it is assumed that members will adjust their efforts in future cooperative ventures in such a way that all will be worse off. In a number of papers Ouchi and colleagues have distinguished three different mechanisms through which organizations can seek to cope with the problem of performance evaluation and control. The three are referred to as (i) markets, (ii) bureaucracies, and (iii) clans.

(i) As a pure model, the market is a very efficient mechanism of control. Under the assumption of perfect competition, prices are sufficient statistics in the market. They convey all of the information necessary for rational decision making. In addition, prices provide a mechanism for solving the problem of goal congruity. Given a frictionless price mechanism, the firm can simply reward each employee in direct proportion to this contribution - no more, no less - so that an employee who produces little is paid little, and all inducements, being exactly in proportion to the contribution, are fair.

(ii) In marked contrast to the market, the bureaucracy described by Weber [1922] is subject to a variety of explicit routines of monitoring and directing. The fundamental mechanism of control involves close personal surveillance, and direction of subordinates by superiors. The information necessary for task completion is contained in rules which are partial rather than

complete bundles of information, and which consume a good deal of administrative overheads. Generally, prices are more efficient means of controlling transactions than rules are. However, the conditions necessary for frictionless prices can rarely be met. In such conditions the bureaucratic form is preferred.

(iii) In the clan, the information is contained in the rituals, stories, and ceremonies which convey the values and beliefs of the organization. Thus, the clan has a very efficient set of symbols with which to communicate complex ideas, which fits the very limited information processing capacity of the organization. The information system does not require an army of middle managers, controllers, and accountants. Moreover, outsiders cannot quickly gain access to information concerning the decision rules in the organization. A classic example of a clan are the ethnic enterprises in America (cf. Ouchi, 1980). The Chinese American 'Hui', and the Japanese American 'Tanomoshi', are revolving credit lending societies which provide venture capital for starting new business. They carry out all the functions of any Wall Street investment bank, but within their ethnic group they are able to make loans which would be far too risky for any bank because they enjoy considerable advantages in obtaining, interpreting, and evaluating information about potential borrowers or members. None of their practices are explicit - even the rate of interest paid by borrowers is left unspecified and implicit. The clan has also comparative advantages with regard to controlling and disciplining its members. Entry into these ethnic groups is strictly limited by birthright, a practice which guarantees that each member is a part of a social and kinship network which will support the values upon which the control mechanism is founded.

### 4.2.1. The Efficient Culture Hypothesis

Clearly, a clan is more demanding than either a market or a bureaucracy in terms of the social agreements which are prerequisite to its successful operation. Because the clan lacks the explicit price mechanism of the market, and the explicit rules of the bureaucracy, it relies for its control upon a deep level of common agreement between members of what constitutes proper behavior. In contrast to the market and the bureaucracy, not only reciprocity (market) but the combination of reciprocity and legitimate authority (bureaucracy) are normative requirements. For the clan, intensive commitments and common values are important as well. Despite the costs associated with the development of a clan, the clan will be more efficient than competing bureaucratic or market forms under conditions of ambiguity, complexity, and interdependence of transactions. This is the efficient culture hypothesis (Wilkins and Ouchi, 1983) On the basis of collective interests, decisions can be made relatively quickly, and with a high level of agreement, which allows the clan to function under conditions of great uncertainty (Ouchi, 1979).

Wilkins and Ouchi have argued that clan control requires the development of shared knowledge in two areas: (i) a general paradigm that helps participants determine what is in the best interest of the collective, and (ii) the perception of goal congruence, i.e. the belief in a general or long term equity. The paradigm provides members with a sort of master routine that enables them to solve two problems stemming from their bounded rationality. The first problem is that they are limited in their ability to comprehend and process information. The paradigm may give them categories, processing routines, and examples of good and bad solutions which will greatly increase their ability to determine how to operate. The second problem is that boundedly rational members of an organization must communicate with other boundedly rational members. This allows for misunderstandings, especially in transactions which are complex and uncertain. The paradigm of the clan, however, provides shared frameworks (values, code, knowledge of facts) that can help members to start from similar assumptions in deriving solutions to previously unfamiliar problems.

The clan is similar to organizational forms which are described by other authors, e.g. Etzioni's (1961) 'normative organization', Selznick's (1957) 'institution', Peter and Waterman's (1982) 'excellent company', and to one of Mintzberg's (1979) configurations, i.e. the missionary configuration (standardization of values). While some degree of ideology can be found in every organization, that degree can vary considerably. At the one extreme are organizations where direct supervision or standardization of the work process are dominant. In most of these organizations ideology is less important than in those organizations where standardization of norms is the central coordination mechanism. One of the consequences of standardization of norms is that members need not be closely supervised. For example, the long intensive training of scientists is a guarantee that wherever they go afterwards, they will be able to do their work in accordance with the methodological and professional standards of the scientific forum. Other characteristics of clan-like organizations are charismatic leadership (Weber, 1922; Etzioni, 1961), and non-market or altruistic relationships. More or less pure examples of this form have been found found in utopian communities (Kanter, 1973), the Royal Navy (Lammers, 1963), and R&D units (Ouchi, 1980). The empirical studies presented here, however, will only deal with the general and specific values as a characteristic of a clan-like organization. Moreover, they will focus on the content rather than the strength of these values.

The efficient culture hypothesis suggests that economies of atmosphere are to be expected in clans, because the price mechanism and central authority are inadequate to deal with the complex information that has to be processed in the clan. The hypothesis can be tested in two

ways: by comparing the coordination mechanisms of a sample of markets, bureaucracies, and clans, and by comparing clans which operate within the same sector.

When it can be demonstrated that the clan is better off with economies of atmosphere than with sufficient statistics (price mechanism) or bureaucratic procedures, or that the bureaucracy is better off with rules than with atmosphere, the hypothesis is confirmed. In order to compare the efficiency of these different governance structures, it is necessary to measure their performance in a standard way. This, however, will in general not be feasible, because different governance structure are often associated with different technologies and different outputs. The performance of a financial market, a paper mill (bureaucracy) and a university hospital (clan-like), for instance, are yet difficult to compare.

Consequently, the design here is to compare the performance levels of clan (-like) organizations which are active within the same sector. The advantage of this alternative approach is that the production technology, the type of skills required to do the job, and the performance criteria are fairly constant. The efficient culture hypothesis here states that economies of atmosphere are captured by high performers rather than by low performers.

The organizations included in the sample here are university research units. On the one hand, it should be mentioned that these units are not organized as clans. Since they work within the university they are operating part of a multi-level professional bureaucracy (Mintzberg, 1979; Hazeu, 1989). In addition, they are subject to centralized decision making (government, central administration). Since the members of a university research unit are differentiated by rank (traditionally, assistant, associate, and full professor), the decision making in the unit will generally be hierarchical. On the other hand, university research units have similarities with the clan organization. First of all, the members share professional values. The research unit relies for its control upon a deep level of common agreement between members of what constitute proper scientific behavior. Loss of reputation (which is their main scientific capital) is associated with disobeying the methodological norms of the international scientific 'Forum' (De Groot, 1984). Since reputation in science is comparable with brand name in industry, income effects can be expected when the scientific capital of individuals or units (funding) increase or decrease. In addition, the work process cannot be coordinated by centralized rules, so that bottom-up planning rather than top-down planning, and consummate rather than perfunctory cooperation are required. Furthermore, university research is characterized by high task uncertainty. As a result, incomplete contracting is unavoidable, and focal principles are required to complete the incomplete contracts. Thus, atmosphere can be an efficiency inducing mechanism in the university research unit. However, since it is a hybrid

organization, having both bureacratic and clan features, its performance is dependent of a combination of rules and atmosphere rather than atmosphere alone.

In sum, provided that the efficient culture hypothesis is tested in the empirical studies presented in chapter 6-7, it is certainly an imperfect test of the hypothesis. First of all, instead of comparing markets, bureaucracies, and clans, high and low performers are compared within a sample of university research units. These units represent a hybrid form combining both bureaucratic and clan features. However, assuming that the (central) bureaucratic features of university research units operating within the same country and scientific discipline will be rather constant, it may be conjectured that high performers in university science capture economies of atmosphere rather than bureaucratic economies.

### 4.2.2. Interim Conclusions

Organizational theory provides a theoretical basis for partitioning the sample. The preceding section focused on Ouchi's distinction of markets, bureaucracies, and clans. Since Ouchi assumes that atmosphere is especially efficient in the clan organization, his typology provides a theoretical basis for studying economies of atmosphere at the microlevel. Arguments are given for a design which enables the comparison of performance levels of clan -like organizational units operating within the same sector and the same governmental structure. The advantage of this approach is that the production technology, the skills required to do the job, the central (governmental) decision making, and the performance criteria are fairly constant. The efficient culture hypothesis here states that economies of atmosphere are captured by high performers rather than by low performers, i.e. that organizational climate and culture will be positively correlated to performance. Since a hybrid form rather than a typical clan organization has been included in the sample, due to practical reasons, the efficient culture hypothesis is imperfectly tested.

## 4.3. Organizational Climate Research

Wilkins and Ouchi deal with the benefits of supplying an adequate atmosphere in the clan organization. The tough question is, of course, how to study their efficient culture hypothesis. Obviously, the availability of instruments for the assessment of atmosphere is important for the conduct of this research. Organizational behavior as a research field has specialized in the design of instruments to assess organizational dimensions (Van de Ven and Ferry, 1980; Price and Mueller, 1986). Regarding atmosphere, the literature has focused on the measurement of organizational climate and culture. No instruments are yet available with regard to atmosphere as a common stock of knowledge. Consequently, the efficient culture hypothesis can be tested

only with regard to atmosphere as a set of values. The next section focuses on the measurement background of general and specific values in organizational climate, and general values in culture research at the national and organizational level. Furthermore, attention is paid to empirical research in which these measures have been used to test construct validity.

### 4.3.1. General Climate Measures

The first studies of organizational climate were initiated by Kurt Lewin in the 1930s. Lewin believed that it was possible to undertake experiments in the social sciences comparable with those in physics and chemistry. Lewin and colleagues attempted to study atmosphere as an empirical reality in an experiment involving the behavioral effects of three different leader-induced atmospheres. In nearly all cases, differences in behavior were attributed to differences in the experimentally induced climate rather than to constant characteristics of the group members. In addition, it was found that the climate had an important effect in determining the perception of leader behavior and the reaction to it by the group members. A group which had passively accepted an authoritarian leader in the beginning of its group history, for example, was resistant to a second authoritarian leader (Lewin, et al., 1939).

Litwin and Stringer (1968) experimentally created three simulated firms competing in a realistic, competitive industrial market under simulated business conditions. Three different climates were created: an authoritarian climate, a democratic climate, and an achieving climate. The differing orientation of the president of each firm was the means by which the three climates were created. The differing leadership styles had a marked effect in creating different organizational climates. Once created, the styles had significant effects on participants. Subjects in the achieving climate produced the most, whereas the democratic climate resulted in high levels of job satisfaction. Field studies of organizational climate have been conducted in R&D organizations (Pelz and Andrews, 1966), industrial organizations (Zohar, 1980), and the services sector (Schneider and Bowen, 1985).

In their field research, Litwin and Stringer measured climate by asking organizational members to respond to questionnaire items pertaining to categories like responsibility, reward, risk, support, standards, conflict, and identity. These categories were then used to develop some 50 specific items for a questionnaire. Each item was measured on a 4-point scale. When administered to the members of an organization, the tabulated results were considered to be a measure of the perceived climate of that organization. In their book on Motivation and Organizational Climate, Litwin and Stringer (1968) reported the first climate findings in services and manufacturing units. Their dimensions have been developed through their theoretical and empirical studies. In contrast to recent investigations on organizational

climates or practices (Hofstede et al., 1988), Litwin and Stringer did not use factor analysis but content analysis and MANOVAs. In addition, they preferred laboratory studies rather than the survey method.

The dimensions included by Likert (1967) to measure the human characteristics of organizations include, in large part, the dimensions assessed by Litwin and Stringer. Likert's questionnaire has been used to assess the degree to which organizations are perceived as system 1, as opposed to system 2-4 types. Likert called these organizational types: exploitive authoritative, benevolent authoritative, consultative, and participative. In the Likert model, each type is conceived as an internally consistent whole of which organizational climate is a major part. In terms of Burns and Stalker (1961), the system 1-2 types are more mechanistic, whereas the system 3-4 types are more organistic.

Litwin and Stringer's dimensions were originally designed to describe motivational climates. Redding (1977) successfully applied Litwin and Stringer's climate questionnaire in a study on the climate-performance relation in supermarkets, thus establishing convergent validity of the motivational climate measure. However, the questionnaire has also been used to measure general values. Poole (1985) has argued that this general use of the measure is not always justified by empirical research, for example because factor analyses in other studies isolated considerably different dimensions from those found by Litwin and Stringer. This should not be very surprising given the fact that Litwin and Stringer's dimension were not isolated by factor analysis. Moreover, they used laboratory studies which have high internal but low external validity.

### 4.3.2. Specific Climate Measures

Problems with general climate dimensions have given rise to an approach which identifies climates at a lower level of abstraction, i.e. climates of specific organizations. Schneider and Bartlett (1970) have explored climates in life insurance agencies. Schneider (1980) isolated dimensions of customer service climates for banks. He hypothesized that service customers are exposed to the same climate that affects employees, and that customers would be better served if service organizations were structured to meet and satisfy the needs of their employees. The logic of this hypothesis is that employees in service agencies desire to give good service, due to a self-selection effect, and when those desires are made easier by management's support, both employees and consumers are likely to react positively. Since service organizations are extremely dependent on goodwill, the study of Schneider and co-workers (1980) have focused on the goodwill perceptions of bank customers.

Poole (1985) has observed that the relation between climate and performance measures tends to be stronger when specific climate measures are used. For example, using a specific measure of customer service climate, Schneider and colleagues (1980) found higher zero-order correlations between climate dimensions and customer perceptions of quality than Johnes and James (1979, in: Poole, 1985) who used general climate dimensions for two samples of naval divisions. An example of the specific climate approach is Zohar's (1980) paper on the safety climate in industrial organizations. Zohar constructed a 40-item measure of organizational climates for safety. This measure reflects employees' perceptions about the relative importance of safe conduct in their occupational behavior. It can vary from highly positive to a neutral level, and its average level reflects the safety climate in a given company. Zohar shows that there is an agreement regarding safety climate in their company, and that the level of safety climate is correlated with safety program effectiveness as judged by safety inspectors.

In the first half of the 1970s, the literature on organizational behavior contained discussions regarding the possible overlap of job satisfaction and organizational climate research. It has been argued that the new climate measures have been created from old measures of job satisfaction (Guion, 1973). In addition, Johannesson (1973) found that most of the variance in a perceptual measure of organizational climate could be subsumed in factors traditionally found in job satisfaction research. However, the data from which this was inferred are from studies in which the unit of analysis was predominantly the individual. Schneider and Snyder (1975) have argued that an empirical distinction between the concepts of satisfaction and climate is possible if each variable is assessed according to an appropriate unit of analysis which is the individual in satisfaction research. In contrast, organizational climate is mostly conceptualized as an aggregated perception which people have of their organization, so that the appropriate unit of analysis is the organization rather than the individual (Glick,1985).

#### 4.3.2.1. Productive Climates in R&D

The utility of specific climate measures for the understanding of organizational effectiveness has also been demonstrated by Pelz and Andrews (1966). Their book on productive climates for research and development was one of the first major studies to examine the relationship between scientific performance and the organization of the laboratory which, in essence, implies a managerial approach to science. Rigorous methods of research were applied to answer the question what constitutes a stimulating atmosphere for R&D. Information about technical performance, working relationships, and motivation was collected from 1300 scientists and engineers located in eleven industrial and governmental laboratories, and seven university departments. The data were analyzed to determine what conditions - either in the environment or in the individual's orientation towards it - actually accompanied a high or low level of

performance. Pelz and Andrews (1966: 80) give the following description of a typical atmosphere: "In some laboratories the air seems to hum with excitement. Investigators are absorbed in what they are doing - their individual projects or the laboratory's mission. Coffee breaks buzz with shop talk instead of baseball; 5 o' clock quitting time is the exception instead of the norm. The morale, in one sense of that overworked term, is superb".

#### 4.3.2.2. Selection of a Specific Climate Measure

Pelz and Andrews have attempted to measure such an atmosphere of excitement and dedication by questionnaires. Concerned with the reliability of their measures, they examined the extent to which answers were stable over a two-month interval. Their climate measures showed highly consistent results. Concerning the construct validity of their standardized measures, the extent to which the empirical relationships based on using the measures are consistent with theory about the concept, the expected relationship between climate and performance were empirically verified. Since all data in Pelz and Andrew's study were collected in American laboratories, and it was not clear how applicable the findings would be in other countries, UNESCO commissioned an international research team to conduct a large scale European study on the organization and performance of research units. One of the most important findings of their investigation was that the R&D process seems to be responsive to similar organizational factors whatever the particular national setting in which research units happen to be located. Although significant differences appeared in the survey data between the participating European countries as regards R&D management and climate of work, the relations that emerged between these factors and the scientific productivity of research units tend to show the same directional patterns (Andrews, 1979: 9). Furthermore, the major relationships observed in the data from European countries tend to be consistent with the findings from Pelz and Andrews. 'General atmosphere of the (research) unit' is the climate measure which is most relevant for the purpose of study I and II (Andrews, 1979: 453-54). This measure was selected to be used in the empirical studies reported in part III of this study. In order to optimize the UNESCO measure , it was extended with items which were specific for the Dutch samples. In addition, factor analysis was used to determine latent variables in the extended measure. As a result, two climate dimensions were found. One of them was labeled 'innovative climate', the other 'publication climate'. Detailed results of the factor structures are given in Bally et al. (1987: statistical appendix).

### 4.4. Culture Research

Cultural anthropology is the discipline which has specialized in studying customs and values of distinct groups of people - in exceptional cases, of whole nations. As compared to the qualitative mainstream of anthropological research, Hofstede's (1980) work stands out as having provided a scientific advance, because it seeked to compare cultural dimensions on a quantitative basis. Measurements in more than 40 countries were collected pertaining to different subsidiaries of one multinational company. The results reflect both national and organizational characteristics. They are based on 116,000 questionnaires completed by respondents matched by occupation, age, and sex, at two different points in time. One of the strengths of the study is that it relates the general values identified among the employees of that multinational to numerous other studies (thus obtaining convergent validity), as well as to the antecedents and consequences of these values. Looking for national patterns in work-related values, factor analyses revealed that the value patterns dominant in these 40 (later expanded to 50) countries varied along 4 dimensions which were called (i) individualism versus collectivism, (ii) large or small power distance, (iii) strong or weak uncertainty avoidance, and (iv) masculinity versus femininity. According to Hofstede all 4 are related to fundamental issues in human societies, but issues to which different societies can produce different answers. The next section discusses the relation between two of these dimensions and organizational theory.

#### 4.4.1. Work-Related Values and Organizational Theory

Power distance and uncertainty avoidance are subjective indices of two organizational dimensions, i.e. centralization (distribution of power) and formalization (reduction of uncertainty). Combining the two dimensions, Hofstede distinguishes 4 organizational types: the pyramid, the well-oiled machine, the village market, and the family.

Exhibit 1. Images of Organization

| | power distance | |
|---|---|---|
| uncertainty avoidance | low | high |
| high | machine | pyramid |
| low | market | family |

The pyramid is a hierarchical structure held together by the unity of command as well as by rules and procedures. The exercise of personal command is largely unnecessary in the machine because the rules settle everything. The market is characterized by a lack of decisive hierarchy and flexible rules. The family is characterized by undisputed charismatic authority of the leader but few formal rules. Hofstede's findings suggest that the dominant underlying model of an organization for the French is the pyramid, for the Germans the well-oiled machine, for the British the village-market, and for the Indonesians the family. Although national data are the basis for Hofstede's typology, it tends to be consistent with the classification of Likert (system 3-4 versus system 1-2 organizations). Ouchi (markets, hierarchies, and clans), and Mintzberg (adhocracy, bureaucracy, and missionary). This would imply varying national preferences for specific organizational forms.

### 4.4.2. Robustness, Convergent Validity, and Test-Retest Reliability of the VSM

Bosland (1985) has addressed the temptation of confusing Hofstede's culture dimensions with dimensions of personality, measured at the individual level of analysis. Like the Value Survey Module (VSM) which permits the replication of Hofstede's (1980) comparison among countries, cultural scales are composed of items collected from individuals, but for which the mean country scores are strongly correlated across countries. The same items do not necessarily correlate across individuals within a country, and thus the VSM should not be used as a personality test.

Nevertheless, the findings of other researchers testify to the convergent validity of Hofstede's method. Independent of Hofstede's work, Hui (1984) developed a 63-item individualism-collectivism scale showing discriminant validity in the various subscales, i.e. one can predict some phenomena from one of the scales but not from the other scales. Triandis (1985) used the most promising items of Hui in a new instrument that was administered to samples in nine countries. Since these countries were included in Hofstede's study, scores and ranks obtained for the nine countries in the two studies could be compared resulting in a significant rank correlation coefficient of $rho=.73$, and $p<.013$ (Triandis and Bontempo, et al. 1987).

Hofstede and Spangenberg (1987) have found that correlation patterns of the same dimensions differ not only between individual data and aggregated data, but that the level or type of aggregation is equally important. Factor analyses showed that the fourteen items which formed the basis for measuring individualism and masculinity, two meaningful and repeatedly validated measures at the national level, cannot be used at either the occupational or the organizational level. Other operationalizations are required to apply these concepts for those levels, based on how they manifest themselves as characteristics of an occupation or

organization. Concerning the remaining dimensions, it appears that power distance can be measured with the same questions at the country, occupation, and organizational levels, while the measurement of uncertainty avoidance is specific to the country levels. Concluding, the VSM is not an adequate instrument for the measurement of work-related values at the organizational level - except, perhaps, for the power distance index.

Hofstede's data bank contains data from two points of time (around 1968 and 1972). Consequently, it is possible to examine the test-retest reliability of the VSM. It appears that the country answers on the items composing the Power Distance Index do not shift together over the four-year period, nor do those composing the Uncertainty Avoidance Index. This means, that, as far as the shift over time is concerned, PDI and UAI are not homogeneous indexes. The two remaining dimensions, masculinity and individualism, show more or less homogeneous shifts, so that an overall shift toward stronger individualism and masculinity could be identified. Compared with the shift in individualism, however, the shift in masculinity is relatively minor (Hofstede, 1980: 361).

### 4.4.1. Interaction between National and Organizational Level

As mentioned before, the concept of culture can be studied at different levels of analysis. Lewin (1948) and Hofstede (1980) explored cultural differences between countries. Lammers and Hickson (1979) have studied the influence of national culture upon organizations, whereas other authors explored corporate cultures in a variety of organization like the Royal Dutch Navy (Lammers, 1963) and high tech multinational firms (Schein, 1985). The interaction between national and organizational cultures was investigated by Soeters and Schreuder (1988). Using the VSM, the authors describe the cultural differences between local and international (USA) oriented accounting firms operating in the same national culture. From Hofstede's study it could be hypothesized that, if any differences exist between the Dutch and the international (U.S.-oriented) firms, they would be especially pronounced on the dimension of masculinity (achievement motivation). Since the members of international offices were found to be more oriented towards high income and good career perspectives, this hypothesis was confirmed, thus validating the VSM at the national level. With respect to uncertainty avoidance, Soeters and Schreuder found a deviation from Hofstede's findings which has been attributed to an industry-specific difference between the accounting firms and Hofstede's multinational company (IBM).

In addition, Soeters and Schreuder (1986b) have studied the relationship between work-related values and performance in accounting firms. The performance of individual accountants was measured by self ratings of their work performance, contribution to the corporate goals,

latest overall evaluation, and promotion opportunities as compared to their colleagues. Relating these (individual) performance indices to Hofstede's dimensions, the authors found that accountants who valued income and career perspectives higher than tenure and good relations with colleagues (higher masculinity) make more than average effort and perform better. In addition accountants who expect to work longer for the organization (higher uncertainty avoidance) make more than average efforts. This result is explained as follows: first of all, accountants who expect to stay longer than average are the members with the best career perspectives in the 'up or leave' reward system. Second, long term perspectives increase the identification with the firm which is generally expected to result in increasing work efforts and productivity. The relevant conclusion for the present study is that the authors, more or less, showed construct validity of the VSM with regard to work performance.

### 4.4.2. Organizational Practices

In a recent paper, Hofstede distinguishes 4 cultural levels: symbols, heroes, rituals, and values. Symbols are the most superficial expression of culture, while values are at the deepest level of mental programming. The previously mentioned study of Hofstede (1980) has emphasized the differences in values at the national level. Recent work focuses on heroes and rituals as well (Hofstede et al., forthcoming). Unlike the first study which kept the organizational environment constant while maximizing the variance between countries, the second study maximizes the variance at the organizational level within the same countries. Organizations in the private and public sector were included, and within these organizations marketing, production, and R&D units participated in the study (N=20). Factor analyses of the answers across the 20 units revealed six dimensions of 'practices' (symbols, heroes, and rituals), together explaining more than 70% of the variance in the unit means. They were process versus results oriented, employee versus job oriented, parochial versus professional, open versus closed, tight versus loose, and flexible versus rigid. Factor analyses concerning work-related values yielded similar dimensions to those from the IBM study (power distance and uncertainty avoidance) and one new dimension (work centrality). The range of mean scores across the units is much smaller for the value questions than for the practices questions composing the six dimensions which are the core of the organizational culture. Practice differences are only partly related to value differences, which suggests that a change in organizational culture is feasible without a change in values.

The organizational culture dimensions found by Hofstede and colleagues show some resemblance to Litwin and Stringer's (1968) general climate measures. For example, an organization which sets high standards for performance (Litwin and Stringer's 'standards') is likely to be

results rather than process oriented; an organization in which members of the organization support each other ('support') is likely to be employee rather than job oriented.

### 4.4.3. Interim Conclusions

The organizational behavior literature has provided valid and reliable instruments for the measurement of organizational climate and culture. Measures of specific climate dimensions which are relevant for the purpose of study I and II have been designed by Andrews (1979), while Hofstede (1980; Hofstede et al., forthcoming) has constructed measures for general 'values' or 'practices' at the national (value survey module) and organizational (organizational culture module) level. Apart from the latter, these standardized measures proved to be useful in organizational research. Empirical studies testing the extent to which these measures are associated with performance suggest construct validity.

## 4.5. Concluding remarks

The tough question is how to study economies of atmosphere. In order to test the hypothesis that amosphere affects internal efficiency, it is necessary to: (i) select organizational units where economies of atmosphere can reasonably be expected, (ii) select instruments for the measurement of atmosphere, (iii) select instruments for the measurement of efficiency, and (iv) design controls for internal and external validity

This chapter has concentrated on (i) and (ii). Organizational theory provides a theoretical basis for partitioning of the sample. The text has particularly focussed on Ouchi's typology of markets, bureaucracies, and clans. Since Ouchi assumes that atmosphere is especially efficient in the clan organization, his typology provides a useful theoretical basis for studying economies of atmosphere at the micro level.

The organizational behavior literature has provided useful instruments for the measurement of organizational climate and culture. This chapter has discussed several climate and culture measures of which have been selected for further use: an UNESCO measure of work climate in research units, and Hofstede's measures for general values or practices at the national (VSM) and organizational level (OCM). Although research has shown that, except for power distance, VSM items do not provide robust operationalizations at the organizational level, the VSM has been selected for the studies which are reported in the next chapters. The reason for selecting the VSM is a pragmatic one: alternative measures were not yet available when the first study started. When the second study started, Hofstede and co-workers had just finished their psychometric work, resulting in the formulas required for the computation of OCM dimensions.

Consequently, the follow-up study could explore economies of atmosphere in terms of work-related culture (VSM: 4 dimensions) and organizational culture (OCM: 6 dimensions).

This chapter has discussed the background and the main dimensions of this measurement tradition. Since the research reported in the next chapters will focus on scientific organizations, a selection has been made of one specific climate measure. In addition two general measures were selected for the assessment of work-related values and organizational culture. In sum, the following measures of atmosphere were inserted in the questionaire of the present studies:

(i) a specific research unit climate measure designed by UNESCO (Andrews, 1979) (study I and II);
(ii) a general work-related values measure, i.e. the VSM which is composed of 13 items measuring 4 work-related values (Hofstede, 1980) (Study I and II):
(iii) a general measure for organizational culture - the OCM which is composed of 18 items measuring 6 organizational practices (Hofstede et al., 1988)(study II).

While measures (ii) and (III) are used in a previously standardized way, measure (i) has been extended with items specific to the samples being investigated. The factor analyses resulting in two new climate dimensions, labeled 'innovative climate' and publication climate', are discussed in Bally et al. (1987: Statistical Appendix). They include principal components analysis and Varimax rotation ($SPSS^X$).

# 5

# University Research Management [1]

"Before the twentieth century, most research and development was conducted by a single scientist-engineer who worked alone or with a few assistants. Today, institutes and research centers are multiplying in many parts of the world. Most of today's scientists and engineers depend on these organizations for equipment and support" (Pelz and Andrews).

## 5.1. Introduction

This chapter is based on the premise that research organizations provide more than facilities for their members. They also provide an atmosphere which may either stimulate or inhibit the scientist's performance. Despite the immense resources used in the support of university research, little is known from scientific evidence about the best way to operate a university department. Until recently, all data were collected in R&D laboratories (Pelz and Andrews, 1966; Andrews, 1979; Allen, 1977). Only recently, has the managerial approach to science been applied to university departments (Keller, 1986).

Two empirical studies have been conducted: a study in medical research departments of Dutch university hospitals, and a study in comparable units in economics. The first study was carried out in the period 1986-1987 by a team consisting of Y. Bally, J. Spangenberg, R. Starmans, B. Breemhaar, and F. Nijhuis. It consisted of a qualitative part (coordinated by Starmans and Bally), and a quantitative part (coordinated by Spangenberg). The report of study I has been published by the Nederlandse Staatsuitgeverij (Bally, Spangenberg, and Starmans, 1987). The design and main results of the quantitative part of study I are reported in chapter 6 of this book. The study departments of economics - study 2 - emphasized the quantitative aspects, and was carried out in the period 1987-1988 by Spangenberg with statistical assistance of Alfenaar. The results of study 2 are reported in chapter 7.

[1] A review of the comparative methodology on which this chapter is based has been accepted for publication: Hofstede, G.H. and J.F.A. Spangenberg, Technike der Internationale Vergleiche. Macharzina, K. und M.K. Welge, Handwörterbuch der Internationale Unternehmung. Enzyklopädie der Betriebswissenchaftslehre. Stuttgart: C.E. Poeschel Verlag.

Both studies were conducted in academic research departments. The research question was simple to formulate but hard to investigate, viz.: which factors facilitate (incentives) or inhibit (constraints) academic research performance, and to what degree? This question has also been raised in large-scale performance evaluations of the Dutch contribution to the international growth of medical knowledge (Raad voor Advies Wetenschapsbeleid (RAWB), 1983b) and economics knowledge (Verkenningscommissie Economische Wetenschappen (VEW), 1986). Until 1970 the Ministry of Education and Science's strategy towards university research had been an 'emergent' strategy (cf. Hardy et al. 1984; Mintzberg and Waters, 1985). If patterns of consistency were realized, they were realized in the absence of deliberate intentions. In the last two decades, however, Dutch research policy has dropped its laissez-faire attitude concerning academic research. On the one hand it was realized that 'academic freedom' is a valuable intermediate good that may generate unforeseen technological and humanitarian progress. Seeking excellence has to be encouraged because basic research in universities continues to be the national 'think tank' - the crucial reservoir for new ideas and methods (OECD, 1986). On the other hand, there was an increasing recognition that an overvaluation of this academic freedom may have counterproductive consequences. Von Humboldt's concept of "die reine Wissenschaft, in Einsamkeit und Freiheit" (quoted in Dynamus, 1987, p. 6) was only loosely coupled with academic excellence. The above mentioned evaluations demonstrated that the international standing of Dutch medical and economics research is, on average, moderate or even low. Notwithstanding this general observation, many individuals and groups of researchers were able to maintain high quality standards. The lack of uniformity in research performance at the organizational level - even within the same specialty - has been the starting point of our studies on the organizational determinants of academic research performance.

### 5.2. Universities as Organizations

In contrast to industrial research and development (R&D) units, academic research units operate within universities which are known to be very special organizations. Several authors have stressed that university monitoring devices are extremely underdeveloped. Cohen and March (1974) describe universities as 'organized anarchies' characterized by ambiguity of goals and fuzzy decision making procedures. The most appropriate metaphor the authors could think of was the 'garbage can'. Universities are largely populated by professionals. In addition, there is an unusually high degree of task specialization. It is frequently difficult for faculty members to understand fully the research of colleagues in their own department, let alone those in other departments. The university shares few characteristics with supermarkets, governmental agencies, banks or insurance companies.

Weick (1984: 27) describes the university as a very exotic animal: "the university organization is an adhocracy, organic organization, clan, decentralized structure, loosely coupled system, organized anarchy, garbage can, or situation of pooled interdependence". He believes that "an organizational culture consistent with relative inattention to coordination and control is reinforced within universities" (Ibid.: 28).

In contrast to the literature mentioned above, there is an increasing recognition, of late, that university performance can, in principle, be monitored and improved, and that the differences between the university and other organizations are matters of degree. Many of the 'unique' characteristics attributed to universities have been found and studied in such diverse locations as Japanese companies, Swedish automobile plants, law firms, and hospitals (Vroom, 1984). In his typology, Mintzberg has emphasized the common elements between accounting firms, law firms, hospitals and universities. He defines them as professional bureaucracies (Mintzberg, 1979). In this type of organization, skills and knowledge have been standardized through long years of training. The skills have a 'general' rather than a specific character (Becker, 1964), i.e. they are trained in educational systems - not on-the-job. In a sense academic members have been programmed through their own doctoral or professional studies to do 'Normal Science' (Kuhn, 1970), that is to approach their field of endeavor in generally accepted ways. Von Humboldt's 'academic freedom' may be explicit freedom from administrators, but it is not explicit freedom from professional control (Hardy et al., 1984). Another characteristic of universities is that many of its members are 'cosmopolitans', that is, they are oriented to the (external) international scientific forum - in contrast to the 'locals' who are mainly oriented to life within the organization (Ritti, 1968).

### 5.3. The Research Unit as a Clan-like Organization

Given the extreme degree of specialization of academic research units (RUs), the whole university organization would not be an appropriate level of analysis for this investigation. If one wants to compare performance levels, research units have to be compared with other units within the same specialty (like with like). Therefore the focus of the two investigations described below has been on teams. Research teams are small peer groups. According to the literature (Williamson, 1975; Ouchi, 1980), economies of atmosphere are more likely to be found in small groups than in large systems - especially when the team consists of peers. Wilkins and Ouchi's (1983) typology of markets (where the price mechanism is efficient), bureaucracies (where rules are efficient) and clans (where culture is efficient) may provide a theoretical justification for the selection of academic research units when economies of atmosphere are explored. If culture is especially efficient in the clan - as has been argued by

Wilkins and Ouchi - this should be empirically demonstrated by studying the determinants of performance in a typical clan. As part of the bureaucratic university system the university research unit cannot be conceived as a a typical clan. At best, it can be characterized as a hybrid organization (Mintzberg, 1983) having both clan and (professional) bureaucratic features. Since the clan is an ideal typical configuration which is hard to find in reality, no attempt has been made to select a typical clan. Moreover, sampling decisions were influenced by practical considerations as well. The main clan characteristics of academic research units are the shared values of the members, the combination of a small number condition with the impossibility to control the work process (requiring consummate rather than perfunctory cooperation), the dominant control mechanism (professional control/mutual monitoring), and the high task uncertainty - scientific research is conducted in a sea of unforeseen contingencies, so that clear focal principles are needed to complete the incomplete contract. As a result, prices are considered to be less efficient in research units than in the market form of organization. However, since university research units represent a mixture of the clan and bureaucratic form, rules cannot be excluded from the efficiency calculus. Consequently, atmosphere is not a substitute for rules, but assumed to be a compensating efficiency-inducing mechanism in the university research unit. Given the fact that the units studied here operate under the same governmental (bureaucratic) constraints, and given the low variance between university research policies as compared to, for example, U.S. universities, it may be conjectured that high performers in Dutch university science capture economies of atmosphere rather than bureacuratic economies.

### 5.4. Methodological Considerations

Before tackling the substantive issues which forms the empirical core of this investigation, it is necessary to consider the methodology and design of our study. In this section, the design and methodology will be described. The succeeding sections focus on hypotheses, and the measurement of the independent (predictor) and dependent (criterion or performance) variables. Finally, the chapter concludes with a discussion of the research model and the assumptions regarding causality. There are six main elements to methodology which will be dealt with in the succeeding sections.

#### 5.4.1. Inputs, Throughputs, and Outputs

First, it is based on an input-throughput-output approach - that is, it involves identifying and evaluating the various inputs (e.g. number of scientists), throughputs (e.g. managerial coordination and atmosphere) and outputs (e.g. publications and citations), and then relating the outputs to the inputs and throughputs. The basic premise of the model is that scientific

research can be considered as a conversion process in which inputs are converted into outputs by the coordination of throughputs. Throughputs are conceived as the characteristics of the conversion process. Since there are no exact criteria to classify variables into inputs and throughputs, the main classification is between predictor (independent) and criterion (dependent) variables. All input and throughput variables are called predictor (X) variables, while all output variables are called criterion (Y) variables. In general, there are more than one measures for a predictor variable. For example, X4 (atmosphere) has been measured by X41 (work-related values), X42 (organizational culture), and X43 (research climate). In one of the studies (II) combined and single criterion variables are distinguished. The overall performance (Y) is indicated by the membership of a unit (high versus low performance). Single performance can be indicated by the peer review (Y1), and the number of publications (Y2) and citations (Y3). The research model is presented in exhibit 5.4. of this book.

### 5.4.2. Managerial Approach

Second, our approach differs from that typically used in science and technology studies. Philosophers of science primarily focus on the internal logic or 'context of justification' of science - thereby emphasizing methodological implications (Popper, 1959; Lakatos, 1970). Here we simply report the differences between research units with high and low performance levels - thereby looking for quality control implications. Historians and anthropologists of science concentrate on the 'context of discovery' (Fleck, 1935; Kuhn, 1962; Latour and Woolgar, 1979). Operating from an ethnomethodological or symbolic interactionistic point of view, the results are often qualitative, explorative and descriptive. Although recognizing the value of their approach (De Groot, 1961), the orientation here is a different one - emphasizing quantification of variables and multivariate testing of hypotheses. Our approach may be characterized as a 'managerial' or 'research policy' approach of science (Pelz and Andrews, 1966; Andrews, 1979; Allen, 1977; Keller, 1986; Dobrov and Tonkal, 1985). In essence, it represents the last stage in Simon's (1982) 'municipal methodology' - that is the analysis of factors which facilitate or inhibit public effectiveness in order to improve it. Many studies in the field of research policy utilize cost-benefit analyses (RAWB, 1983a, 1983b). Unlike these studies, our approach pays attention not only to inputs (though not expressed in monetary values) and outputs (performance), but also to organizational throughputs.

### 5.4.3. Team as Unit of Analysis

Third, the approach is focused on the team. Thus, the unit of analysis is not the individual scientist, the discipline (Whitley, 1984), the institution (Irvine and Martin, 1985), or the Dutch inter-university 'conditionally financed' (VF) research programme, but the research

unit (in Dutch: 'vakgroep'). It is recognized that the major capital investment decisions in science tend to focus on institutions rather than the individual or the specialty. The research units within institutions, however, may represent a variety of fields which, moreover, may vary considerably in their performance levels.
Robinson (1950) has argued that individual (within-system) and group (between-system) correlations should not be confused. The 'ecological fallacy' is committed when group correlations are interpreted as if they applied to individuals. This is attractive, because group correlations are often stronger than individual correlations (Nijhuis, 1984). The 'reverse ecological fallacy' (Hofstede, 1980) is committed in comparing research units on indices created for the individual. In order to avoid this reverse ecological fallacy, all inputs, throughputs, and outputs in this study - if not measured at the level of the research unit - have been aggregated to the level of the research unit.

The term 'research unit' is used here as defined in nomenclature adopted by the UNESCO project (Andrews, 1979). In order to regard any group of individuals as a research unit the following criteria had to be met: (i) the group has at least one recognized leader who is significantly involved in its work; (ii) the group has to include a total of at least three people (including the leader) who are significantly involved in its work, and each of these people has been a member of the group for at least half a year; (iii) the group has an expected life span of at least one year; (iv) the group members have, grosso modo, the same specialty.

### 5.4.4. Comparative Method

Fourth, because an absolute quantification of research performance is virtually uninterpretable, here the approach is comparative, with the added condition that one can only compare 'like with like'. The comparative method, it has been argued (e.g., Campbell and Stanley, 1966; Warwick and Osherson, 1973), is the core of the scientific method; without comparison, co-variation and causality cannot be observed or inferred. As Irvine and Martin (1985) have noted, one cannot compare directly the performance of a large optical telescope with that of a radio telescope, but one can compare it with the performance of similar-sized optical telescopes at other observatories. Several bibliometric studies have demonstrated the existence of large variations in publication and citation characteristics between specialties - even within disciplines (Moed et al., 1985a). Therefore, the concept of high and low performance should be applied in a relative rather than an absolute sense. This study compares the performance of research units within the same specialty at different institutions. Hypotheses are tested by examining the differences in high and low performers. This approach was inspired by project SAPPHO - an attempt to substantiate generalizations about industrial innovation by the systematic comparison of pairs of successful and unsuccessful industrial

attempts to innovate in several branches of industry. By matching attempted innovations it was hoped to discriminate between the organizational characteristics of success and failure (Freeman, 1982).

### 5.4.5. Triangulation of Performance Indicators

Fifth, the approach involves the combined use of several performance indicators. These indicators reflect different facets of research performance, although they are to some extent interrelated. The method of converging imperfect indicators (Irvine and Martin, 1985) is based on the application of a range of indicators to matched research groups. When the indicators all point in the same direction, the results are regarded as reliable. What Irvine and Martin refer to as reliability or internal consistency is comparable with the concept of 'convergent validity' in Campbell and Fiske's (1959) classic multitrait-multimethod matrix approach. Campbell and Fiske suggested that convergent validity is demonstrated when the partial indicators are correlated. Webb and colleagues (1966) call this process 'triangulation' - where constructs cannot be measured directly, we should use at least two measurement approaches with different error sources. The more convergence in the results the more accurate the measurement (Hofstede, 1980).

### 5.4.6. Internal and External Validity

Sixth, our approach is concerned with internal and external validity. Internal validity pertains to the justifiability of conclusions within the research design, and therefore affects the controls of the design - a relevant question is, whether, for example, scale or atmosphere really makes a significant difference. External validity or 'generalizability' is concerned with the extent to which an observed relation between, for instance, atmosphere and performance can be generalized. Kerlinger (1973) has pointed out that in basic research, generalizability is not the first consideration, because the central interest is the relations among variables (co-variation) and why the variables are related as they are (explanation). This puts an emphasis on the internal (design controls) rather than the external aspects of the study. In applied research the central interest forces concern to be more directed towards external validity because one wishes to apply the results to other populations and to other conditions.
In order to check for internal validity the research units (RUs) in the sample have been matched with regard to their performance. An attempt has been made to maximize the variance in their performance levels. In order to investigate generalizability to science in general, the design of the first study (medical research units in university hospitals) is replicated in a different field, i.e., economic research units in Departments of Economics and Business Administration. Although economic and medical research units are both working within a

university environment - so that they can be compared - they represent disciplines that operate at a different scale (in terms of expenditures, manpower, and output), and require different skills and technologies. Whitley (1984) has developed a typology of scientific disciplines. Comparing economics and medicine, he concludes that economics is characterized by high technical task uncertainty and low functional dependence, while medicine is characterized by low technical task uncertainty and high functional dependence. These are of course relative chacterizations. Although the task uncertainty of medical research units is regarded as low in comparison to other scientific disciplines, it will be high in comparison to, for instance, cleaning firms. On the basis of Whitley's typology, variance may be regarded as maximized in a sample which includes the above mentioned disciplines. When replication of the design in economics yields similar results as in medicine, the results may to some extent be expected to be general to academic research departments in general. The design of our study is summarized in the following table.

Exhibit 5.1. Design of the study

| | **External Validity** | | |
|---|---|---|---|
| | Field I | Field II | |
| High performance | Medical units | Economics units | **Internal Validity** |
| Low Performance | Medical units | Economics units | |

### 5.5. Some Facts and Figures on Dutch University Research

Facts and figures on Dutch university research have been presented in a recent report of the Ministry of Education and Science, the Higher Education and Research Plan (in Dutch: HOOP) (1988). Dutch expenditure on university research in dollars per head of population in the period 1975-1982 was $52 - i.e. higher than other OECD countries (including Japan and the U.S.). Expenditures on university research as a percentage of overall expenditure on research is 15.7% (1630 million guilders). The expenditure per university researcher in 1983 is $101,000 (third in the OECD list). Expenditures on human resources and capital resources are 225 (55%), and 186 million guilders (45%) respectively for medicine, and 44 (86%), and 7 million guilders (14%) respectively for economics. Manpower levels stand at 4,630 scientists working at departments of medicine/university hospitals, and 420 scientists

working at departments of economics. Spending levels are 760.6 million guilders for medical university research, and 102.5 million guilders for economics university research. With respect to output, the statistics show that the number of doctoral theses in the period 1980-1985 was 1892 for the health sector and 199 for economics. According to the Central Bureau of Statistics (1985), the average time spent on university research is approximately 30% for medicine and 36% for economics. The difference is explained by the time-consuming patient care in medicine. These numbers show that medicine and economics are not only different in their subject, their task difficulty and mutual dependence (Whitley), but also in capital intensity, and scale. The health sector has a closer resemblance to 'big science' (de Solla Price, 1963) than economics does in all respects.

### 5.6. Incentives and Constraints of Research Performance

In Section I, the relation between corporate culture and performance was explored. The literature has suggested that economies of atmosphere may be expected in small groups, especially when members are homogenous in their goals and values. We would argue that - although some hierarchy exists - the research unit may be regarded as a fair approximation to what Williamson (1975) referred to as a 'peer group' and Ouchi (1980) as a 'clan'. Research units are small groups consisting of peers - people who have been exposed to similar professional training where their basic objectives, standards, routines, values, and skills may have been 'standardized' (Mintzberg, 1979). Culture is assumed to be efficient in the research unit because (i) it provides excellent (ex ante) screening and (ex post) monitoring devices, (ii) research performance is difficult to measure, (iii) research performance is often the result of teamwork, so that it is difficult to attribute the performance to individual contributions (especially in medicine), and (iv) task uncertainty is relatively high. The professional values incorporated in a cooperative attitude and an intrinsic research motivation are required in order to do the job well.

#### 5.6.1. Scale, Scope, and Atmosphere

The first hypothesis is that atmosphere facilitates academic research performance. The emphasis is on the selective meaning of atmosphere as a set of general values (organizational culture) and specific values (research climate - Pelz and Andrews, 1966). In contrast to the other aspects of culture, general and specific values have been operationalized and validated fairly well by behavioral scientists (Hofstede, 1980; Andrews, 1979). In addition, the impact of culture on scientific productivity is emphasized. We have neglected production and transaction costs, since the evaluation studies (RAWB-report/VEW report) which have provided the basis for our investigation did not include financial data at the unit level.

Moreover, transaction costs are very difficult to measure. Thus, the empirical studies focus on the impact of general values and specific values on the performance level of academic research units in two unrelated disciplines. As a consequence, the impact of this study is restricted to cell 3 and 6 of the economies of atmosphere framework.

Atmosphere, of course, is not the only source of efficiency. In chapter 3, two competitive sources have been recognized: economies of scale, and economies of scope. It is assumed that the scale and scope of production influence the level of research outputs as well. Economies of scale in academic research departments have been demonstrated by Graves, Marchand, and Thompson (1982), while Pelz and Andrews (1966) found a relationship between diversification of activities (scope) and research performance in academic and industrial environments.

In the terminology of this study, the model consists of factors related to economies of atmosphere (culture and climate variables), economies of scale (capital and human resources, and time spent on research), and economies of scope. In order the operationalize the concept of 'economies of atmosphere', we may further specify our definition given in chapter 1. In the empirical studies, 'economies of atmosphere' are defined as the increase in performance level due to culture (general values, e.g. work-related culture) and climate (specific values, e.g. innovative climate and publication climate) variables. Economies of scale refer to the increase in performance level due to the size of factor inputs (capital and human resources). Economies of scope have been defined as the performance increase due to having a multi-product function, i.e. producing different kinds of output (publications in various fields). It is hypothesized that diseconomies of scale exist concerning time spent on non-research activities (especially, time spent on patient care (study I), and time spent on teaching - study II).

Related to scale is the input mix or composition of factor inputs (i.e. the age, research experience of the staff, and interdisciplinary mix). Pfeffer (1986) has shown that demographic variables are important for organizational effectiveness. By analogy to the well-known experience curve (total cost per unit being a decreasing function of the cumulative number of units produced), it is hypothesized that high performing research units have more research experience than low performers, although they do not differ in age. Furthermore, it is hypothesized that high performers may capture synergy effects (which affect performance levels in the long term) by having a more interdisciplinary mix of staff members in their team.

### 5.6.2. Additional Predictors

Are scale, scope, and atmosphere the only predictor variables? In selecting the variables for the model for the first study, the following information sources were consulted: (i) the international literature on research management and scientific productivity; (ii) the literature on cross-national differences in the infrastructure of medical research - especially those countries with a high reputation in this field: the U.S., the U.K., and Sweden; and (iii) professors in clinical medicine themselves. These experts (6 medical professors, 1 policy maker) were the members of a medical advisory council. They were requested to indicate the main facilitating and inhibiting factors of research performance in their field. The results of each of these procedures are reported in Bally et al. (1987: 9-30). The variables identified by these three procedures converged with the results of the interviews with experts in the field of health sciences, held by the Dutch Advisory Council for Research Policy (RAWB, 1983b). Following discussions with the medical advisory committee on the content of the variables identified by these procedures, a theoretical model - including the most critical variables - was advanced.

Three additional important factors were identified in our review of the literature, i.e. management, control, and communication. These 'throughput' factors are presumably related to culture, but they are conceptually different. Although culture may save on coordination and control costs, it is no substitute for management and control. Research management refers to the craftsmanship and the leadership qualities of the research supervisor. The craftsmanship of the supervisor may have a major impact on the quality of the learning environment of the staff, whereas leadership (Selznick, 1957) may influence the unit atmosphere and the cooperative attitude of the staff. In her study of scientific elites, Zuckerman (1977) showed that most Nobel prize winners have worked under the supervision of former Nobel prize winners. The importance of research management in university environments has been pointed out in De Groot's Forum Theory of Science (1984), and has been demonstrated in large scale studies conducted in the U.S. (Pelz and Andrews, 1966), and in European countries (Andrews, 1979).

Management control is the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives. Anthony (1965) conceives 'management control' as the planning and control level between 'strategic planning' (goal formulation) and 'operational control' (assuring that specific tasks are carried out). Strategic decisions are made by the top management (e.g. the university or hospital management). In peer groups, operational control is exercised by the operating core (i.e. the

scientific staff). The middle management (i.e. the supervisor of the unit or responsibility center) is responsible for the management control.

Recent literature suggests that organizational effectiveness can be increased by quality control procedures. In line with the arguments of Hofstede (1981) and Ouchi (1979), Merchant (1985) distinguishes three types of control: personnel control, action control, and result control. Action controls put behavioral constraints on the work process and is generally assumed to play a marginal role in task environments where uncertainty is high. This is the case in academic research departments. Personnel controls (e.g. research motivation - Andrews, 1979) and result control (e.g. pecuniary rewards) are considered to be very important in relatively uncertain task environments. Consequently, positive relations are assumed between motivation (personnel control) and pecuniary rewards (result control) on the one hand, and research performance on the other.

What would science be without the diffusion of public knowledge? The information flow linking various scientists through formal and informal communications has been seen as the 'central nervous system' of science (Allen, 1977). In our study, we have made a distinction in working communications (i) those within the unit (within-unit communication), (ii) those with other Dutch units (between-unit communication), (iii) those with units abroad (international communication), and (iv) those with other disciplines (interdisciplinary communication). Considering the results of the large scale U.S. study of Pelz and Andrews (1966), and Allen (1977), and the European UNESCO study of Andrews (1979), we assume that high performance is related to a high frequency of the above mentioned working communications. Caution, however, is needed in interpreting the results, because communication (especially international communication) may be the cause as well as the effect of high research performance. Since a cross-section design has been used, this applies to the other predictor variables as well. The design enables the test of hypotheses concerning the sign of the predictor-criterion relations, but not concerning the cause-effect relation (direction) between two variables. With regard to interdisciplinary communication, moderate positive correlations (Andrews, 1979) as well as negative correlations (Nijhuis and Spangenberg, 1986) have been observed in previous studies.

### 5.7. Hypotheses

A set of hypotheses based upon the model and on the previous literature was generated. It was hypothesized that research units classified as 'high performers' show the following characteristics in comparison to other research units within the same specialty or field. These

hypotheses particularly apply to study 1 (clinical medicine). In chapter 7 (section 5) some additional hypotheses and modifications will be given for study 2 (economics).

Exhibit 5.2. Hypotheses

| In comparison with low performers, high performers (...) | |
|---|---|
| **X1. Scale** | |
| 1. have critical mass in human resources | HUMAN RESOURCES |
| 2. have a larger unit size | UNIT SIZE |
| 3. have larger research projects | PROJECT SIZE |
| 4. spend more time on research | TIME RESEARCH |
| 5. spend less time on patient care/education | TIME NON-RESEARCH |
| 6. have critical mass in capital resources | CAPITAL RESOURCES |
| **X2. Input Mix** | |
| 7. have the same age distribution | AGE |
| 8. have more research experience | HUMAN CAPITAL |
| 9. have more staff members from other discipl | INTERDISCIPLINARY MIX |
| **X3. Scope** | |
| 10. conduct research in more fields | SCOPE |
| **X4. Atmosphere** | |
| 11. have a more innovative climate | INNOVATIVE CLIMATE |
| 12. have a more stimulating publication climate | PUBLICATION CLIMATE |
| 13. have different general values (VSM) | WORK-RELATED CULTURE |
| **X5. Management** | |
| 14 have a superior research management | CRAFTSMANSHIP |
| 15. have superior leadership | LEADERSHIP |
| **X6. Control** | |
| 16. are more motivated for research | MOTIVATION |
| 17. expect more pecuniary incentives from research | REWARD EXPECTATION |
| **X7. Communication** | |
| (18-21) communicate more often with peers of: | |
| 18. their own unit | WITHIN UNIT COMMUNICATION |
| 19. other units in the Netherlands | BETWEEN UNIT COMMUNICATION |
| 20. other units abroad | INTERNATIONAL COMMUNICATION |
| 21. units of other disciplines | INTERDISCIPLINARY COMMUNICATION |

## 5.8. Measurement of Predictor Variables

In order to measure the input and throughput variables, using standard and new scales, a questionnaire has been designed. Standard scales have been developed by the Institute for Social Research of the University of Michigan (Pelz and Andrews, 1966) , the Massachusetts Institute of Technology (MIT: Prakke, 1974), UNESCO (Andrews, 1979), the Institute for Research on Intercultural Cooperation (IRIC: Hofstede, 1980), and the University of Pennsylvania (Van de Ven and Ferry, 1980). The scales were translated into Dutch (among others by Kunst, 1986) with adapted or new scales being constructed to measure specific aspects of the two disciplines. The medical version of the questionnaire was pretested in a

department of medicine (Bally et al., 1987), and the economic version was tried out in a department of economics before data collection was started. Discussions with members of these departments led to improvements in the design of the Dutch-language questionnaires (cf. Appendix 2).

Below are examples of one or two measurement items for each variables as an example. The scales include semantic differentials (item 1) and Likert type 5-point scale (item 13) (Kerlinger, 1973). The numbers of the items (1-21) refer to the variable names in exhibit 5.2.

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1. The research team is too small to conduct the research effectively (1-2-3-4-5) The research team has enough staff members (critical mass) to conduct the research effectively.
2. Indication of the number of staff members in the research unit: (1) 1-4 FTE (3) 10-FTE (5) >20 FTE (rating by the unit's secretary)(FTE=full time equivalent for research).
3. Indicate the average number of colleagues with whom you cooperate in your research projects: (1) zero (5) ≥10.

4-5. Please indicate in percentages how much of your total work time (=100%) you have spent this year on: research (% time research), patient care (% time patient care in the hospital; % patient care off the hospital- only study I),teaching (%time teaching), and administration (%time administration).

6. The current budget of the unit is inadequate to allow successful completion of the unit's current research tasks (1-2-3-4-5) The current budget is adequate to allow successful completion of the unit's current research tasks.
7. How old are you? (1 = ≤30 years; 3 = 41-50 years old; 5= ≥60 years old).
8. How much research experience have you had (a) during your study leading to your masters degree?(b) after your study? (c) abroad ?(1 = no experience; 3 = 3-5 years; 5 = ≥10 years).
9. What is your original discipline? (aggregation of answers at the unit level shows the (inter)disciplinary composition of the team).
10. Rating of the number of fields in which the unit conducts research (source: the VEW report - the number of fields in which a unit publishes has been taken as an index of the diversification of its research activities).
11. Very few new ideas for research or other technical matters are given adequate consideration (1-2-3-4-5) Nearly all new ideas for research or other technical matters are given consideration.
11. There is the feeling that everyone in the unit only works to make a living (1-2-3-4-5)

There is an atmosphere of great dedication to work in the unit.

12. Members of this unit are not encouraged to publish their research (1-2-3-4-5) Members of this unit are strongly encouraged to publish their research.

12. In our unit nobody manages to do research (1-2-3-4-5) In our unit everybody manages to do research.

13. How long do you think you will continue working for this organization? (1) Two years at the utmost, (2) from two to five years, (3) more than five years (but I probably will leave before I retire), (4) until I retire.

13. An organization's rules should not be broken - not even when the employee thinks it is in the organization's best interest (1) strongly disagree (3) undecided (5) strongly agree.

14. I am very dissatisfied with my immediate supervisor as regards his knowledge of the fields in which the unit is active (1-2-3-4-5) I am very satisfied with my immediate supervisor as regards his knowledge of the fields in which the unit is active (These questions were answered by non-supervisors only. Unit supervisors were requested to pass over all questions regarding variable 14-15).

15. I am very dissatisfied with my immediate supervisor as regards his leadership qualities (1-2-3-4-5 ) I am very satisfied with my immediate supervisor as regards his leadership qualities. (Supervisors were requested to pass over this scale).

16. I invest more energy in my (a) patient care tasks (study I), (b) educational tasks (study II) than in my research tasks (1-2-3-4-5) I invest more energy in my research tasks than in my (a) patient care tasks (study I), (b) educational tasks (study II).

17. If your performance with regard to research is fine, what is the probability that you will achieve promotion in your research department? (1) no chance (3) 50% (5) almost certain.

17. If your performance with regard to (a) patient care (study I), (b) education (study II) is fine, what is the probability that you will achieve promotion in your research department? (1) no chance (3) 50% (5) almost certain.

18. How often do you discuss your work with other members of your own research department? (1) annually or less (3) monthly (5) daily.

19. How often do you discuss your work with members of other Dutch research departments working in the same field? (1) annually or less (3) monthly (5) daily.

20. How often do you discuss your work with members of other research departments abroad? (1) annually or less (3) monthly (5) daily.

21. How often do you discuss your work with members of other disciplines? (1) annually or less (3) monthly (5) daily.

Measurement sources and reliability of the standard and adapted scales are given in exhibit 5.3. For climate (4-5) and management (7-8) the raw data were subjected to factor analysis to provide a basis for combining items to form latent variables. The factor structures are reported in Bally et al. (1987: 135-36). Factor analysis reduces a large number of items to a smaller number of presumed underlying constructs called factors. Explained variance of factor solutions and Cronbach's alpha coefficients were sufficiently high to warrant confidence in the measurement qualities of the scales. The average Cronbach's alpha is 0.72 for medicine and 0.69 for economics. The factors found in study I were used as scales for study II. These scales proved to be rather reliable (cf. variables 4-5 and 7-8). Work-related culture (5) was assessed by the Value Survey Module (VSM) which includes four work-related values: power distance, uncertainty avoidance, individualism, and masculinity. The dimensions are computed on the basis of formulas developed in a 40-country study in national subsidiaries of a large multinational business corporation (IBM) (Hofstede,1980). Since the VSM has been developed at the national level, it is essentially unsuitable for discriminating units at the organizational level. Despite this drawback, we used the VSM because better measures were not available at that time.

Exhibit 5.3. Reliability of Instruments

| Variable Name (number of items) | Source (A=author) | Reliability: Alpha or % Expl. Var. (decimal points have been omitted) | |
|---|---|---|---|
| | | Medicine | Economics |
| **Scale** | | | |
| critical mass (3) | Andrews | 76 | 63 |
| unit size (1) [a] | A | @ | @ |
| project size (1) | A | @ | @ |
| time research (1) | Pelz and Andrews | @ | @ |
| time non-research (4) | Advisory Co/Pelz & Andrews | n.a. | n.a. |
| capital resources (2) | Andrews | 77 | n.a. |
| **Staff Mix** | | | |
| age (1) | A | @ | @ |
| human capital (3) | A | n.a. | n.a. |
| interdisc mix (1) | A | @ | @ |
| **Scope** | | | |
| scope (1) [a] | A | 0 | @ |
| **Atmosphere** | | | |
| innovative climate (5) | Andrews + factor analysis | 30% | 83 |
| publication climate (3) | Advisory Council + factor an. | 8% | 88 |
| work-related culture (13) | Hofstede (original formulas) | @ | @ |
| **Management** | | | |
| craftsmanship (2) | Andrews + factor analysis | 11% | 86 |
| leadership (5) | Andrews + factor analysis | 49% | 87 |
| **Control** | | | |
| motivation (7) | Van de Ven | 79 | 75 |
| reward expectation (8) | Van de Ven | 80 | 77 |
| **Communication** | | | |
| within unit comm (2) | Andrews/MIT | 65 | 64 |
| between unit comm (2) | Andrews/MIT | 66 | 58 |
| international comm (3) | AndrewsMIT | 63 | 87 |
| interdisc comm (2) | Andrews/MIT | 74 | 68 |

**Key**: @ = not applicable (1 item only - Cronbach's alpha indices the consistency between a number of items); n.a. = not applicable (items do not form a scale); [a] All data (except two) were collected at the individual level, and subsequently aggregated to the unit level. The exceptions regard 'unit size' and 'scope'. The former was defined as the number of staff members. The information regarding unit size was transmitted by the unit's secretary. The latter was defined as the number of fields in which the unit has been active. This information could be derived from the evaluation report of the VEW (economics). Unfortunately, data regarding the scope of units were not available in the RAWB report (medicine=0). As a result, the economies of scope hypothesis is only explored in study II.

## 5.9. Quality and Quantity of Research Performance

Scientific performance is a multi-dimensional concept. Consequently several indices have to be used in evaluating performance. Both qualitative and quantitative evaluations of scientific performance exist. The main qualitative type of evaluation is the peer review, while publication and citation numbers are the main quantitative types of science evaluation. Each of these indices covers another dimension of scientific performance. This section reviews some of the pros and cons of each of these measures, and argues that a multi-indicator approach is the best way to evaluate scientific performance.

In the past, empirical studies of the relationship between culture and work performance have floundered to some extent because of an inability to measure satisfactorily the performance or quality of the output. Soeters and Schreuder (1986b), for example, have studied the relation between culture and work performance of staff employees in accounting firms. Their performance measurement was based upon self-ratings, so that subjectivity bias may affect the validity of the conclusion - a fact that is well recognized by the authors. Since virtually all organizational effectiveness studies depend upon assessing the calibre of output produced by organizations (Cameron and Whetten, 1983), an adequate and relatively simple measure has to be found. Without such measure it would be impossible to determine the independent influence of the atmosphere on performance. We believe that substantial progress has been made towards solving this measurement problem in research departments. Concern about the quality of research in science has increased in recent years (Elkema et al., 1978; De Groot, 1984; Becker and Van Raan, 1986). Scientists and policy makers agree on the importance of quality in all the links of the research chain. It is, however, virtually impossible to operationalize the concept of quality. Thus reliable and acceptable surrogate measures have to be found.

Cole and Cole (1973) have pointed out that quality may be defined in two different ways. A traditional historian of science might apply a set of absolute criteria in assessing the quality of a scientific paper. Those papers which embody scientific truth and enable us to understand better empirical phenomena are high quality papers. The fact that a particular set of works may be momentarily in fashion or temporarily ignored tells us nothing about the quality of the work, if we use the absolute definition (Lakatos and Musgrave, 1970). Another way to conceptualize quality is built upon the philosophical view that there is no absolute truth. Since what is believed to be true today may not be true tomorrow, few if any scientific discoveries will ever meet the absolute criteria. In the long run all discoveries will be seen as being in some fundamental aspect incorrect. Therefore high quality work is defined as that which is currently thought useful by one's colleagues. This relativistic view emphasizing the demand-

side of science is rather similar to the 'perceived quality' view (product quality is how the consumer sees it) that has been adopted in marketing science (Jacoby and Olson, 1985).

Consistent with the demand-side approach of quality is the argument that we can only gain insight into the contribution of a publication to the growth of knowledge by assessing its impact at the research front (Moed et al., 1985a). Thus, the scientific quality of a publication is defined by its use by peers. The authors assume that there is a research front in every scientific field. At this front scientists develop theories about the structure of reality and these theories are confronted with each other through experimental research. In the end certain theories will triumph and be added to the basic knowledge in the field. The authors distinguish long-term and short-term impact. Looking at impact over a long period offers the possibility of relating impact to 'durability' - the degree to which a research group has made a more permanent contribution to scientific advance. Short-term impact refers to the impact of researchers at the research front a few years after the publication of research results. The short-term impact indicates how groups maintain themselves at the research front, whereas the long-term impact indicates to what extent they eventually succeed in scoring 'triumphs'. However, for research to have impact, it is necessary that colleague researchers do have the opportunity to form an opinion about the basic quality of that research. According to this view, one aspect of successful research performance is that researchers are active in presenting their research findings to peers. Scientific quality thus defined includes basic quality as well as the extent to which researchers successfully perform 'public relations' activities.

### 5.9.1. Convergence of Partial Indicators

A judgement of basic quality is based on criteria intrinsic to scientific research. Therefore only colleague researchers - peers working within the same specialty (de Groot, 1984) - can evaluate quality. The peer-review system is the method for evaluating research performance most favored by scientists. Within the context of research policy, Irvine and Martin (1985) have argued that the peer system is coming under increasing strain. The successful operation of peer-reviews depends on the existence of 'disinterested' peers able to provide independent expert judgements - that is, there must be sufficient scientists familiar with the research for which funds are being sought, but whose own material circumstances will be unaffected by the decision outcome. When the number of distinct research groups working in a specialty is large, this condition is approximately met. However, this situation has changed, at least for 'Big Science' (De Solla Price, 1963). Instead of the free market of scientific ideas, all competing for funding solely on the basis of scientific merit, there has been a trend towards a situation of 'oligopoly' in which a few large centers and interest groups can exert a dominant influence over claim on resources. As a consequence, the perceived implication of evaluation results of

competitors for their own center may affect the quality judgements of scientists. This problem can only be partially overcome by using a complete sample, or a large representative sample of peer reviewers.

Irvine and Martin (1985) have argued that evaluation based upon triangulation of performance measures is more reliable than a single-indicator approach. Their comparative method of converging imperfect indicators is based on the application of a range of performance indicators to matched research groups. When the indicators all point in the same direction, the results of evaluation are regarded as being relatively reliable, and certainly as being more reliable than those based on a single indicator like peer-review (Porter et al., 1988). The approach involves the combined use of several indicators. These indicators reflect different facets of research performance, although they are, of course, to some extent interrelated. For example, numbers of (high quality) papers per researcher reveal something about the basic quality and productivity of that group. The average number of citations per paper gives an indication of the impact those publications have on the scientific community. Moed and colleagues (1985a) consider a three-year citation-counting period as a standard period for short term impact. Short term impact should be related to the visibility of a group at the research front, and can be ranked with other visibility indicators such as international contacts, awards, and invitations to take part in important conferences. While the short term impact is an indicator of 'visibility', the 'durability' of scientific work is indicated by a citation-counting period larger than three-years. Citation counting is consistent with the view that high-quality work is that which is currently thought useful by peers (Cole and Cole, 1973). Peer rankings (where peers rank in order the performance of similar research groups according to their relative scientific contributions over a given period) provide evidence of the perceived significance of the results from different groups.

All these measures are, of course, partial measures. They reflect partly the relative magnitude of contributions to scientific knowledge, and partly a variety of institutional, psychological, and economic factors. Scientific performance is a multi-dimensional concept. Consequently, several indices are needed to assess the dimension. As mentioned before, measures of scientific performance can be divided in qualitative and quantitative measures. The main qualitative measure is (i) the peer review, the quality evaluation of colleagues. The main quantitative measures are the number of (ii) publications and (iii) citations. The oligopolistic bias in peer-evaluation (the effect of perceived implications of their judgement on prospective resource allocation) has already been mentioned. Problems also exist with regard to publications and citations. One problem with publication counts or similar 'scientific productivity' measures (Andrews, 1979) is that each publication clearly does not constitute an equal contribution to scientific knowledge. A second problem is that publication traditions vary

among specialties. This is one reason why comparisons can only be drawn between 'matched' research groups using similar research facilities, and publishing in the same body of international journals subject to comparable refereeing procedures. Use of citation analysis (Garfield, 1979) presents a number of technical problems, for example, incomplete coverage of journals by the Science Citation Index and the Social Science Citation Index which provide the source data for citations. In addition, a paper containing results subsequently found to be mistaken may be heavily cited, at least until the error is clearly revealed. Here one must distinguish between the intrinsic quality of a paper and its impact at the research front. Only for the latter does citation frequency provide a reasonable indicator. Another problem with citations is the variation in citation rates among specialties. Moed and colleagues (1985b) have demonstrated that rankings of publications from different fields, based on citation counts, can be affected seriously by differences between citation characteristics in those fields. High short term citation levels, for example, were found in Biochemistry, medium citation levels in Experimental and Molecular Physics, and low citation levels in Mathematics and Inorganic Solid State Chemistry. However, as with publication counts, this problem can be overcome by applying citation analysis only to matched research groups within a single specialty. Clearly each of the indicators has its own pros and cons, and each of the criticisms has well-known replies. As Leamer (1981, in Palmer and Liebowitz, 1988: 93) humorously put it: "Many of you will conjure up reasons why the number of citations should be ignored. There are fads; there are self-citations; there are citation conspiracies; there are derogatory citations; there are bribes to editors and referees; there are sycophantic students; and there are subjects capable of direct understanding only by the few. But why didn't your paper starts fads; why don't you publish more and cite yourself; why did your conspiracies fail; why don't you become an editor; why don't your students care about your welfare; and why do you insist on writing about obscure issues?".

The method of converging imperfect indicators is essentially comparative, with the added condition that one can only legitimately compare 'like with like'. One cannot, for example, compare directly the performance of a medical research unit with that of an economic research unit, but one can compare it with the performance of medical groups within the same specialty at other university hospitals . The combination of a comparative methodology (Campbell and Stanley, 1966; Warwick and Osherson, 1973) with triangulation of imperfect measures (Hofstede, 1980), regarding the results as more reliable when the indicators all point in the same direction, is Irvine and Martin's (1985) contribution to the comparative method of converging partial indicators. In general, bibliometric techniques, including publication countings and citation analysis, tend to be correlated with more conventional measures such as peer-reviews. Using the Science Citation Index, Cole and Cole (1973) have shown that Nobel Prize laureates, who can be safely assumed to have made outstanding contributions, have a

higher average number of citations than other scientists - even before they won the prize (cf. Nederhof and Van Raan, 1987). Narin (1987) has pointed out that bibliometric results are seldom counter-intuitive. The results are often in substantial accord with the opinions and expectations of knowledgeable research administrators. Moed and co-workers (1985a) interviewed researchers in the faculties involved in their citation analysis. These interviews were meant as an 'acceptance test', i.e., to examine whether their results and interpretations differed or agreed with the ideas of the scientists in the field (peer-review). The authors found that in many cases the researchers interviewed did not reject their results and interpretations, but tried to find explanations for the observed output and impact of the research group. Irvine and Martin (1985), finally, applied their method to compare the past performance of the accelerators at CERN, the joint European Laboratory for Particle Physics, with that of the world's other main accelerators (research facilities). Comparing the bibliometric indicators and the peer-review assessments made by high-energy physicists, they found some consistency between the results yielded by these independent measures. Certainly, there was a 'self-ranking effect' in the peer evaluation- a tendency to rate one's own work more highly than do others - but (except in one case) this was not significant. On the other hand, it should be noted that imperfect or even lack of correlation between the results of bibliometric indicators and the results of peer judgement have been found too. A systematic comparison of these two types of past performance analysis (Moed et al., 1985a), for example, revealed a serious lack of agreement between citation analysis and peer-review results. Therefore the convergence of imperfect indicators should be tested, and not be regarded as a priori given.

### 5.9.2. Selection of Performance Measures

Scientific performance is a multidimensional concept. The above mentioned indicators measure different dimensions of scientific performance. They measure 'basic quality' (peer-review), 'scientific productivity' (publication counting), 'short term impact' or 'visibility' (short term citation analysis), and 'long term impact' or 'durability' (long term citation analysis). Obviously, long term impact would be the best proxy, since 'growth of knowledge' has been recognized by various authors as the ultimate criterion for scientific effectiveness (Nagel, 1974; Popper, 1966; Lakatos, 1970). Unfortunately, long term impact evaluations are hardly useful for research policy, because permanent contributions can only be determined after a considerable period of time (Moed et al., 1985a, and 1984). Although the other indicators provide less good proxies, they are certainly more feasible. Thus, we conceive (i) the (qualitative) peer review, (ii) the number of publications, and (iii) the number of (short term) citations as the main indices of academic research performance. More detailed information regarding the measurement of performance in medicine and economics will be

given in the subsequent chapters. The pros and cons of each of the science indicators mentioned above are more extensively discussed in Rigter (1986), Becker and Van Raan (1985), and Bally and colleagues (1987). The main performance measures used in the studies presented here are: (Y) overall performance which is the convergence measure of partial indicators, (Y1) peer review, (Y2) number of publications, and (Y3) number of (short term) citations. The preceding sections have focussed on the measurement of inputs, throughputs, and outputs in research units. The next section discusses the research model which presents the expected predictor-criterion relations mentioned above in a nutshell.

### 5.10. Theoretical Model: Analysis of Variance

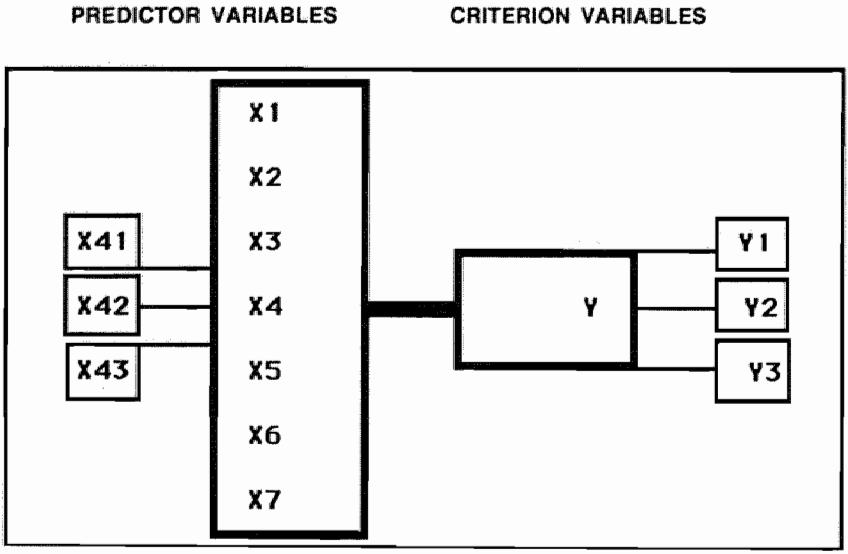
Exhibit 5.4. summarizes the model which forms the theoretical foundation of study I and II. Predictor variables include scale, staff mix, scope, atmosphere, management, control, and communication, whereas criterion variables include peer reviews, and the amount of publications and citations.

The model suggests causal relations between inputs, throughputs and outputs. However, evidence for causal chains between variables in a specific direction can only be given by process or trend analysis. Study I and II use a cross section design. They are typical examples of variance or level analysis (Miller and Friesen, 1984; Moed et al., 1985a). It is standard methodology to state that the use of a cross-section design does not permit the identification of cause-effect chains. Although the model suggests that, for example, atmosphere affects scientific performance, it is possible - and even plausible- that the relation between atmosphere and performance might have a reverse or two-sided causality, with higher performance (also) resulting in increasing atmosphere. Although longitudinal designs are often assumed to generate more accurate causal propositions, the problem of causality is not solved by time series designs when simultaneous models are used, i.e. $X_t$ (instead of $X_{t-1}$) and $Y_t$ (instead of $Y_{t-1}$) are measured in order to compare the consumption effects of income with the income effects of consumption.

The static model enables inspection of the (positive, neutral or negative) nature (sign) rather than the direction of predictor-criterion relations. Thus, it allows falsification of hypotheses. Hypotheses are falsified when the nature of the predictor-criterion relation deviates from the expected statistical association. In addition, the model enables a comparison of the relative contribution of each predictor in 'explaining' (in a restricted statistical sense) the variance in the performance of research units. Consequently, answers can be given to the question whether economies of atmosphere are more important than economies of scale or that interdisciplinarity is more important than economies of scope. Nevertheless, since reverse

causality cannot be ruled out with the data collected in the cross-section design of study I and II, the results have to be interpreted with caution. Future research should attempt to address this issue with a longitudinal (Van Heeringen and Dijkwel, 1987) or a quasi-experimental design (Allen, 1977).

Exhibit 5.4. Theoretical Model




**Key**

| Variables | Measures |
|---|---|
| **predictor variable** | |
| X1 = economies of scale | **Predictor measures** |
| X2 = input mix | Y1 = peer review |
| X3 = economies of scope | Y2 = number of publications |
| X4 = economies of atmosphere | Y3 = number of citations |
| X5 = management | |
| X6 = control | **Criterion Measures** |
| X7 = communication | X41 = work-related culture (example) |
| **Criterion variable** | X42 = organizational culture (example) |
| Y = overall scientific performance | X43 = research climate (example) |

## 5.11. Concluding Remarks

In order to test the hypothesis that atmosphere affects internal efficiency, it is necessary to:

(i) select instruments for the measurement of efficiency
(ii) design controls for internal and external validity

(i) A commission of the Netherlands Ministry of Education and Sciences has offered the opportunity to study economies of atmosphere in medical research units of university hospitals. This study was replicated in departments of economics and business administration. The research performance of these fields has been the subject of large scale evaluation studies which have combined partial indices like publications, citations, and peer reviews. These studies provide the empirical basis for our classification in high and low performers. The empirical studies emphasize a managerial approach to university science. Chapter 5 deals with this approach, and discusses some pros and cons of the monitoring devices mentioned above.

(ii) In order to check for internal validity, the research units have been matched with regard to their relative research performance. In order to demonstrate external validity, the results of study I (medicine) and II (economics) are compared with each other. Given the variance beween these disciplines, it is apparent that consistency would provide confidence in the generalizability of the findings. This chapter has discussed the design of study I and II. Furthermore, hypotheses are formulated concerning the predictors of research performance. In addition to atmosphere, they include economies of scale, scope, and various managerial factors. A questionnaire has been designed to measure these predictors in research units.

While Section I of this book deals with the economic rationale for economies of atmosphere, Section II has focussed on design and measurement. Section III, finally, will report the results of the empirical studies concerning scientific performance in medicine and economics.

# SECTION III. EMPIRICAL STUDIES

# 6

# Scientific Performance in Clinical Medicine[1-2]

## 6.1. Introduction

This chapter will explore economies of atmosphere in clinical departments of university hospitals. Additional hypotheses will be tested concerning the advantages of scale, staff mix, management, control, and communication. Ideally, economies of scope are investigated as well, but no empirical data were available regarding joint production in medical fields. The chapter starts with a discussion of the performance evaluation concerning clinical medicine (in Dutch: patientgebonden onderzoek). Then it will focus on the procedures concerning sampling, data collection, and data analysis. Finally, the univariate and multivariate results will be discussed, especially regarding to economies of atmosphere.

## 6.2. State of the Art in Clinical Medicine

Clinical research seems to be in trouble in several countries on both sides of the Atlantic Ocean. The decline in the number of clinical researchers and the shortage of clinical faculty, especially the faculty that could do research, has been noted in many prestigious medical journals such as The Lancet (1979) and The New England Journal of Medicine, viewing clinical

[1] The research on which this chapter is based was supported by a grant of the Netherlands Ministry of Education and Science. The research team consisted of Y.W. Bally, J.F.A. Spangenberg, R. Starmans, F.J.N. Nijhuis, and B. Breemhaar. The team was supported by a national advisory committee consisting of A.Th. Schweizer (Leiden University Hospital), E. Mandema (Groningen University Hospital), J.L. Touber (Amsterdam University Hospital), W.C. Hulsman (Rotterdam University Hospital), H.J.J. Wellens (Maastricht University Hospital), A. Querido (Leiden University Hospital), and C. van Dorp (Netherlands Ministry of Education and Science)

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medicine as a 'threatened institution', and the clinical investigator as an 'endangered species'. Heyssel (1984) sets out the quality problems in Academic Medical Centers. In the U.K., doubts about the quality of clinical research are often echoed by those who should be the natural partners of the clinical researchers - the biological scientists. The Stoker Report on the future of the Clinical Research Center refers to a "malaise affecting clinical research" (Swales, 1986) shown by, for example, the fall in numbers of grant applications received from clinical academic departments. It concludes that clinical research in the United Kingdom is at present not well placed to take advantage of the remarkable advances in basic medical research. In the Netherlands, the past performance of clinical research was measured by the National Advisory Council for Research Policy (in Dutch: RAWB). The concept of clinical research covers medical research activities inspired by the illness of the patient. It takes place in clinical departments of university hospitals, and may be focused on prevention, cure or care. In general, the evaluation study of the RAWB indicates that medical research in The Netherlands has a reasonable international standing. Nevertheless, none of the medical disciplines appear to be uniformly strong. Large variance in research quality between units appears to exist between units within medical disciplines. With regard to clinical research, the RAWB concluded that research quality on average is low.

Consequently, the Dutch government commissioned a team of the University of Limburg, consisting of Bally (Faculty of Health Sciences), Starmans (Faculty of Medicine), and Spangenberg (Faculty of Economics and Business Administration), to analyze the main organizational factors influencing the research performance of clinical units in Dutch University Hospitals. The team (which included two additional researchers, Breemhaar and Nijhuis, as well) issued its report in May 1987 (Bally, et al., 1987). With special attention given to the competitive advantages captured by economies of scale and atmosphere in the scientific enterprise, the subsequent sections will present findings of the quantitative part of this investigation.

### 6.3. Measurement of Performance

The hypotheses are tested by examining the differences between successful (high) and less successful (low) performers. The concept 'performers' refers to teams (clinical units) not to individuals. The distinction between high and low performers is based on large scale evaluations of the performance of clinical research (RAWB, 1983b; Rigter, 1986). The evaluation of the RAWB included five measures of clinical research performance at the unit level. All these measures were aggregated to - if not already defined at - the unit level.

Rigter gives the following description of the measures:

i ) measuring the output of the research units in terms of the papers published in the international literature in the period between 1976-80 [productivity];

ii) estimating the influence of these papers on the international scientific community by determining the extent to which this work is cited between 1978-81 [impact];

iii) estimating the standing enjoyed by Dutch scientists in the international scientific community by assessing how often they are asked to edit leading scientific journals (these individual data were then aggregated to the unit level)[editorship];

iv) obtaining the views of a large number of foreign scientists as to which Dutch researchers carry out work of outstanding quality (the individual data were then aggregated to the unit level)[international peer review];

v) interviewing prominent Dutch scientists working in many fields of clinical research to establish their view on the quality of units in their field [national peer review].

Evidently, each of these measures has its own limitations. The pros and cons have been extensively discussed by Rigter (1986), and Moed and co-workers (1985a, 1985b, 1985c). Despite the limitations of each measure, the overall evaluation produced a reasonably consistent picture. The concordance of the various approaches is evident from the following findings reported by Rigter (1986): "All groups excelling on the citation measure and all groups excelling on the editor measure, in each case except one, were judged positively by the Dutch experts. All groups mentioned by the foreign experts were also mentioned appreciatively by the Dutch experts". Recently, the evaluation of the RAWB has been updated by the Royal Netherlands Academy of Sciences (in Dutch: KNAW). The KNAW (1985) used, broadly, the same combination of performance measures. Their updating did not significantly deviate from the evaluation of the RAWB. Taken together, the performance measurements provide information of relatively high validity on the past performance of clinical research in the Netherlands.

### 6.4. Sample

The selection of units with a high and low performing research performance was carried out after careful consultation with experts of the RAWB and KNAW who were involved in the evaluation studies. In addition, these experts were familiar with the (shifts in) management, internal organization and performance of the units. Several bibliometric studies (Moed et al., 1985) have demonstrated large variations in publication and citation behavior of fields within

disciplines. Therefore the term high and low performance should be applied in a relative rather than an absolute sense. Clinical units perform better or less well in comparison with other units of the same field. A wide variety of medical fields were selected for inclusion in the study: gastroenterology, haematology, clinical immunology, nephretic diseases, endocrinology, clinical pharmacology, anesthetics, clinical genetics, social psychiatry, child psychiatry, orthopaedics, otorhinolaryngology (TNE diseases), gynaecology, cardiology, urology, neurosurgery, child surgery, neurology, and child medicine (19 fields representing the major basic, intermediate, and top specialisms in medicine). Per field, a selection was made of two or more high performers and two or more low performers. High performers are units with above average performance on three or more of the above mentioned indicators (productivity, impact, editorships, (inter)national peer reviews). If no unit met this criterion, units with above average performance on at least one measure were selected. Units which did not perform above average on any of the performance measures were classified as low performers. In consultation with the experts of the RAWB and the KNAW, an attempt was made to match units in each discipline that differed most in their performance (highest performance or second best versus low performance), and that differed as little as possible with regard to other sample characteristics such as unit size, age, and mobility. In total 27 high performing units and 34 low performing units were requested to participate in the study. These 61 clinical units were spread over 19 medical fields. All Dutch university hospitals (N=8) were represented.

Evidently, the selection was not random: a bias was introduced to ensure sufficient numbers of scientists in high and low performing units. This bias does not distort our empirical analysis since we are concerned with estimating the relationships between organizational factors and performance, and not with establishing the size, scope or atmosphere of the representative clinical unit (Philipsen, 1969). Having 'pure' samples of high and low performers (maximizing the variance in performance levels) is more appropriate for the present research purpose than having large numbers or having a representative sample of the population.

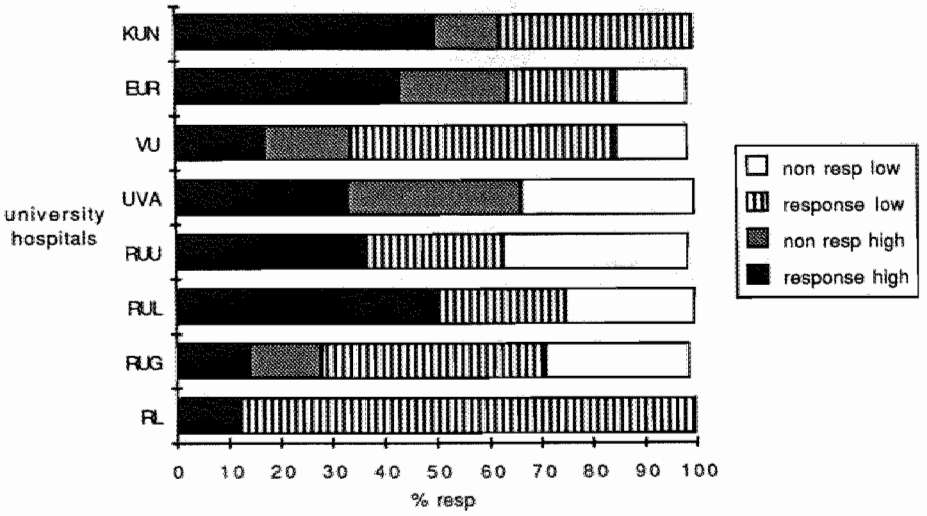
### 6.5. Data collection

A mail questionnaire accompanied by a letter of recommendation from the advisory committee was sent to the selected clinical units, addressed to all staff employees of the unit, who (i) were academically educated (thus, excluding administrative and support staff), and (ii) were appointed to participate in clinical research (thus, excluding those staff members with exclusively patient care, medical training and administrative duties).
These criteria produced a population of 680 respondents of whom 337 were working in units with high performance, and 343 were working in units with low performance. In total 53

units (70%) decided to participate in the study. Analyses were made of 43 units only, because 10 units were represented by less than 25% of their researchers. The sample consisted of 20 high performers and 23 low performers. The degree of nonresponse of high and low performers is rather similar, because more low than high performers were requested to participate in the study. In order to prevent response bias, the research units were not informed about our classification in high and low performers.

Exhibit 6.1. shows the response distribution of high and low performers over university hospitals, while Exhibit 6.2. shows the response distribution over medical fields. The tables with the facts and figures are given in Bally et al. (1987: statistical appendix).

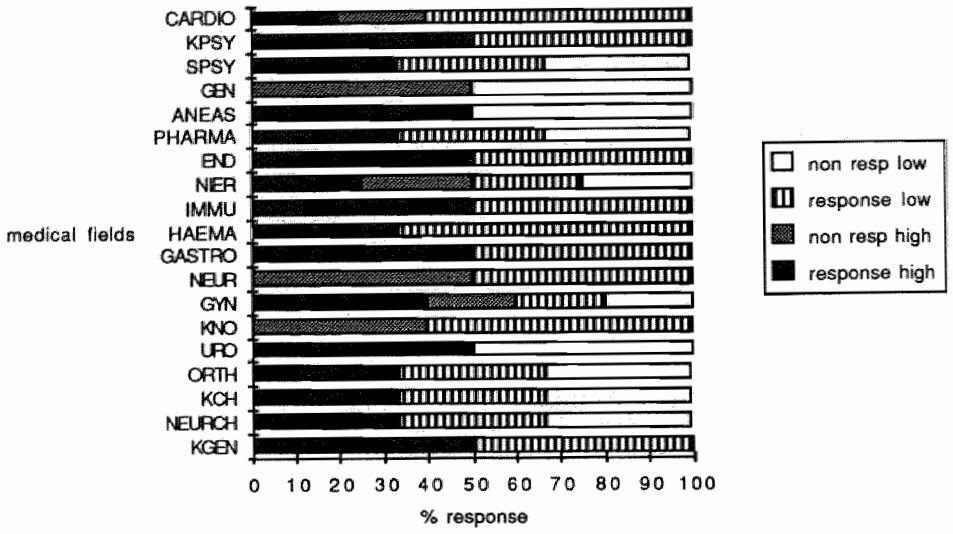
Exhibit 6.1. Response distribution university hospitals




**Key**

| | | | |
|---|---|---|---|
| KUN | Katholieke Universiteit Nijmegen | RUU | Rijksuniversiteit Utrecht |
| EUR | Erasmus Universiteit Rotterdam | RUL | Rijksuniversiteit Leiden |
| VU | Vrije Universiteit Amsterdam | RUG | Rijksuniversiteit Groningen |
| UVA | Universiteit van Amsterdam | RL | Rijksuniversiteit Limburg |

Exhibit 6.2. Response distribution medical fields




**Key** (Dutch Abbreviations versus U.S. Spelling)

| | | | |
|---|---|---|---|
| cardio | cardiology | gastro | gastroenterology |
| kpsy | child psychiatry | neur | neurology |
| spsy | social psychiatry | gyn | gynecology |
| gen | clinical genetics | kno | TNE diseases |
| anaes | anesthesiology | uro | urology |
| pharma | pharmacology | orth | orthopedy |
| end | endocrinology | kch | child surgery |
| nier | nephretic diseases | neur | neuro surgery |
| immu | immunology | kgen | child medicine |
| haema | hematology | | |

Exhibit 6.2. shows that clinical genetics is the only field that is not represented in the sample. A total of 274 (of which 259 usable) questionnaires were returned by the 43 units (individual response: 45%) from researchers in units with a high performance (48%) and with a low performance (53%). Nonresponse analysis - including interviews with non-responding unit supervisors - showed that the following factors account for nonresponse on the unit or individual level:

(i) lack of time, caused by work pressure (patient care on the one hand, and colleagues' holiday on the other hand - note that the data were collected in the period June-August). This is rather plausible for clinical staff members who repeatedly have been found to work more than 58 hours per week (CBS, 1985).
(ii) questionnaire lassitude: these clinical units have been subjected to several output evaluations and time determination studies in the recent past;
(iii) one unit did not respond because it differed in opinion with regard to our selection of variables; while another unit did not respond because it did not conduct 'clinical research' - at least not according to our definition.

What about the representativeness of the response sample? Oppenheim (1966) has suggested that late responders resemble nonresponders rather than early responders. If it is true that the answers of late responders are a fairly good estimate of the answers of nonresponders, the similarity between late and early responders in this survey provides ground for confidence in the representativeness of the response sample. Early and late responders could be easily identified in our sample. Data were gathered in the period June-September. Postal questionnaires were sent in the third week of June. From the month July, units were reminded three times to send the questionnaire back. Early respondents were defined as those who sent their questionnaire back in the period June-July, that is within 6 weeks (212 subjects). Late respondents were defined as those who send their questionnaire back in the period August-September (62 subjects). T-tests did not show significant differences between early and late respondents on relevant items (Bally, et al., 1987), thus indicating that the individual response is fairly representative for our sample of clinical research units in Dutch university hospitals.

### 6.6. Univariate Results

As mentioned before, the instruments appeared to be relatively reliable with average Cronbach's alphas of .72. Data analysis was performed at the unit level. For this purpose the individual scores per unit have been aggregated to the group level. Several organizational studies have found that aggregated scores tend to increase the reliability of organizational measures (Nijhuis, 1984). To check the reliability of our aggregated scores, we tested the differences between units of variance in the individual scores (Bartlett-Box F). This test revealed no substantial differences between units in the homogeneity of the answers of individual scientists, thus permitting the conclusion that high and low performers are similar in the degree to which their aggregated scores are a reliable representation of the measured variables.

The univariate data analysis include t-tests, cross tabs, (partial) correlation analyses, and ANOVAs. Different procedures were employed because of their greater applicability to specific data sets or substantive questions. Whenever possible, more than one technique was used to analyse the same data set, although only one procedure is reported. In general, substantive conclusions have been found to be supported by all forms of analysis. This should be no surprise, since essentially all of the statistical modes of analyses rest on similar logical foundations (Nunually, 1981). Exhibit 6.3 shows the correlations between the predictor variables and the performance measure. The next section will discuss the univariate results, while the subsequent section focuses on the covariance analysis including the partialized correlations.

Exhibit 6.3. Pearson correlation matrix

| variable | correlation with performance (decimal points have been omitted) | partialized for time research |
|---|---|---|
| **1. Scale** | | |
| human resources | 37** | 30** |
| unit size | n.s. | n.s. |
| project size | n.s. | n.s. |
| time research | 35** | n.a. |
| time non-research: | | |
| (i) patient care hospital | n.s. | n.s. |
| (ii) patient care off the hospital | -31** | -29** |
| capital resources | 30** | n.s. |
| **2. Staff (Input) mix** | | |
| age | n.s. | n.s |
| human capital: | | |
| (i) research experience during study | n.s. | n.s. |
| (ii) research experience on the job | n.s. | n.s. |
| (iii) research experience abroad | n.s. | n.s |
| interdisciplinary mix | n.s. | n.s. |
| **4. Atmosphere** | | |
| innovative climate | n.s. | n.s. |
| publication climate | 34** | n.s. |
| work-related culture | n.s. | n.s. |
| **5. Management** | | |
| craftsmanship | 38*** | 30** |
| leadership | n.s. | n.s. |
| **6. Control** | | |
| motivation | n.s. | n.s. |
| reward expectation | -32** | -33** |
| **7. Communication** | | |
| within unit commmunication | 32** | n.s. |
| between unit communication | 33** | n.s. |
| international communication | 38*** | 30** |
| interdisciplinary communication | n.s. | n.s. |

* Significant at the .1 level; ** the .05 level of significance; *** the .01 level of significance

### 6.6.1. Economies of scale

Univariate analysis provided positive confirmation for the economies of scale hypothesis - both with respect to human and capital resources. In comparison with low performers, high performers conceive their human resources and capital resources to be adequate to do the research successfully. Moreover, they spend more time on research, and less time on patient care outside their university hospital (private practices) than low performers. Surprisingly, high and low performers do not differ in size - neither in absolute unit size (in terms of absolute number of staff members) nor in project size. An explanation for this finding is that the present study did not take into account the full time equivalents (FTEs) for research. Large

groups may be small groups in terms of FTE, and vice versa. The main difference in scale is human resources, i.e. the critical mass of high performing units was adequate compared to that of low performers.

Regarding the input mix of high and low performers, no differences could be detected. This finding confirms the sampling procedure which has focused on homogeneity in demographic respect. Consequently, other than demographic variables are accountable for the variance in research performance in clinical medicine.

### 6.6.2. Economies of Atmosphere

High and low performers only differ significantly in the factor publication climate. In other words, "scientists were encouraged to publish research results", and "it is ensured that everybody in the unit manages to do research" (see Dutch language items in Appendix 2). It is uncertain whether the non-correlation between work-related values and performance is due to inappropriate measurement or to a true non-relationship between work-related culture and performance. As mentioned before, the present study has applied the value survey module in order to assess work-related culture. This measure, however, was originally designed for use at the national rather than the organizational level. A measure which is more appropirate to differentiate between organizational units is the organizational culture module (Hofstede et al., 1988). But this measure was not yet available when the present investigation started.

### 6.6.3. Management

The craftsmanship of the supervisor is evaluated as more favorable by members of units that are classified as high performers. No relationship could be demonstrated between the leadership qualities of the unit supervisor and research performance.

### 6.6.4. Control

Neoclassical economic theory assumes that people are profit mazimizers. Unexpectedly, we found that high performers expected fewer rewards when they performed well in research efforts than when they performed well in patient care. This finding is inconsistent with their time spending pattern, i.e. more time is spent on research. It is, however, highly consistent with the fact that less time is spent on (private, and more profitable) patient care outside the university hospital - than that spent by scientists from low performing units. These findings suggest that (pecuniary) profit maximization does not pay in terms of scientific productivity -

at least not in clinical medicine. We will later deal with the interpretation of this intriguing non-maximization finding.

### 6.6.5. Communication

Communication is essential for research performance. High performers have more communications with other research units in the Netherlands. In addition, they communicated more frequently with peers within their unit. The fact that they have more working communications with (excellent) units abroad may be an effect rather than a cause of their performance level. The univariate analyses failed to demonstrate a (positive or negative) relationship between interdisciplinary communication and performance. This is consistent with the non-correlation between the input mix (including interdisciplinary composition of the staff) and performance.

### 6.6.6. Summary of the Univariate Results

In sum, the analyses showed positive relations between research performance and scale, communication, and management. Partial support was found for economies of atmosphere (publication climate). Unexpectedly, an inverse result was found with respect to result control (reward expectation). No support was found for the hypotheses concerning unit size, research experience, project size, innovative climate, work-related culture, leadership, motivation, and interdisciplinary communication. These variables appeared to be unrelated to scientific productivity in clinical medicine.

## 6.7. Covariance Analysis

The previous analyses showed that high performers devote more time to research than low performers. Clearly, the differences with regard to capital resources, publication climate and international communication may be correlated with the amount of time spent on research. Consequently, the value added by these variables in explaining clinical research performance would range from low to zero. In order to test the alternative plausible hypothesis that time spent on research exclusively accounts for the variance in research performance, the analyses were repeated correcting for time devoted to research. The results of the co-variance analysis (with time spent on research as co-variate) and the partial product moment correlations (where we eliminated differences in time spent on research between the units) are shown in the following table.

Exhibit 6.4. Differences between high and low performers after correcting for time devoted to research (results of the MANOVA)

| | Covariance Analysis | Partial Correlation | Significance |
|---|---|---|---|
| Variables | F | r | p |
| human resources | 3.89 | | .01 |
| time patient care off the hospital | 6.34 | | .02 |
| capital resources | | .23 | n.s. |
| publication climate | 1.75 | | n.s. |
| craftsmanship | 4.04 | | .05 |
| reward expectation | 2.40 | | .07 |
| within unit communication | | .18 | n.s. |
| between unit communication | 2.00 | | n.s. |
| international communication | 3.89 | | .01 |

The table is consistent with the partial correlation matrix (Exhibit 6.3). It shows that, similarly to time spent on research, the following factors appear to be related to performance in a fairly independent way: scale (human resources, and time patient care off-hospital), communication (international), management (craftsmanship), and control (reward expectation). The other variables, including publication climate, are strongly correlated to time devoted to research, so that they do not explain extra variance. Including these variables in a predictive model of past performance would generate diminishing returns and decreasing 'predictive efficiency' (Kerlinger, 1973).

### 6.8. Multivariate Results

The next section focuses on the multivariate analysis - particularly on the Fisher linear discriminant analysis. First, the background of the technique will be discussed. Then, the multivariate results will be presented. While these results pertain to the between-unit variance, section 6.8.4. examines the between-discipline variance with regard to the discriminant function.

#### 6.8.1. The Fisher Linear Discriminant Analysis

In the mid 1930s Sir Ronald Fisher developed a method for the solution of the two-group case known as linear discriminant analysis. To explain more fully the difference between high and low performers, discriminant analysis was conducted with the univariately significant predictor variables (time devoted to research, and the variables which were related to

performance after the correction for time spent on research) as a starting point. Since discriminant analysis is of crucial importance in study I and study II, we will first discuss the technique. Discriminant analysis has not been used much in organizational effectiveness studies (Cameron and Whetten, 1983), but it has interesting potentialities.

Discriminant analysis is a multivariate technique used to study the relations among variables in two or more different populations or samples. Its main aim is the maximization of multivariate group means. Essentially, it addresses itself to the question how individual cases can best be assigned to groups on the basis of several variables. It is used for predictive purposes (Kerlinger and Pedhazur, 1973), and classification purposes in various disciplines such as biology and medicine (Anderson, 1973), business administration (bankruptcy prediction, Altman, 1982), and personnel psychology (personnel selection, Tatsuoka, 1970) - measures that in the past successfully predicted performance can be combined into a discriminant function, and future individuals (if they not differ too much from the original sample) can be classified on the basis of them.

A discriminant function is a regression equation with a (dichotomous) dependent ('criterion') variable that represents group membership. The function maximally discriminates the units of a sample - it tells us to which group each unit probably belongs. When dealing with two groups, for example high and low performers, the discriminant function is a multiple regression equation with the dependent variable a nominal variable (coded 0,1) representing group membership. The discriminant function maximally discriminates the units of a given sample. In addition, it provides us with information which variables 'explain' the discrimination, since the (standardized) discriminant function coefficients show the relative weights of the predictor variables in the discrimination function. The selection rule for variables to enter into the discriminant function is Wilks' Lambda minimization. Thus, weighted linear combinations of variables are computed in order to maximize the multivariate group difference. The discriminant function, Z, can be expressed as:

$$Z = \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p,$$

where $\beta_i$ (i = 1,...,p) are weights, socalled (standardized) discriminant function coefficients, and $X_i$ (i = 1,...,p) are the predictor variables. In discriminant analysis, the weights in a discriminant function are estimated to achieve the best possible separation between, in the present case, high and low performers (Tatsuoka, 1970).

A stepwise discriminant analysis was carried out, using SPSS$^X$ (Norusis, 1985: 75-122). In this type of analysis only a limited set of the predictor variables are included in the

discriminant function. By definition, only the non-redundant variables are selected which cannot be predicted from any linear combination of the remaining variables. In following such a stepwise procedure one can control for multicollinearity (statistical interdependence between predictor variables). Multicollinearity is indicated by a statistical criterion, called tolerance, defined as the within-groups variance which is not accounted for by other predictor variables in the analysis. If a variable passed the (arbitrary) tolerance level of .01, it was included. In the next step (s) the remaining variable(s) with the largest tolerance was (were) included. In this way, variables were included according to their unique contribution in establishing maximal group differences. Three types of results from the discriminant analyses will be presented.

(i) The standardized discriminant function coefficients which represent the relative importance of each variable included in the discriminant function. Their importance for the discriminant function is indicated by the order of inclusion, the most important variables being included first. The standardized discriminant functions can be interpreted proportionally (Tatsuoka, 1970: 54-55). Coefficients with an absolute value of .30 were considered too low to be interpreted.

(ii) The squared canonical correlation, $R^2$, can be interpreted as the discriminatory power, representing the proportion between-group variance explained by the discriminant function (Tatsuoka, 1970: 43-48). A significant value of $R^2$ indicates that two group centroïds (i.e. multivariate discriminant score means) produced by the particular set of predictor variables differ (Schaufeli, 1988: 200-201).

(iii) The classification success of a particular function refers to the degree to which the probability of misclassification is minimized. A discriminant function selects predictor variables on the basis of their relative contribution to classifying cases correctly into predefined groups (Schreuder, et al., 1988). Values result from efforts to classify cases (=research units) on the basis of the discriminant function. In all cases the base rate for correct classification was 50%. The significance of the function, $p_{(function)}$, is tested by a chi-square test.

A potential problem with discriminant analysis is that it disregards cases with missing values of the specified variables (Schreuder et al., 1988). To partially offset this problem several analyses have been performed. In order to minimize chance capitalization, the discriminant analyses were restricted to the univariately significant variables.

First, a stepwise discriminant analysis is performed on the scale variables. Then the scale and atmosphere variables are analysed together. Finally, a stepwise analysis is performed on all univariately significant variables including management, control, and communication. More sets of alternative variables were tried out in search for an optimal discriminant function. We conceived a function, $Z_i$, as optimal when (i) the probability of misclassification is minimized; (ii) the function has a larger discriminatory power ($R^2$); (iii) $p_{(function)}$ has a higher significance; (iv) the sample contains more cases. Since there are tradeoffs between these criteria, judgement is required to select a satisfactory function. This is not unusual, because human judgement is always necessary in the methodological cycle - not excluding the data analysis stage.

### 6.8.2. Multivariate Results

#### $Z_1$ (scale)(scale and atmosphere)

Regarding the univariately significant scale variables, a significant discriminant function emerges ($R = .62$; $R^2 = .38$; $X^2 = 19.00$; d.f.= 5; $p_{function} = .002$) which is a linear combination of the following predictor variables for 43 cases in our sample:

$Z_1 = .70$ TMRS - .79 TMPC + .56 HMRS,

where: TMRS = time research
TMPC = time patient care off the hospital
HMRS = human resources

correct classification = 77%; mean discriminant score high performers = .88; mean discriminant score low performers = -.69

$Z_1$ was not changed when atmosphere variables were introduced into the analysis.

#### $Z_{2-3}$ (all variables)

When various sets of univariately significant variables were analyzed, more than one significant discriminant function emerged. $Z_2$ shows the linear combination of the following predictor variables for 42 cases of our sample ($R = .59$; $R^2 = .35$; $X^2 = 14.11$; d.f. = 4; $p_{(function)} = .002$):

$Z_2 = .46$ HMRS + .50 TMRS - .74 TMPC + .37 CRFT,

where: HMRS = human resources
TMRS = time research
TMPC = time patient care off the hospital
CRFT = craftsmanship of the management

correct classification = 76%
mean high performers = .79
mean low performers = -.65

Having the most classificatory success and the largest discriminatory power, the optimal function for 42 cases of our sample, $Z_3$, is a linear combination of five predictor variables ($R = .64$; $R^2 = .41$; $X^2 = 19.7$; d.f. = 5; $p_{(function)} = .001$):

$Z_3 = .56$ CRFT + .51 TMRS + .28 HUMRS - .83 EXPR + .38 INTC,

where CRFT = craftsmanship management
TMRS = time research
HMRS = human resources
EXPR = expectation rewards
INTC = international communication

correct classification = 81% (total number of cases = 42)
mean discriminant score high performers = .89
mean discriminant score low performers = -.73

Exhibit 6.6. presents graphically the match between observed and predicted (correctly classified) research performance in the function that was conceived as most satisfactory, i.e. $Z_3$. There is a match when units with a discriminant function score > 0 (predicted high performance) are observed to be high performers, and units with a discriminant function score < 0 (predicted low performance) are observed to be low performers. The figure shows that there is a match for 15/19 (79%) high performers and 19/23 (83%) low performers (mean correct classification is 81%).

Exhibit 6.6. Match between predicted and observed performance

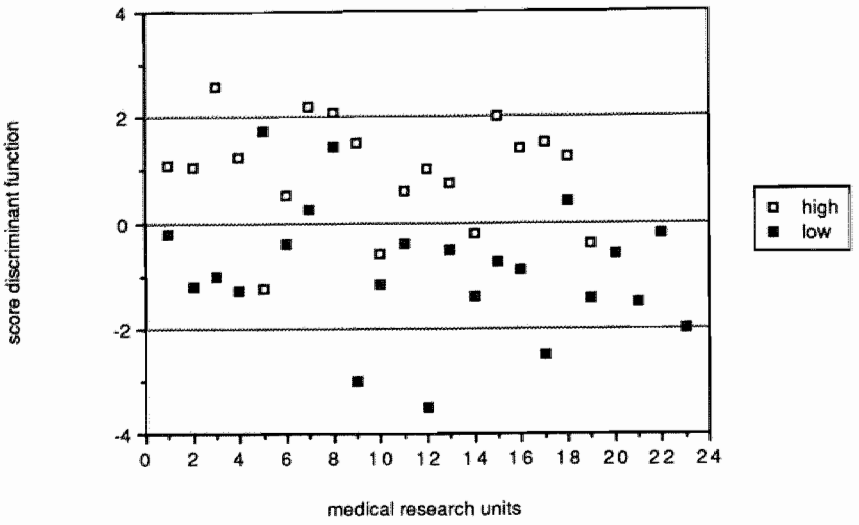



Exhibit 6.7. presents all predictor variables which have entered the above mentioned significant functions.

Exhibit 6.7. Standardized canonical discriminant function coefficient variables

| variables | times entered | sign |
|---|---|---|
| **scale** | | |
| human resources [a] | 3 * | + |
| time research [a] | 3 * | + |
| time patient care off the hospital [a] | 2 | - |
| **Management** | | |
| Craftsmanship | 2 | + |
| **Control** | | |
| expectation rewards | 1 | - |
| **Communication** | | |
| international communication | 1 | + |

* Variable has entered the discriminant function first, i.e. it optimizes the Wilks' Lambda minimizing selection rule; [a] Note that the variables mentioned above have not had an equal number of opportunities to enter a discriminant function.

### 6.8.3. Summary of Multivariate Results

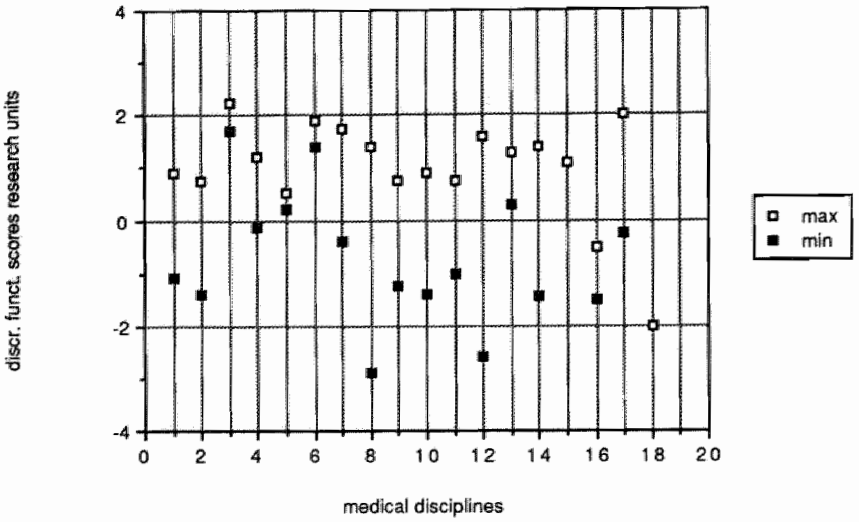
Explaining large percentages of variance in the criterion variable, the discriminant analysis confirm a number of univariate findings.

1. Regarding scale, it was found that high performers evaluate the 'critical mass' of their human resources for research as adequate compared with low performers. Besides, high performers spent more time on research, and less time on patient care outside their hospital. Repeatedly, human resources and time spent on research entered a significant discriminant function, thus, minimizing Wilks' Lambda.
2. Regarding atmosphere, no relation with scientific productivity could be detected. With regard to work-related culture, this is at least partially due to inappropriate measurement.
3. Regarding management, it was found that craftsmanship is of importance for clinical research. Repeatedly, craftsmanship entered a significant discriminant function.
4. Regarding control, it was found that reward expectation for research is inversely related to performance in the multivariate analysis.
5. Regarding communication, it was found that high performers have more international communications than low performers. Like all other predictor-criterion relations presented in this study, it is unclear whether this is the cause or the effect of their superior scientific productivity. As mentioned before, the procedure used in the present study does not allow a test of the direction of the relationship between variables. Since a cross-section design was used, only the nature of the relationship can be investigated.

### 6.8.4. Variance between Medical Disciplines

Rigter (1986) has observed that medical disciplines are not uniformly strong or weak in their performance. The data of the study presented here suggest that a similar observation can be made with regard to the predictor variables. The next exhibit, 6.8, shows the variance within and between 16 medical fields with regard to their discriminant score. For each medical discipline, the units with the maximum and minimum discriminant function score are represented. Two of the medical disciplines, area 15 and 18 in the figure, are excluded from the analysis because they contained only one observation. In order to maintain anonymity of those who participated in our investigation, names of the disciplines are not mentioned. Exhibit 6.8. shows the differences in variance between 16 medical disciplines.

Exhibit 6.8. Differences between medical fields




Consistent with Rigter's observation regarding performance, large differences in input and throughput levels appear to exist between the disciplines. Some disciplines score homogeneously high or low in their international communication, managerial craftsmanship, human resources, time spent on research, and result control. Most of the disciplines, however, appear to be very heterogeneous. They include both units with negative scores and units with positive scores on the discriminant function. Since the discriminant function may be interpreted as the degree to which the management and organzation of a clinical research unit is appropriate for conducting high quality research, we may conclude that most of the medical disciplines are not uniformly 'equipped' with the professional organization to conduct clinical research that can meet international standards, and that may contribute to the growth of clinical medicine as a science.

Following Rigter's conclusion, the analysis shows that variance between research units within disciplines not only exists with regard to performance, but also with respect to the organizational infrastructure. Of course, these are correlations which cannot substitute causal analyses. Nevertheless, since this chapter has uncovered some organizational features that are associated with scientific performance in a non-trivial manner, we have some indication to believe that future research policy should pay attention not only to the differences between fields, but also to those between research units within fields. Research policy emphasis on selective stimulation within disciplines may improve the future performance of clinical research (Bally et al., 1987).

### 6.9. Economies of Atmosphere?

One of the purposes of this empirical study is to study the relationship between culture and performance. In contrast to our conjectures, evidence was found for economies of scale, economies of scope, and the efficiency function of management and control variables in a clan-like organization, but no substantive evidence has been found for economies of atmosphere. So it is legitimate to ask why the present study failed to support the 'efficient culture' hypothesis.

Two alternative arguments will be considered. First, it may be conjectured that the non-correlation has been caused by inappropriate measurement of work-related culture. Improving the measuring qualities would then expected to show a relationship.

Second, it may be conjectured that salient differences between high and low performers do exist, but that they are unfortunately not labelled as 'culture'. Note that several authors have argued that leadership (Schein, 1985) and control (Merchant, 1985) are related to the concept of culture. Note that culture is a holistic concept - it is related to several organizational variables such as structure (Mintzberg), strategy (Weick), and clan control (Ouchi). Reinterpretation of the data, however, has the serious disadvantage of 'facts in search of a theory'. It is generally known that nearly all statistical correlations can be explained on a post hoc basis - even random ones. Consequently, a reinterpretation of the data in favor of economies of atmosphere is a debatable enterprise risking the criticism of post hoc speculation. The only legitimate basis for this speculation is its plausibility which, in the end, may only be usefully addressed in future research. In this respect, the next chapter will explore economies of atmosphere with a more adequate instrument in departments of economics.

#### 6.9.1. Inappropriate Measurement Argument

The work-related (organizational) culture has been assessed with the value survey module (VSM)(Hofstede, 1980). Hofstede has developed this instrument by factor analyses at the country level of analysis. However, an instrument that has proven to be valuable at one level of analysis is not necessarily appropriate at other levels of analysis. Hofstede and Spangenberg (1987) have shown that the same VSM items form different clusters when factor analyzed at the individual, occupational, organizational or national levels. Since we used the original VSM formulas, our assessment of organizational culture is probably invalid.

In order to look for the salient cultural dimensions hidden in our sample of research units, we repeated Hofstede's factor analysis at the group level (43 observations). The factor solution has an explained variance (EV) of 56.1%, and showed three factors which were named 'work centrality' (EV=17.5%), 'power distance/uncertainty avoidance' (EV=15,6%), and 'work intrinsic vs work extrinsic' (EV=11.7%). Although this procedure may be more appropriate for the assessment of organizational culture (Robinson, 1960), these new dimensions were not significantly correlated to performance. MANOVAs, t-tests, and (partial) correlation analyses failed to demonstrate the existence of economies of atmosphere regarding work-related culture. One may conclude that even if the validity of the VSM were improved, no relationship between work-related culture and performance could be detected. Since the procedure mentioned above did not include reformulation of the items (in order to focus them on the organizational rather than the national level), the quality of the instrument was only partially improved. Thus, not all sources of measurement error have been eliminated.

### 6.9.2. Re-Interpretation Argument

Since our cultural measure is inappropriate, the predictor variables which entered the discriminant function may be inspected. This leads to an interpretation of the existing data which favors the economies of atmosphere hypotheses. This interpretation, however, is debatable, because it is *ad hoc* , yet there may be some justification because of an unexpected finding, which, moreover, has intrigued the members of the research team and the advisory council, and has been the source of bold conjectures. This is the negative relationship between reward expectation and clinical research performance. We conjectured that high performers would expect more financial (career) rewards for conducting research than for patient care. The incentive system of high performing units would be more favorable for high research efforts. Note that all members of high performing units, including the supervisors (t-test; p=.05), spend more time on research than members of low performing units (t-test; p=.02). In addition, they have more frequent working discussions with colleagues on research topics (t-test; p=.08), and they feel more responsible for their research task (t-test; p=.01). In the neoclassical paradigm, individuals are assumed to maximize their subjective expected utilities. If members of clinical research units were profit maximizers, they would only do so in the expectation of a pay-off. In contrast to this reasoning, it appeared that high performers expected that (a) patient care is more appreciated than research (t-test; p=.05), and that (b) in comparison to research, patient care offers better opportunities for their career development (t-test; p=.02). Although the high performers are aware of the fact that patient care generates the best pay-off, they mainly invested their time and efforts in medical research.

Consequently, it may be concluded that high performers in medicine are intrinsically motivated in research. For them, participating in high quality research is a goal in itself. They are dedicated researchers - driven by the motivation to increase medical knowledge (and indirectly, improving patient care) rather than by pecuniary pay-offs. From a neoclassical point of view, their behavior is (reciprocal) altruistic rather than calculative. Though not expected, this finding is consistent with Staw's conjecture on faculty motivation: "Instead of viewing the individual faculty member as an intense calculator of personal costs and benefits, activities like services, and perhaps even aspects of teaching and research, might be better explained by altruistic motivation" (Staw, 1984, p. 78). Although motivation is an attribute of individuals, it is more plausible that altruistic motivation in research is a group attribute influenced by professional norms including high quality requirements. A high degree of personnel control is exercized by these internalized norms. Take as a contrast the low performers. The low performers are more consistent with the hedonistic image of man. Their expectations are more 'rational'. They invest their time in patient care rather than in research. Moreover, they spend significantly more time on private ('off-hospital') patient care practices (which is generally known to be more profitable than patient care in the hospital not to speak of research) than high performers. In terms of individual financial performance, the low performers are better off. However, at the team level - in terms of research performance - it is the non-calculative attitude (call it research dedication or atmosphere) which increases the effectiveness. Of course, these are interpretations of the data. Another plausible interpretation is that high performers do make cost-benefit analyses - but not concerning financial benefits. They are more motivated to reach immaterial targets such as international recognition for their work, publication in outstanding journals, etc. If this interpretation is plausible, the difference in atmosphere is that high performers (in research) are more stimulated by non-pecuniary incentives, whereas low performers (in research) are more stimulated by pecuniary incentives. Whether this attitude is a general trait of staff members of research units in other disciplines, e.g. in economics, will be discussed in the subsequent chapters.

### 6.9.3. Interim Conclusions

In summary, there is some, though debatable, (ad hoc) evidence for the existence of a cultural difference between medical research units. The 'culture's consequences' in clinical medicine may be interpreted as economies of atmosphere, because they discriminate between high and low productivity. If the economies of atmosphere reinterpretation is plausible, it is worthwhile mentioning that reward expectation is the most important variable in the optimal discriminant function. Despite these arguments in favor of economies of atmosphere, cultural transformation is not a substitute, but rather a complement for improving the research

infrastructure of medical units in university hospitals. Finally, some attention should be paid to removing some of the personal costs for the intrinsically motivated behavior of members of high performing units. Although research efforts may not be economically motivated in clinical medicine, they would undoubtedly be reduced in the long term when the opportunity costs remain high.

### 6.10. Concluding Remarks and Discussion

This chapter has explored economies of atmosphere in clinical departments of university hospitals. Additional hypotheses have been tested concerning the advantages of scale, management, control, and communication. Since no empirical data were available regarding multi-product functions in medical fields, economies of scope were not investigated. Univariate and multivariate procedures were used in the analysis of data. Explaining large percentages of variance in the criterion variable, discriminant analysis confirmed a number of univariate findings.

In general, the conjectures on economies of scale, craftsmanship, and communication were corroborated; those on economies of atmosphere were not; and those concerning reward expectations were refuted. (i) Regarding scale, it was found that high performers evaluate the 'critical mass' of their human resources for research as adequate compared with low performers. Besides, high performers spent more time on research, and less time on patient care outside their hospital. (ii) Regarding atmosphere, no relation with scientific productivity could be detected. This is at least partially due to inappropriate measurement. (iii) Regarding management, it was found that craftsmanship is of crucial importance for clinical research. (iv) Regarding control, it was found that reward expectation for research is inversely related to performance in the multivariate analysis. On an ad hoc basis, this unexpected finding may be reinterpreted as an economies of atmosphere effect. (v) Regarding communication, it was found that high performers have more international communications than low performers. Like all other predictor-criterion relations presented in the present study, it is unclear whether this is the cause or the effect of their superior scientific productivity. As mentioned before, the procedures used in the present study do not allow a test of the direction of the relationship between variables. Since a cross-section design was used, only the nature of the relationship can be investigated.

While study I focused on incentives and constraints of scientific productivity in clinical medicine, the follow-up study, study II, has dealt with the determinants of productivity in economics. The findings of the latter study are reported in the next chapter.

# 7

# Scientific Performance in Economics [1-2]

"The extreme clannishness, not to say xenophobia, of the Econ makes life among them difficult and perhaps even somewhat dangerous for the outsider. This probably accounts for the fact that the Econ have so far not been systematically studied (...) More research on this interesting tribe is badly needed" (Leijonhufvud, 1963).

## 7.1. Introduction

In 1985 the Dutch government asked a review commission, the 'Verkenningscommissie Economische Wetenschappen' (VEW), to evaluate the performance of university research in economics and to advise on possible improvements. The VEW issued its report in 1986, concluding that strong productivity differences existed between research units in Departments of Economics (which include units of business administration, bedrijfseconomie, in the Dutch system). On the one hand, there were units that published 180 (weighted) pages per person per year. On the other hand, there were units that did not publish at all. Comparisons with the productivity of U.S. economics departments, Graves, Marchand, and Thompson (1982), showed that the overall performance is rather low. This chapter makes an attempt to explain why performance records differ among departments of economics. It is assumed that, in principle, the same set of incentives and constraints influence research effectiveness as in clinical medicine.

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[1] For their stimulating critical comments, we owe thanks to A. van Heeringen (RAWB), W. Schaufeli (KUN), P. Nijkamp (VU), and J.S. Cramer (SEO).

[2] Accepted for publication: Spangenberg, J.F.A., Buijnk, W., and Alfenaar, W., Some Incentives and Constraints of Scientific Performance in Departments of Economics, Part I: Predictor-Criterion Relations, Scientometrics, An International Journal for all Quantitative Aspects of the Science of Science and Science Policy, Elsevier Science Publishers, Vol. 17, No. 5-6, November 1989 Issue.

Spangenberg, J.F.A., Breemhaar, B., Nijhuis, F.J.N., and Alfenaar, W., Some Incentives and Constraints of Scientific Performance in Departments of Economics, Part II: Validity and Robustness, Scientometrics, An International Journal for all Quantitative Aspects of the Science of Science and Science Policy, Elsevier Science Publishers, Vol. 17, No. 5-6, November 1989 Issue (forthcoming).

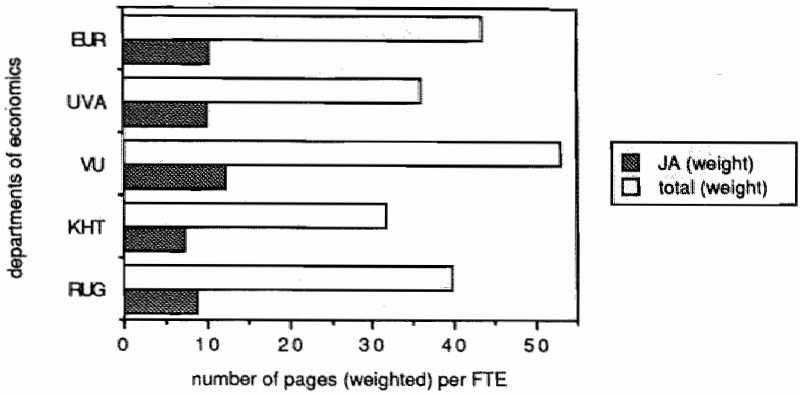
The VEW findings have been used for the classification in high and low performers. After collecting data on the organization of research units, univariate and multivariate statistics, including multiple regression analysis, have been applied to explore the research questions regarding competitive advantages in the scientific enterprise.

### 7.2. Measurement of Performance

The VEW has highlighted the need for the development of productivity indices in the university sector. Their own proposal is that performance of research units should be established on the basis of publications by staff based on numbers of pages published in the period 1979-1984 (six years). Journal articles were weighted according to a U.S. ranking based on citations. Liebowitz and Palmer (1984) have assessed the relative impact of economics journals, and provided a ranking of journals based on their relative influences on the writings of academics, either within the economics profession or in the world at large. The measure of journal impact used to create this ranking is the number of citations that authors make to articles appearing in various journals. The authors have controlled for both journal size and age in constructing the measure. The values of their citation index (CI) varied between 0 and 100. On the basis of Liebowitz and Palmer's set of journals the VEW differentiated A-journals ($CI \geq 10 \leq 100$), B journals ($CI \geq 1 \geq 10$), and C-journals ($CI < 1$). Examples of A-journals are the American Economic Review , Econometrica , and the Journal of Money, Credit & Banking . Examples of B-journals are Administrative Science Quarterly, European Economic Review, and Decision Science. Examples of C journals are History of Political Economy, International Journal of Industrial Organization, and Interfaces. Two categories were added: D-journals and E-journals. The scientific standing of these journals has been estimated to be low; so is their contribution to the growth of economic knowledge (VEW, 1986, p. 65-80). The following weighting factors were allocated to these journals: 4 (A-journal), 3 (B), 2 (C), 1 (D), 1/2 (E). Three kinds of publications were distinguished: journal articles [JA (unweighted), and JA(weighted), book articles [BA (Dutch), and BA (international)], and books [BK (Dutch), and BK (international)].

Exhibit 7.1. shows the distribution of productivity per university. (Key: EUR is Erasmus University Rotterdam; UVA is University of Amsterdam; KHT is University of Tilburg; RUG is University of Groningen; VU is Free University Amsterdam). In total 93 research units were evaluated by the VEW. They were associated with departments of economics and with departments of other disciplines such as departments of law, and departments of management and organization. (The source of exhibit 7.1. is the VEW report (1986) Statistical appendix, table 19).

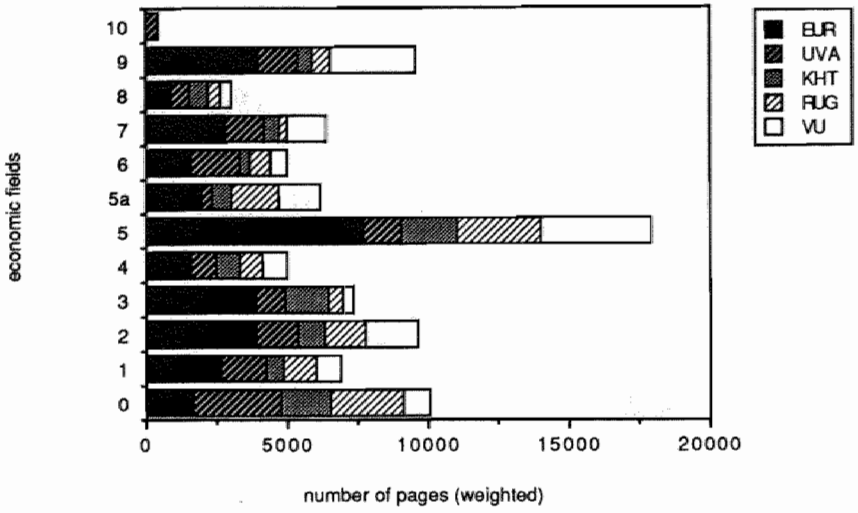
Exhibit 7.1. Departmental Productivity in Dutch Economics




Journals were also classified as to subject. The VEW made use of an amended version of the Journal of Economic Literature (JEL) index of classification codes (Cf. key Exhibit 7.2). Each publication has been classified under one subject only, so that double countings were excluded. It should be mentioned that the JEL index is essentially a classification code for general economics (Dutch abbreviation: AE) and econometrics (KE). Business administration (BE) is included in its entirety in code 5. Nevertheless a large portion of the staff of a Dutch department of economics (30-50%) works in this area.

Exhibit 7.2. illustrates the distribution of productivity per field per university . Only universities with a department of economics were requested to participate in the study. Since the evaluation period is 1979-1984, the Department of Economics of the University of Limburg, which was officially established only in 1984, was not requested to participate in this study. The source of Exhibit 7.2. is the VEW report (1986) Statistical appendix, table 18.

Exhibit 7.2. Total Productivity in Dutch Economics

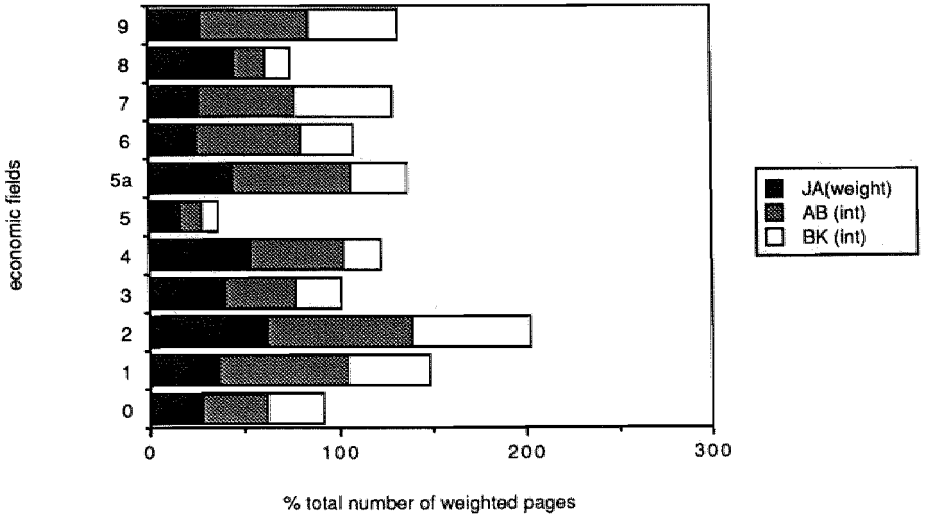



**Key**

| | |
|---|---|
| 0 | General economics; Theory; History; Systems |
| 1 | Economic Growth; Development; Planning; Fluctuations |
| 2 | Quantitative economic methods and data |
| 3 | Domestic monetary and fiscal theory and institutions |
| 4 | International economics |
| 5 | Administration; Business Finance; Marketing; Accounting |
| 5a | Decision science (distribution and location problems) |
| 6 | Industrial Organization; Technological Change; Industry Studies |
| 7 | Agriculture; Natural resources |
| 8 | Manpower; Labor; Population |
| 9 | Welfare Programs; Consumer economics; Urban and regional economics |
| 10 | Actuarial sciences |

However, the differences in the degree to which Dutch economists working in various fields contribute to the international literature (JA weighted; BA int and BK int) is graphically shown in Exhibit 6.3. Although field 5 (Administration), for example, scores high in an absolute sense (total productivity), its contribution to the international growth of knowledge, according to U.S. standards, appears to be rather low. Its productivity is mainly caused by high output in local journals and books. More internationally oriented fields are economic growth (1), econometrics (2), and decision science (5a). Since one of the fields, 10, did not publish in the international literature, the next exhibit will only show the contributions of the remaining 9 fields.(The source of the figure is the VEW report (1986) Table IV.2 - the table neglects field 10).

Exhibit 7.3. Contribution to the International Literature




In contrast to the evaluation of medical research performance where a combination of 5 indices has been applied, only the results of publication countings (indicating 'total productivity' and 'contribution to the international literature') have been used for the ranking of departments and research units in economics. Citations have been counted, but, in general, they proved to be uncorrelated to the productivity criterion. The same is true for the number of editorships. The number of Ph.D. theses per university was so low (average number per university in the

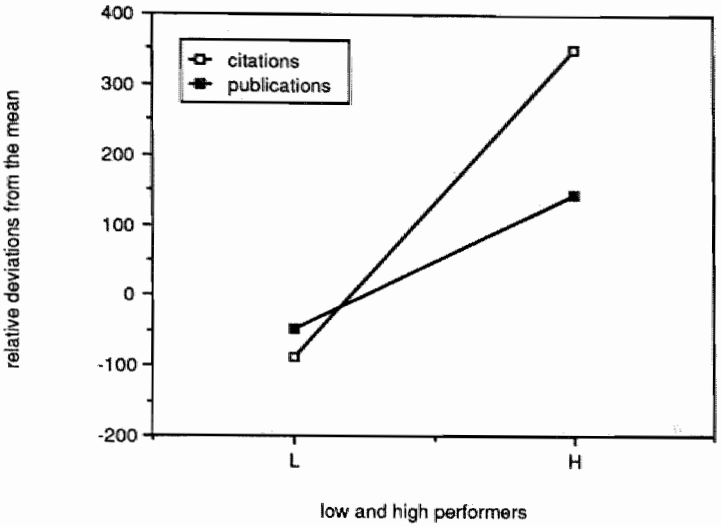
period 1979-1984 was 31; min. 21, max. 47) that Ph.D. theses were meaningless as a measure of differential productivity.

These shortcomings raise some doubt about the validity of the productivity criterion, as has been pointed out by several Dutch economists (Cramer, 1986). As a result of the lack of convergence between partial indicators, the findings of the VEW must be interpreted with caution. However, it cannot be denied that, up to now, they represent the best available evaluation of the performance of Dutch research units in economics. Therefore, the VEW evaluation has been the basis for study II which will be reported in the subsequent sections.

### 7.3. Sample

According to the procedure described in the previous chapter, research units were classified as high and low performers. A wide variety of economics fields has been selected for inclusion in the study: general economics (JEL code: 0), economic growth (1), quantitative economic methods (2), domestic monetary and fiscal theory (3), international economics (4), administration (5), decision science (5a), industrial organization (6), agriculture (7), manpower (8), and welfare programs (9). Per field a selection was made of one or more high performers and one or more low performers. Given our uncertainty about the validity of the VEW evaluation, the sample was restricted to those units with extreme (high or low) performance scores. Moreover, only units were considered that combined above average performance (in the case of high performers) or below average performance levels (in the case of low performers) on both publication and citation indexes (VEW, 1986, table 479-484). Thus, the convergence of performance indicators was introduced as a selection rule restricting our sample of units. In total 29 units were requested to participate in the study. Exhibit 7.4. shows the differences between high and low performers in the response sample (N=16 units) with regard to scientific productivity (relative deviation of the mean number of publications) and citation impact (relative deviation of the mean number of citations). On average, the impact difference between high and low performers is considerably larger than the productivity difference. The lines between the performance scores are meaningless.

Exhibit 7.4. Subsample Performance Differences




In order to check our classification a number of full professors of economics (N=7) working in various fields were consulted. These peer reviews were consistent with our classification of units on the basis of the VEW statistics.

### 7.4. Data collection

Data were collected in the period April-July 1987. A mail questionnaire was sent to the selected units, addressed to all staff employees who (i) were academically educated (thus, excluding administrative and support staff), and (ii) were appointed to participate in economics research (thus excluding members with exclusively educational tasks). These criteria produced a population of 152 respondents of whom 86 were working in units with high performance, and 66 were working in units with low performance. In total 25 units (group response 86%) responded to our questionnaire. Only data from 16 units were analyzed, because 9 units were represented by less than 25% of their researchers. The sample consisted of 8 high performers (33 subjects; individual response 38%) and 8 low performers (30 subjects; individual response 45%).

Nonresponse analysis showed that in the main two factors accounted for nonresponse on the unit or individual level: lack of time and lack of interest. It should be noted that the questionnaire was sent shortly after the VEW evaluation, and that a large number of economists did not agree with the VEW procedure. Cramer (1986), for example, has noted that the quality of the *content* of economics research (cf. Pen, 1982) has not been assessed, and that economics in the Netherlands should be compared with the productivity of similar European countries (cf. RAWB, 1983b) - such as that of U.K., Belgian or Swedish departments of economics rather than those in the U.S. Despite the apparent shortcomings, it has been argued that the VEW report is the best available evaluation of economics research effectiveness (Ad hoc Commissie Voorzitters Vaste Commissie Wetenschapsbeoefening, 1988).

Alhough the units are rather evenly distributed over universities, disciplines, and fields (with the exception of general economics - as will be shown in exhibit 7.6), we realize that the combination of the low response, the small number of observations, and the large number of variables restrict the generalizability of this study. These shortcomings may be partially overcome by comparing the findings with the outcome of other studies on the determinants of scientific productivity in economics (cf. section 7.9). The logic is that one can more rely upon the results when they are consistent despite the large differences in discipline.

As exhibit 7.5. indicates the distribution of high and low performers over universities (100% =16 units) is fairly even. As mentioned before the youngest department of economics (University of Limburg) was not requested to participate in the study because it was not yet in existence in the time of the evaluation period 1979-1984, and consequently only very recent performance measures were available.

Exhibit 7.5. Response Distribution Universities

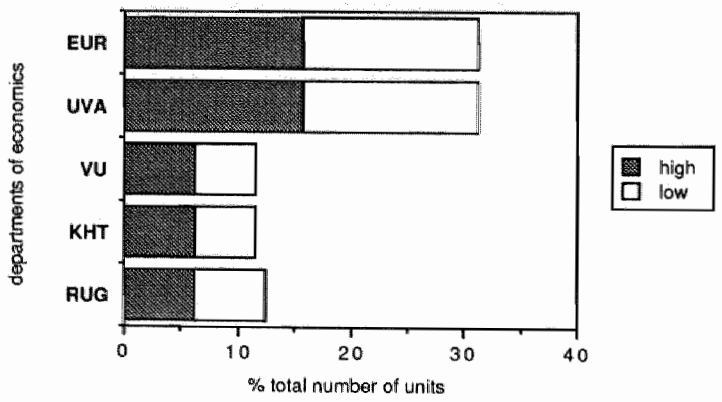
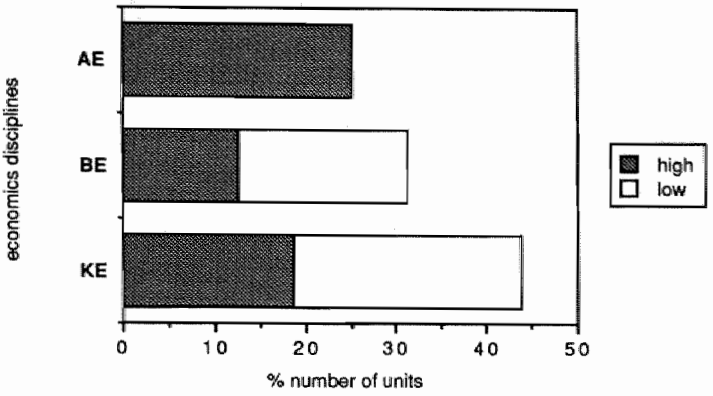


Exhibit 7.6. clarifies the distribution of high and low performers over three major disciplines in the Netherlands: econometrics (KE), business administration (BE), and general economics (AE). Econometrics and business administration are represented more by low than high performers. As a result of nonresponse, general economics is only represented by high performers - which, of course, does not mean that low performers do not exist in that field.

Exhibit 7.6. Response Distribution Disciplines




## 7.5. Additional Hypotheses

De Groot (1984) has rightly emphasized that scientific research is a learning process. Consequently, what was learned from study I (clinical medicine) that could improve study II (economics)? Learning effects will be discussed concerning atmosphere, scale, input mix, and performance.

### 7.5.1. Atmosphere

Study I has confirmed that Hofstede's value survey module (VSM) is an inappropriate instrument for the measurement of organizational culture. Therefore, we added the organizational culture module (OCM) to our questionnaire. The OCM was developed by Hofstede and colleagues (1988) in a large scale survey of 20 organizations in the Netherlands and Denmark. Hofstede and his co-workers found that the OCM adequately showed differences in general values at the organizational level ('practices'), whereas the VSM only elicits the national value differences. The OCM consists of 18 items indicating 6 dimensions. The dimensions were found by factor analysis. They were labelled: (i) process oriented (= bureaucratic) vs. results oriented (non-bureaucratic), (ii) employee oriented vs. job

oriented, (iii) parochial vs. professional, (iv) open system vs. closed system, (v) loose vs. tight control, (vi) normative vs. pragmatic.

Only two of the six OCM dimensions proved to have an acceptable internal consistency in the sample: bureaucratic culture (Cronbach's alpha OCM1 is .63) and normative culture (Cronbach's alpha OCM6 is .70). The bureaucratic dimension (OCM1) opposes a concern with goals and products (results oriented) to a concern with means and procedures (means oriented). The key items show that in results oriented non-bureaucratic cultures, people perceive themselves as comfortable in unfamiliar situations and putting in a maximal effort, while each day is felt to bring new challenges. In process oriented or bureaucratic cultures people perceive themselves as avoiding risks and spending only a limited effort, while every day is pretty much the same. Results oriented cultures can be found in professional organizations (e.g. R&D laboratories), while bureaucratic organizations tend to have process oriented cultures.

The other dimension (OCM6) deals with customer orientation: pragmatic units are market-driven, while units with a normative culture perceive their tasks towards the outside world (e.g. the scientific forum) as the implementation of fixed rules. As we assume that high performers are more oriented to the international forum and would have more rigorous professional standards, it was conjectured that high performers are more normative (Ritti, 1968), while low performers are more pragmatic (variable 26). In addition, we assume that high performers would be more innovative, and, consequently, less bureaucratic (process oriented) than low performers (variable 27).

### 7.5.2. Scale

Measures were inserted to assess capital inputs - since they were underemphasized in the previous study. The following items concern economies of scale: (i) number of full time research equivalents (FTE size - variable 22), and (ii) total research expenditures in 1986 (variable 23). We expected that high performers would have more FTEs for research. Study I failed to demonstrate the relationship between unit size (in terms of number of staff members) and performance, and we conjectured that this failure may have been caused by not weighting staff members for the degree to which they were appointed to do research. The 'full time equivalent' enables the weighting of unit size for research intensity. Furthermore, we conjectured that high performers would operate on a larger scale so that they would have higher research expenditures than low performers.

### 7.5.3. Input Mix

Note that additional measures have been developed for study II. While study I only deals with human inputs in the 'staff mix', capital inputs were rated as well in study II. Consequently, it is more appropriate to speak of 'input mix' rather than staff mix. The following items concern the input mix: (i) cash flow mix (variable 24) and (ii) tenure intensity (variable 25) in the research unit. The cash flow mix indicates the distribution of 'primary cash flow' and 'secondary cash flow' (mainly basic research) versus the 'tertiary cash flow' (mainly contract research)(Central Bureau for Statistics, 1988). Tenure intensity indicates the distribution of tenured versus non-tenured in the research unit. Regarding the cash flow mix, we assumed that high performers will be more oriented towards basic research than towards contract research in comparison with low performers. It is widely assumed that basic research leads more often (or more quickly) to (international) dissemination of knowledge. According to this view, contract research seldom leads to such dissemination, because of property rights - especially when the customer operates in a market environment. Adequate as this may be for high tech research, high performers in economics are hypothesized to have higher percentages of secondary and tertiary funding. With regard to tenure intensity, we assumed that increasing the proportion of tenures in a research unit would lower the overall incentive to perform, so that fewer tenures were expected in high performing units.

### 7.5.4. Scope

Although the economies of scope variable is not a learning effect of the previous study, it certainly is a new variable. Unfortunately, it was not feasible to assess economies of scope in study I. In the present study, however, the VEW report provided a point of departure to approximate economies of scope. Economies of scope are realized in team production activity in which joint use of inputs yields a larger output than the sum of the products of the separately used inputs. It will be recalled that knowhow may represent a shared input which can find a variety of end product applications. Whenever the knowledge can serve as a common input into two or more production processes, joint production (utilizing common resources) will produce economies of scope. Thus, if the skills to publish in econometric journals display economies of scale, and these economies are not exhausted, and if the knowhow can also be used in publishing in business administration journals, e.g. finance, then economies of scope will exist in the production of scientific knowledge. In general, economies of scope can be defined as arising from inputs that are shared or utilized jointly. The shared factor may be imperfectly divisible, or some human or physical capital may be a public input (Jones and Hill, 1988).

Economies of scope exist when for all outputs, $y_1$ and $y_2$, the cost of joint production is less than the cost (c) of producing each output (y) separately. That is, it is the condition for all $y_1$ and $y_2$,

$$c\ (y_1, y_2) < c\ (y_1, 0) + c\ (0, y_2).$$

With economies of scope, joint production of knowledge in two fields is less costly than the combined costs of production of two specialized research units. The present study has defined scope as joined production of knowledge in more than one field but within the same discipline, i.e. economics. Diversification was indicated by publishing in more than one research fields (N=10). Note that the fields were classified according to the Journal of Economic Literature (JEL) index. The VEW report contained useful data concerning the multi-product functions of units in terms of their JEL publications. These data, however, had to be transformed since publishing in one field with 1 publication, while the largest output of that unit in another field consists of 100 publications, cannot seriously be defined as joint production in two fields. Consequently, a simple decison rule was applied to assess whether a unit publishes substantially in another field. The 25% criterion regarded a unit to be active in another field when it publishes the equivalent of at least 25% of its largest research output (in terms of weighted pages) in one field, the principal field, in that other field. The 10% criterion regarded a unit to be active in another field when it publishes at least 10% of the publications in the principal field in the other field.

### 7.5.5. Performance

An exploratory study conducted by Cramer (1988) suggested that members of research units in economics may be rather mobile. Consequently, it would be the best procedure to assess the organization and performance of these units simultaneously. The VEW has evaluated the performance of research units in the period 1979-84. How can these performance outcomes be attributed to organizational characteristics of units diagnosed in 1987? Of course, it may be argued that the evaluation outcome has also been reviewed by peers so that they may be regarded as fairly up-to-date. Nevertheless, it may be argued that the classification of high and low performers would be more plausible if it were validated by recent, if possible independent, ratings. As a consequence, items were added to our questionnaire regarding the individual output of subjects in 1986. It was expected that members who were associated with high performing units would have a higher score on their individual performance index (variable 28) than those of low performing units.

Since publications are more highly valued than working papers and international publications are more highly valued than national publications, individual performance (Y) was indexed as follows:

$$Y = \Sigma WP + 2\Sigma DJA + 3\Sigma IJA,$$

WP: number of working papers
DJA: number of articles written in Dutch journals
IJA: number of articles written in international journals

The VEW report (1986, table 479), in which quantitative data were presented about the performance of research units, provided two objective measures: (i) the unit's relative deviation of the average productivity score (scientific productivity), and the (ii) unit's relative deviation of the average citation score (citation impact). In contrast to the individual performance index, scientific productivity and citation impact were not independent of overall performance (classification of research unit into high and low performers). The statistical relationship between overall performance and the single criteria will be discussed later.

In sum, both predictor (independent) and criterion (dependent) variables were added to our original list of variables (Exhibit 5.2). Most of them can be conceived as the learning effects of study I. These additional hypotheses regarding study II are summarized in Exhibit 7.7.

Exhibit 7.7. Additional Hypotheses Study II

| **Predictor variables** | VARIABLE NAMES |
|---|---|
| In comparison with low performers, high performers (...) | |
| **1. Scale** | |
| 22. have more full time research equivalents | FTE UNIT SIZE |
| 23. have higher research expenditures | RESEARCH EXPENDITURES |
| **2. Input Mix** | |
| 24. have higher percentages of secondary and tertiary funding | CASH FLOW MIX |
| 25. have a lower tenure intensity | TENURE INTENSITY |
| **4. atmosphere** | |
| 26. have a less bureaucratic culture | BUREAUCRATIC CULTURE |
| 27. have a more normative culture | NORMATIVE CULTURE |
| **9. Scope** | |
| 31. According to 10% criterion | 10% SCOPE |
| 32. According to 25% criterion | 25% SCOPE |

| **Single criterion variables** | VARIABLE NAMES |
|---|---|
| In comparison with 'low performers' (VEW measure), 'high performers' (...) | |
| **8. Performance** | |
| 28. have a higher individual performance index | IND PERFORMANCE INDEX |
| 29. deviate positively from the average product. score | SCIENTIFIC PRODUCIVITY |
| 30. deviate positively from the average citat. score | CITATION IMPACT |

Exhibit 7.8 shows the reliability scores (Cronbach's alpha coefficient) of these new variables. Some of them have been developed in cooperation with W. Buijink who is associated with the accounting department of the University of Limburg.

Exhibit 7.8. Reliability of additional measures

| Variable name (number of items) | Source | Reliability (decimal points omitted) |
|---|---|---|
| **1. Scale** | | |
| 22. FTE unit size (1) | A | @ |
| 23. research expenditures (3) | Buijink | 62 |
| **2. Input Mix** | | |
| 24. cash flow mix (3) | Central Bureau of Statistics | n.a. |
| 25. number of tenures (1) | A | @ |
| **4. Atmosphere** | | |
| 26. bureaucratic culture (3) | Hofstede et al. | 63 |
| 27. normative culture (3) | Hofstede et al. | 62 |
| **8. Performance** | | |
| 28. individual performance index (3) | Buijink | 68 |
| 29. scientific productivity (1) | VEW report | @ |
| 30. citation impact (1) | VEW report | @ |
| **9. Scope** | | |
| 31. according to the 10% criterion | VEW report | @ |
| 32. according to the 25% criterion | VEW report | @ |

Key: A = author; @ = not applicable (1 item only); n.a. = not applicable (items do not form a scale)

### 7.6. Measurement of Additional Variables

The new variables were included in the Dutch-language questionnaire that was used in study II. For each additional predictor (22-27) and criterion (28) variable, one or two items will be given as an example. The numbers of the items (22-28) refer to the variable names in exhibit 7.7. A complete list of the variables including more than one item is given in appendix 2. Items 29-32 refer to measures (derived) of the VEW report which were not included in the questionnaire.

22. Indicate the number of full time research equivalents in your research unit.
23. What were your research expenditures in the last year (=1986) in terms of (i) gross salaries for research assistants, and (ii) other research expenditures (mailing costs, software purchase, travel costs)? Divide your total research expenditures by the number of colleagues with whom you share this money.
24. How much of your total research expenditures (= 100%) originates from (i) primary cash flow (% direct governmental contribution to your department), (ii) secondary cash flow (% governmental contribution allocated by the national science foundation - in Dutch: NWO - Ecozoek), (iii) tertiary cash flow (% revenues from contract research)?
25. Are you employed on a (1) permanent basis (2) temporary basis with tenure perspectives (3) temporary basis without tenure perspectives?
26. Where I work people do not feel comfortable in unknown situations; they attempt to avoid risk taking (1-2-3-4-5) Where I work people feel comfortable in unknown situations; they do not mind to take risks.
26. Where I work, people exert only a limited effort (1-2-3-4-5) Where I work, everybody puts in a maximal effort.
27. Where I work, the emphasis is on the wishes of the customer (e.g. contract research) (1-2-3-4-5) Where I work, the emphasis is on the application of the correct procedures.
28. Indicate the number of articles which you have had published in Dutch scientific journals in 1986 (no predictor variable).
28. Indicate the number of articles which you have had published in international scientific journals in 1986 (no predictor variable).
29. Indicate the unit's relative deviation of the average productivity score in terms of journal and book pages (VEW report).
30. Indicate the unit's relative deviation of the average (national) citation score in terms of journal and book pages (VEW report).
31. Indicate the number of fields a unit is active in. The 10% criterion conceives a unit as active in another field (B) if it publishes the equivalent of at least 10% of its largest research output (in terms of weighted pages) in a field (A) in B.
32. Indicate the number of fields a unit is active in. The 25% criterion conceives a unit as active in another field (B) if it publishes the equivalent of at least 25% of its largest research output (in terms of weighted pages) in a field (A) in B.

## 7.7. Univariate Results

Exhibits 5.3. and 7.8. have shown that the instruments are fairly reliable with Cronbach's alpha's varying between .58 (only one variable was < .60) and .88. Data were collected at the individual level and aggregated to the unit level. To check the reliability of the aggregated scores, the differences between units in the variance of individual scores (Bartlett F-box) were tested . Except for one item (unrelated to overall performance), the test revealed no significant differences between units in the homogeneity of the answers of individual scientists within high and low performing units. The next section discusses the relation between overall performance and the single performance indices. The subsequent sections will discuss the relationship between the predictor variables and overall performance. The relation between the predictor and single criterion variables will be dealt with in discussing multiple regression analysis.

### 7.7.1. Relation between Criterion Variables

Hypotheses were tested by examining the differences between high and low performers. Evidently, the validity of our results is dependent of the validity of the output measurement. We added the individual output index (variable 20) as an extra check for the validity of our classification in high and low performers. Consistent with our expectations, the analyses showed that high performers (as observed by the VEW) have a higher individual output index than low performers: they produce more working papers (during a period of three years)(r=.28; p=.04), and more international journal articles (r=.31; p=.03). Their production in terms of articles in Dutch journals, however, appeared to be lower than that of low performers (r=-.35; p=01). This surprising finding is consistent with the evaluation of the VEW (1987). The VEW found a remarkable contrast between total productivity and weighted productivity (corrected for international contributions). Groups that were found to be very productive when total production was considered (exhibit 7.2), turned out to be poor performers when contribution to the international literature (exhibit 7.3) was considered.

Since the classification into high and low performers and the two VEW performance measures partially originate from the same source, it was not surprising to find significant correlations between scientific productivity, and citation impact, on the one hand, and overall performance on the other hand. The next table shows the statistical relation between overall performance (classification in high and low performers) and the single scientometric indicators. The results suggest convergent validity of the performance measurement. The highest significance levels exist with regard to the correlation between citation impact (unit's relative deviation of the average citation score) and scientific productivity (the unit's relative deviation of the average productivity score), and with regard to the correlation of the latter with overall performance (classification into high versus low performers).

Exhibit 7.9. Relationship between scientometric indicators

| | Pearson correlations (significance) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | |
| 1. Overall Performance | xx | | | | | | | |
| 2. Scientific Productivity | 69 | (.01) | xx | | | | | |
| 3. Citation Impact | 48 | (.08) | 85 | (.001) | xx | | | |
| 4. Individual Performance Index | 60 | (.03) | 61 | (.03) | 51 | (.07) | xx | |

### 7.7.2. Relation between Predictor Variables and Overall Performance

The main univariate tests which we used were t-tests and correlation analysis. Since the results of the t-tests mainly corroborated those of the correlation analysis, only the latter are reported. Exhibit 7.10. shows the correlation between the predictor variables and overall performance. A general point is that the supportive power of the positive but low correlations is a very modest one, sometimes almost negligible. Furthermore, the high number of significant correlations may be influenced by the low number of observations. Consequently, the univariate results are presented with caution. Conclusive evidence can only be demonstrated on the basis of the combination of univariate and multivariate results as compared to other findings concerning the determinants of scientific performance in economics.

Exhibit 7.10. Pearson correlations of predictor variables and overall performance

| variable | correlation with performance (decimal points have been omitted) | significance level |
|---|---|---|
| **1. Scale** | | |
| human resources | 41 | .004 |
| unit size | n.s. | |
| FTE unit size | 35 | .02 |
| project size | 30 | .03 |
| time research | 33 | .02 |
| time non-research (education) | -32 | .03 |
| capital resources | n.s. | |
| research expenditures | n.s. | |
| **2. Input mix** | | |
| age | -34 | .02 |
| human capital: | | |
| (i) research experience during study | 34 | .02 |
| (ii) research experience on the job | n.s. | |
| (iii) research experience abroad | n.s. | |
| tenure intensity | -33 | .02 |
| interdisciplinary mix | n.s. | |
| cash flow mix | -30 | .05 |
| **3. Scope** | | |
| according to the 10% criterion | 49 | .04 |
| according to the 25% criterion | n.s. | |
| **4. Atmosphere** | | |
| innovative climate | 71 | .000 |
| publication climate | 58 | .000 |
| work-related culture | n.s. | |
| bureaucratic culture | -71 | .000 |
| normative culture | n.s. | |
| **6. Control*** | | |
| motivation | 43 | .003 |
| reward expectation | 33 | .02 |
| **7. Communication** | | |
| within unit communication | 24 | .07 |
| between unit communication | 47 | .001 |
| international communication: | | |
| (i) having international communication | 39 | .006 |
| (ii) stimulating international communication | -47 | .001 |
| interdisciplinary communication | n.s. | |

* all management variables (group 5) proved to be insignificant with regard to overall performance

#### 7.7.2.1. Economies of scale

**Human Resources** - The Pearson correlations provide strong support for economies of scale with respect to the human resources. In comparison with low performers, more high performers believe that the human resources of their unit are sufficient to conduct the research effectively. Consistent with this subjective assessment are the following observations: high performing units are larger in terms of full time research equivalents, and in manpower per project. High performers were not larger in terms of absolute number of staff members (unit size - uncorrected for FTE). The members of high performing units spend more time on research, and less time on education.

**Capital Resources** - The economies of scale hypothesis was not confirmed when capital resources are considered. In contrast to our expectations, no significant relation was found between capital resources or research expenditures and performance. High performers do not have a larger research budget neither do they spend more money on research. Surprising as this may be, we should remember the facts and figures mentioned in section 5.5. The ratio of capital resources to human resources is .16 in economics, and .82 in medicine. In contrast to medicine, economics is not a capital intensive discipline. While the performance of medical researchers is strongly dependent on hardware and physical capital (e.g. laboratory facilities), economics is more a 'paper and pencil' discipline. Human capital is the main capital asset of an economics research unit, while the physical capital assets are a negligible factor. Our findings are consistent with these observations: academic research performance is related to the volume of capital resources in medicine ($r=.37$; $p=.05$), but not related to the volume of capital resources and research expenditures in economics.

#### 7.7.2.2. Input Mix

**Human assets** - Regarding the composition of human assets, we have found that the average member of high performing units is younger, but has had more research experience during his masters training. Age was related to learning by doing (on the job research experience), and international research experience, but not to masters degree research experience. On-the-job experience, and international research experience were unrelated to performance. Apparently, productive research is facilitated when the learning process occurs at a younger age. At an older age counterproductive research habits (de Groot, 1984) may already have been established. Of course, alternative interpretation may be plausible too. For example, it might be argued that high performing units are more successful in getting their research funded. Research which is paid out of the secondary and tertiary flow of money is generally carried out by (non-tenured) junior scientists. Consequently, high performing units have younger

members on average than low performing units. This interpretation would be consistent with the results. The expectation that high performers have a lower tenure intensity has been confirmed. Age and tenure intensity were, not surprisingly, positively correlated (r=.50; p=.00). No relation appeared to exist between interdisciplinary staffing and research performance.

**Capital assets** - Regarding, the composition of capital assets, the analyses showed a negative correlation between the contribution of the primary cash flow (direct governmental contribution) and research performance. The lower the primary cash flow, the higher the contribution of the secondary and tertiary cash flow. Thus, it is suggested that a higher proportion of the research budget of high performers is acquired in a competitive situation, i.e. paid by the national science foundation (secondary cash flow) or contract research customers (tertiary cash flow).

#### 7.7.2.3. Economies of Scope

It will be recalled that the VEW report contained useful data concerning the multi-production functions of units in terms of their JEL publications. These data, however, were transformed by a simple decison rule which determined whether a unit publishes in more than one field in a substantial manner. The 25% criterion regarded a unit to be active in another field (B) when it publishes the equivalent of at least 25% of its largest research output (in terms of weighted pages) in one field (A) in B. The 10% criterion regarded a unit to be active in B when it publishes the equivalent of at least 10% of its A output in B.

The data suggest that economies of scope were captured by departments of economics, since a certain degree of diversification (according to the 10% criterion) appeared to be related to their performance. However, scope was unrelated to performance when the 25% criterion was used. In comparison to the 10% criterion, the 25% criterion decreases the variance in the economies of scope variable, because the production of units is less likely to be conceived as joint production in more than one field. This finding suggests that thresholds exist concerning the existence of scope economies. Whether economies of scope are captured by a research unit is dependent upon the definition of scope. Apparently, further research is required to improve the assessment of the economies of scope variable, and to test further its construct validity.

#### 7.7.2.4. Economies of Atmosphere

Unlike the previous study, study II provides unambigous empirical evidence for economies of atmosphere. There was a stronger pressure to publish in high performing units (publication climate). Furthermore, high performers had a more innovative climate. Finally, it appeared that high performers were less process oriented, i.e. they had a less bureaucratic atmosphere than low performers. No indications were found for differences with respect to normative culture (OCM6). As expected, no relations were found between the VSM dimensions and performance.

#### 7.7.2.5. Management

Contrary to the expectations, research management was not related to performance. All univariate tests failed to show that relation. Neither the craftsmanship nor the leadership qualities of the supervisor appeared to be correlated with academic research performance. Does this mean that coordination is a negligible factor? Not necessarily, since it appeared that management was strongly related to the correlates of performance. The following independent variables were positively related to the leadership and the craftsmanship of the unit supervisor: human resources ($r=.32$; $p=.003$), publication climate ($r=.45$; $p=.00$), innovative climate ($r=.56$; $p=.00$), bureaucratic culture ($r= -.44$; $p=0$); reward expectation ($r=.22$; $p=.01$), within unit communication ($r=.18$; $p=.04$), and international communication ($r=.43$; $p=.00$). An efficiency function may certainly be attributed to the coordination of the unit, but in an indirect way - i.e. with respect to the boundary conditions for efficient production. This non-directive leadership is consistent with the existence of a non bureaucratic corporate culture. To paraphrase Adam Smith, the supervision of a department of economics has to operate like an 'invisible hand' rather than as a 'visible hand' in order to be productive.

#### 7.7.2.6. Control

The existence of a strong publication tradition is consistent with the outcome of the control variables. High performers expected more pecuniary rewards (better career opportunities) when they perform well in research than in education. The average economist researcher is not driven by altruistic motivation - a finding that should not be surprising. This result is consistent with Graves, Marchand, and Thompson (1982) who found a positive relation between the salaries of full professors in economics and publication performance. While salaries at lower ranks appear to be inversely related to publication performance, this may still be explained by a utilitarian framework: "(...) young academics pay a premium to

associate with productive faculties" (Graves, Marchand, and Thompson, 1982, p. 1137-1139). This is also consistent with Cargile and Bublitz's (1986) findings in U.S. accounting departments. In comparison with teaching, policy, and service, published research was perceived to have the greatest relative importance as a determining factor of their present place of employment in decisions on promotion, tenure, and salary increases. Though not expected, this was even true for nondoctoral programs which have an emphasis on teaching rather than on research. Recently, Sauer (1988) estimated the returns of quality in academic research. He found that the incremental return from a (AER-equivalent) page in a top-ranked economics journal (including the additional effects of being cited) is 0.17 percent of salary which is $72.27 in 1982 dollars for his sample mean (consisting of 140 academic economists who are member of the associate or full professor rank at seven 'top 40' departments). His findings clearly indicate that pecuniary returns of research quality in academia are measurably large and provide incentives to produce high-quality research in the economics profession. When comparing economics and medicine, it should be noted that the alternative for the economist (education) is, of course, less financially rewarding than the alternative for the medical specialist (patient care), so that the opportunity costs are considerably higher for the medical researcher than for the economist. With regard to personal control, it appeared that high performers were more motivated toward research than toward education. These findings are consistent with the previous observations concerning the time spent on research (more) and on education (less) of high performers.

#### 7.7.2.7. Communication

High performers appear to have more working communications with their colleagues within the unit. Moreover, they communicated more frequently with peers of other research units - in the Netherlands (between unit communication), and abroad (having international communication). Having more international communications in fact, the members of high performing units were less stimulated to communicate with international peers (stimulating international communication). They already have more international communications. As a result, they do not have to be encouraged.

**Interdisciplinary commmunication** - Having communications with colleagues of other disciplines was not related to performance. This is consistent with study I. Moreover, it is consistent with the above mentioned result that there is no relation, neither positive nor negative, between the interdisciplinary composition of the staff and overall research performance, Finally, and contrary to what might be expected, interdisciplinarity appears to be unrelated to economies of scope.

A possible explanation for this zero correlation is that we have stressed international publication productivity in our performance measurement. It is unlikely that interdisciplinary research is productive in this narrow sense, because the review board of high standing journals is often monodisciplinary. Interdisciplinary journals such as the Journal of Law and Economics, and the Journal of Economic Behavior and Organization belong to the minority of A-journals in the field of Economics. Since the existing review procedures may be a constraint on interdisciplinary research productivity, further research is needed to investigate the complex relationship between interdisciplinarity and research performance.

#### 7.7.2.8. Summary of Univariate Results

1. In brief, the analyses support the economies of scale hypothesis, especially regarding the volume of human resources (FTE unit size, project size). The volume of capital resources and research expenditures are unrelated to economics research performance.
2. The input mix matters, since high performers are younger and have a lower tenure intensity. In terms of research experience, however, they have a larger human capital, because high performers have had more research experience during their master degree study.
Regarding the cash flow mix, a higher proportion of the research budget of high performers is acquired in a competitive situation, i.e. paid by the national science foundation (secondary cash flow) or contract research customers (tertiary cash flow).
3. Whether empirical support is found for economies of atmosphere proves to be rather dependent on the definition of scope. Application of the 10% criterion showed that high performers are more diversified in their research production than low performers. However, the 25% criterion failed to show the relationship.
4. Confirmation was also found for the economies of atmosphere hypothesis. As we expected, high performers have a non-bureaucratic (result oriented) corporate culture. Moreover, they have a more innovative climate, and a climate emphasizing publication. Due to inappropriate measurement, no relationships could be demonstrated between work-related atmosphere and performance.
5. In contrast with our expectations, research management (variable 7-8) was unrelated to research performance. Since craftsmanship and leadership appear to be strongly related to the correlates of performance (human resources, motivation, climate), an indirect rather than a direct relationship between the coordination and the performance exists in economics research units. This would be consistent with the view of universities as 'organized anarchies' (Cohen and March, 1974; Weick, 1984).
6. Control variables matter in research, since high performers are more motivated towards research than towards education. Incentives were important too, since high performers expect better career opportunities when they perform well in research rather than in education.

7. Positive confirmation has been found for the hypotheses concerning between-unit, international, and within unit communication (in that very order). Scientific communication is indeed the 'central nervous system' of the academic system - both in medicine and economics. No support was found for the interdisciplinarity hypothesis.
8. The classification of research units in high and low performers has been validated, since, on average, high performers have a higher individual performance index. In addition, high performers deviate positively from the average productivity score, and from the average citation score.

The previous analyses showed that high performers spend more time on research than low performers. The differences with regard to time concerning variables such as international communication and publication climate may be the effect of the amount of time devoted to research. An examination of the relative impact of other inputs on the production of scientific publications, would require the time spent on research to be held constant. However, the product moment correlational analyses were not repeated partializing for time spent on research, because the low number of observations (N=16) increases chance capitalization in partial correlation results.

### 7.8. Multivariate Results

Study II has both combined dichotomous (high versus low performance), and single criterion measures like number of publications and citations. The Fisher linear discriminant analysis is analogous to a multiple regression analysis in which the criterion variable, Y, assumes only two values, each indicating membership in one or other of two groups. In other words, discriminant analysis is an appropriate statistical method when the criterion variable is dichotomous. In study II, performance, however, is also indicated by non-dichotomous variables, i.e. individual performance index (questionnaire), scientific productivity (VEW report), and citation impact (VEW report). Since these three criterion variables are non-dichotomous measures, i.e. they can have values ranging from 0-n, it is meaningful to apply multiple regression analysis in addition to the discriminant analysis.

Because the number of variables included in the multivariate analyses is quite high relative to the sample size, the results of our analyses will be tentative. Consequently, the discriminant and regression analyses were not used to discover the best predictive equation but rather to control crudely for the interaction between the predictor variables when trying to establish differences between high and low performers. Chance capitalization is minimized by running the analyses on the univariately significant predictor variables. The results of the

discriminant analysis are presented in the next section. Subsequently, we will discuss the results of the multiple regression analysis.

### 7.8.1. Discriminant analysis

To explain more efficiently the difference between high and low performers, discriminant analysis was conducted with the univariately significant variables. Since the interest here is in the impact of scale, scope, and atmosphere on performance, we will first (i) analyze the data regarding the input variables (scale and input mix) , then (ii) the data regarding scale, scope, and atmosphere, and finally, (iii) the data will be analyzed regarding all variables that have been selected in the discriminant function (including management, control, and communication). The total number of cases in the sample is 16. All variables in the discriminant equations are presented in the order of stepwise selection.

#### $Z_1$ (Scale and Input Mix)

First, a stepwise, standardized discriminant analysis on all univariately significant scale and input mix variables has been performed. The following discriminant function resulted for all 16 cases in our sample ($R = .81$; $R^2 = .66$; $X^2 = 11.1$; d.f. = 3; $p_{(function)} = .01$):

$Z_1 = 1.51\ HMCP - 1.71\ AGE + .57\ FTE,$

where HMCP = human capital (research experience during study)
AGE = age
FTE = FTE unit size

correctly classified 94%
Mean discriminant score high performers: 1.10
Mean discriminant score low performers: -1.46

#### $Z_{2\text{-}3}$ (Scale, Input Mix, Scope, and Atmosphere)

For the scale, input mix, scope, and atmosphere variables together, two standardized discriminant functions were satisfactory. Evaluation criteria for these functions have already been discussed in the previous chapter. A function, $Z_i$, is regarded as optimal when (i) the probability of misclassification is minimized, (ii) the function has a larger discriminatory power ($R^2$), (iii) $p_{(function)}$ has a higher significance, and (iv) the sample contains more cases. In practice, human judgement is required to select a function because there are tradeoffs

between these criteria. One of the functions, $Z_2$ (R = .65; $R^2$ = .42; $X^2$ = 6.49; d.f.=2; p (function) = .04), included the following variables for 16 cases:

$Z_2$ = .93 FTE -.59 OCM1,

where FTE = FTE unit size
OCM1 = bureaucratic culture

correctly classified = 81%
mean high performers = .68
mean low performers = -.84

This function, however, is outperformed by $Z_3$ which combines a higher significant function with more accuracy in classification for 15 cases (R=.74; $R^2$=.55; X2=7.81; d.f.=2; p (function)=.02)

$Z_3$ = .77 HMCP + .99 SCPE

where HMCP = human capital (research experience during study)
SCPE = SCOPE (10%)

correctly classified: 87%
mean high performers: .93
mean low performers: -1.08

### $Z_{4-6}$ (all predictor variables)

When we take into account all univariately significant variables, the following 10 variables entered the discriminant function in the order of stepwise selection: FTE unit size, human capital (research experience during study), age, scope (10%), between unit communication, bureaucratic culture, reward expectation, motivation, human resources, and international communication (having). The function was highly significant (R=.99; $R^2$=.98; $X^2$=43.09; d.f.=8; p (function) = .000; correct classification = 93%). The disadvantage of this function is the large number of variables included in the function. Since this study is interested in an efficient prediction of performance, the above mentioned list of variables was conceived as a useful starting point for trying out a number of alternative combinations of variables.

Again more than one satisfactory function has been found. In one of the functions, $Z_4$, which applied to 15 cases in our sample, scope entered as the first variable in the function. $Z_4$ ($R$ = .82; $R^2$ =.67; $X^2$ = 10.54; d.f.=3; $p_{(function)}$ = .01) is a linear combination of the following variables:

$Z_4$ = 1.05 SCPE -.52 OCM1 + .80 INTC

where SCPE = scope (10%)
OCM1 = bureaucratic culture
INTC = international communication

correct classification = 87%
mean high performers = .1.21
mean low performers = -1.42

Another function, $Z_5$ ($R$ = .88; $R^2$ = .77; $X^2$ = 13.86; d.f.=3; $p_{(function)}$ = .003), combines classificatory success with a higher level of significance for 15 cases:

$Z_5$ = 1.05 SCPE - .69 OCM1 + .97 BTWUC

where SCPE = scope
OCM1 = bureaucratic culture
BTWUC = between unit communication

correct classification = 87%
mean high performers = 1.55
mean low performers = -1.81

For reasons that will subsequently be explained, the next function, $Z_6$ ($R$ = .90; $R^2$ = .81; $X^2$ = 15.09; $p_{(function)}$ = .0045), may be conceived as the optimal discriminant function emerging for 15 cases in the sample,

$Z_6$ = .52 FTE + .93 SCPE - .75 OCM1 + .76 BTWUC,

where FTE = FTE unit size
SCPE = scope (10%)
OCM1 = bureaucratic culture
BTWUC = between unit communication

correct classification = 93%

mean high performers = 1.77

mean low performers = -2.07

Comparison of the classificatory success of $Z_6$ (93%) with $Z_1$ (94%) shows that adding scope and atmosphere (and other variables) to scale does not significantly improve the results of the discriminant analysis. However, adding these variables does improve the significance of the function ($p_{(function)}$ $Z_1$ = . 01; $p_{(function)}$ $Z_6$ = .005). Moreover, $Z_6$ explains the largest percentage of variance in the criterion variable ($R^2$ = .81). $Z_6$ is an efficient equation since it classifies units on the basis of 4 variables with the same degree of accuracy as the equation with 10 variables (93%).

Exhibit 7.11. gives a graphical presentation of the 93% match between predicted (correctly classified) and observed performance in the sample of 15 cases in $Z_6$. The match is 7/8 (88%) for low performers and 7/7 (100%) for high performers.

Exhibit 7.11. Match between predicted and observed performance

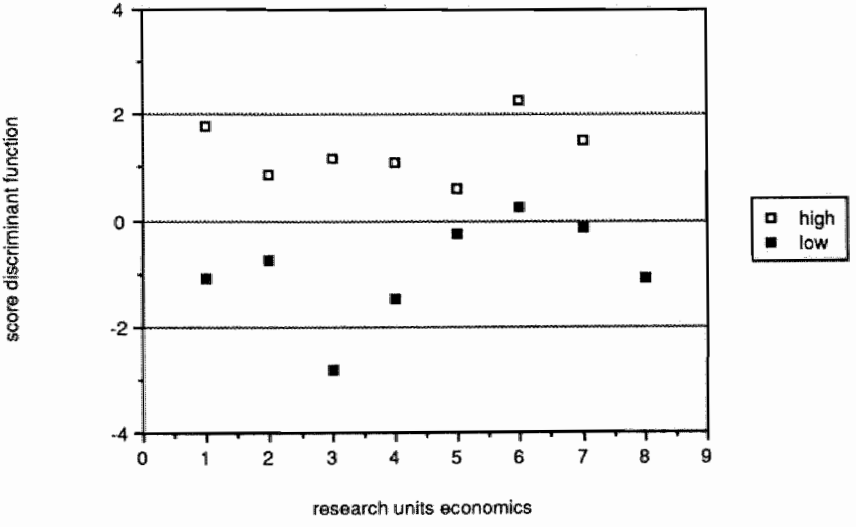


Exhibit 7.12. presents the predictor variables which have entered the above mentioned discriminant functions:

Exhibit 7.12. Standardized Canonical Discriminant Coefficient Variables

| variables | times entered | sign |
|---|---|---|
| **scale** | | |
| FTE unit size[a] | 3 * * | + |
| **input mix** | | |
| age | 1 | - |
| human capital | 2 * * | + |
| **scope** | | |
| according to the 10% criterion | 4 * * | + |
| **atmosphere** | | |
| bureaucratic culture | 4 | - |
| **communication** | | |
| between unit communication | 2 | + |
| international communication | 1 | + |

* indication of Wilks' Lambda minimization; [a] note that the variables mentioned in this table have not had an equal number of opportunities to enter a discriminant function.

In general, the results confirm the correlational findings. Moreover, they explained a very high percentage of the variance in the dichotomous criterion variable. The results demonstrate the importance of economies of scale, scope, and atmosphere in departments of economics and business administration. In addition, communication with other units, in the Netherlands and abroad, appears to be very significant to research performance in economics.

### 7.8.2. Multiple Regression Analysis

Multiple regression analysis is not a substitute for discriminant analysis, since each of the single criterion variables represent imperfect measures of research performance. While the criterion variable in the discriminant analyses is based on the combination of indicators (high versus low performance), multiple regression analysis has been performed on single performance indicators. These single criterion measures, however, are all correlated with the combined performance measure (exhibit 7.9).

The basis for the multiple regression analysis was the selection of the predictor variables which were univariately related to the continuous criterion measures. Exhibit 7.13 presents the results of Pearson correlation analyses. Mention is made only of variables which are correlated with one or more of the performance indices.

Exhibit 7.13. Correlation between predictors and single performance indices

| | Pearson correlations (significance) | | |
|---|---|---|---|
| | Scientific Productivity | Citation Impact | Individual Performance Index |
| **scale** | | | |
| project size | 78 (.004) | 83 (.001) | 48 (.08) |
| **input mix** | | | |
| research experience | 72 (.01) | 62 (.03) | 89 (.000) |
| **scope** | | | |
| scope 10% criterion | 50 (.03) | n.s. | n.s. |
| **atmosphere** | | | |
| bureaucratic culture | n.s. | -47 (.08) | n.s. |
| innovative climate | 65 (.02) | n.s. | n.s. |
| **control** | | | |
| motivation | n.s. | n.s. | 61 (.03) |
| reward expectation | 47 (.09) | n.s. | n.s. |
| **communication** | | | |
| between unit com | n.s. | n.s. | 75 (.006) |
| internat com (hav) | n.s. | n.s. | 85 (.001) |
| internat com (stim) | -68 (.02) | -50 (.07) | n.s. |

In contrast to the preceding analyses concerning the composite performance measure, the results mentioned above concern single performance measures. These univariate results prove to be fairly consistent with the previous analyses. Particularly, when scientific productivity is considered, it is shown that advantages are taken of scale, scope, and atmosphere. This is not very surprising since analysis of criterion variables has shown that scientific productivity correlates with overall performance at a higher significance level in comparison with the other indices. Citation impact is particularly related to scale, input mix, and atmosphere; Individual performance to scale, input mix, and control.

Communication is related to all performance indices. The analyses show that units producing more publications and receiving more citations are less stimulated to communicate with colleagues abroad (stim). When their individual performance index is considered, it appears that they do not need to be stimulated, because they already have more international communications than low performers (hav).

For each single criterion, a stepwise multiple regression analysis was performed including the univariately significant predictor variables mentioned above. As will be shown in the next table, a significant function emerged for each criterion.

Exhibit. 7.14. Multiple Regression Results

| | Scientific Productivity | | Citation Impact | | Individual Performance Index | |
|---|---|---|---|---|---|---|
| | ß | F | ß | F | ß | F |
| **scale** | | | | | | |
| project size | 70 | 8.8** | 82 | 19*** | .008 | .001 |
| **input mix** | | | | | | |
| research experience [a] | 41 | 2.27 | 17 | .52 | 46 | 4.6* |
| **scope** | | | | | | |
| scope 10% criterion | 30 | 1.48 | @ | @ | @ | @ |
| **atmosphere** | | | | | | |
| bureaucratic culture | @ | @ | -18 | .94 | @ | @ |
| innovative climate | 13 | .24 | @ | @ | @ | @ |
| **control** | | | | | | |
| motivation | @ | @ | @ | @ | 9 | 2.1 |
| reward expectation | 14 | .28 | @ | @ | @ | @ |
| **communication** | | | | | | |
| between unit com | @ | @ | @ | @ | 12 | 17 |
| internat com [b] | @ | @ | @ | @ | 52 | 5.9* |
| internat com [c] | -39 | 1.9 | -11 | .21 | @ | @ |
| Multiple R | 70 | | 82 | | 92 | |
| $R^2$ | 49 | | 68 | | 85 | |
| Adjusted $R^2$ | 43 | | 64 | | 82 | |
| d.f. (regression) | 1 | | 1 | | 2 | |
| overall F | 8.8 | | 19.31 | | 24.30 | |
| p (function) | .02 | | .002 | | .0004 | |

the underlined variables are * significant at the .05 level; ** the .01 level; ***the .001 level;

[a] during study; [b] having / [c] stimulating international communications

Most of all, the results show that the contribution of economies of scale in explaining scientific performance is larger than those of economies of scope and atmosphere.

The regression equation consists of project size (F=8.8; p=.02 with regard to scientific productivity; F=19; p=.002 wrt citation impact) for two of the performance indicators. The regression equation for individual performance index consists of two variables, i.e. research experience (F=4.6; p=.06), and international communication (hav)(F=5.9; p=.04).

In order to examine the partial contribution of the variables which were not included in the regression equations, a second stepwise regression analysis was performed. All but the multivariately significant variables mentioned above were included in the second analysis. Again a significant function emerged for each of the single criteria. The regression equation for two of the criteria consists of research experience (wrt scientific productivity multiple R=68; $R^2$=47; adjusted $R^2$=41; d.f $_{(function)}$=1; overall F=8; p=.02; wrt citation impact multiple R=67; $R^2$=45; adjusted $R^2$=29; d.f=1; overall F=5.17; p $_{(function)}$=.05). The regression equation for individual performance index consists of international communication (multiple R=67; $R^2$=45; adjusted $R^2$=39; d.f=1; overall F=7.46; p $_{(function)}$=.02). Again economies of scope and atmosphere did not show up.

### 7.8.3. Summary of the Multivariate Results

Because of the high number of (univariately significant) variables relative to the sample size, discriminant and regression analysis were mainly used as crude control for the interaction effects of the predictor variables. Consequently, the multivariate results should be presented with a degree of reservation. Tentative as they are, however, they confirm the univariate findings, and explain a high percentage of the variance in the overall performance and the single criterion measures. In particular, they support the hypotheses regarding economies of scale, scope, and atmosphere in scientific organizations. Concerning their differential impact, the results show that scale and input mix variables feature prominently.

1. Regarding scale, it was found that high performing units are larger in terms of full time research equivalents. Repeatedly, FTE unit size entered a significant discriminant function as the first variable, thus minimizing Wilks' lambda. Project size seems to be important too. Multiple regression analyses showed that it is significantly related to the single performance measures.
2. Regarding input mix, it was found that members of the high performing units, younger as they are, have had more research experience (acquired during their masters degree training).

Moreover, research experience proves to be multivariately related to individual performance index, citation impact, and scientific productivity.

3. Regarding scope, it was found that high performers have a higher diversification in their production (in terms of publication in JEL fields according to the 10% criterion). Scope entered significant discriminant functions, but was not included with a significant coefficient in a regression equation.

4. Regarding, atmosphere it was found that the variable 'bureaucratic culture' is inversely related to performance. Repeatedly, bureaucratic culture entered the significant discriminant function - including the optimal function. However, atmosphere was not included in the regression equations with a significant coefficient. Apparently, further research is needed to test the robustness of economies of atmosphere.

5. The univariate results are not multivariately confirmed where the control variables are concerned. Regression analyses failed to show a contribution of reward expectation and motivation to the explanation of variance in the single performance measures.

6. Regarding communication, it was found that between unit communication and international communication repeatedly entered significant discriminant functions. Unlike medicine, communication with domestic research units is somewhat more important for economics than international communication, since the $R^2$ increases when international communication is substituted by between unit communication. Regression analyses have confirmed the importance of between unit communication. With regard to international communication, it was shown that low performers (in terms of publications and citation) are more encouraged to have international communications, while high performers (in terms of the individual performance index) simply have those contacts. As the saying goes: good wine needs no bush!

### 7.9. International Comparison

A large number of publications on the performance of economics departments have recently appeared since 1980 (cf. Davis and Papanek, 1984). The literature on the determinants of academic research quality, however, is very scarce. Two large scale surveys have been conducted recently. The first study was been conducted in 240 U.S. departments of economics. In addition to publication countings (in the top twenty-four journals, 1974-1978), Graves, Marchand and Thompson (1982) surveyed economics departments regarding teaching load, teaching and research assistance, secretarial resources, and student/faculty ratio's. As a consequence, insights can be obtained, not only on absolute departmental quality, but also on quality relative to constraints on publishing and incentives to publish. The authors believe that, while ability no doubt varies greatly among departments, costs and returns on publications relative to other academic pursuits are also likely to vary.

The second study was conducted in 40 U.K. departments of economics. Johnes (1988) has ranked British universities according to research performance indicators based upon publications in a selection of American Economic Review-equivalent economics journals. Johnes not only found considerable variation in productivity between departments in different universities, but also that considerable variation exists in the resources available to researchers at these institutions.

The independent variables in the study of Graves, Marchand and Thompson were (i) average salary, (ii) average teaching load in hours per week, (iii) secretary-to-faculty ratios, (iv) student-to-faculty ratios, (iv) support services (phone, photocopy, etc.), and (v) teaching and research assistance. Their expectation had been that high teaching loads and student-staff ratios inhibit publication output, and that the other variables facilitate research productivity.

Johnes expected that performance is constrained by the following two input variables: the number of university staff aged over 55 years per thousand staff. Younger staff tend to have stronger incentives to publish in order to obtain tenure, to pass the efficiency bar and to gain promotion. The second constraint is the student/staff ratio, since teaching and administrative duties all tend to rise with the student-staff ratio. Furthermore, he conjectured that economies and diseconomies of scale might exist within economics departments - as in any other unit of production. The total number of university staff members and the total number of (non PhD) members, although, they are younger graduate students, were regarded as economies of scale variables. The extensiveness of research facilities (as indicated by the stock of library book) is expected positively to influence research productivity. Interestingly, it was also hypothesized that 'privatisation' (indiced by the number of university staff per thousand who are financed by external sources) facilitates research output, since contract research may stimulate productivity. Furthermore, he expected that a department in which a large proportion of staff has achieved professional status to publish more than an otherwise similar department elsewhere. Finally, since research students often relieve staff of some of their teaching duties, the ratio of full-time doctoral research students to staff (ix) was expected to facilitate research output.

### 7.9.1. Differences in Research Design

Before comparing the findings of Graves, Marchand and Thompson, those of Johnes, and the findings of the Netherlands investigation, some attention should be paid to the differences between the various research designs. First of all, differences exist concerning output measurement and level of analysis. The first two studies have ranked departments on the basis of publications, while the present study has classified research units working within the same

field. Furthermore, US, U.K, and Dutch departments differ in the degree to which they include business administration. US departments do not include business administration units, UK departments vary, and Dutch departments always include business adminstration units. The unit has been chosen as the appropriate level of analysis, since units within departments may vary considerably in their publication behavior and research performance. Furthermore, we have used more than one indicator of research effectiveness. The following indicators were used: publication countings, citation countings, and peer reviews. The convergence of these imperfect indicators has been used as a selection rule in the partitioning of our sample. Another difference concerns the research model. Johnes (1988) and Graves, Marchand and Thompson (1982) adopted a typical input-output model, whereas our model has investigated not only scale and input mix variables, but also throughputs. Differences also exist in the measurement of inputs. While Johnes, and Graves, Marchand, and Thompson have employed the institutional method, we have used the questionnaire method. Obviously, cognitive distortions and memory effects are more probable in the questionnaire method. On the other hand, the items in a questionnaire are often more specific with regard to the salient research question. Finally, our investigation is a small scale study - including fewer observations than the earlier studies. This shortcoming, however, makes a comparison with Johnes, and Graves, Marchand, and Thompson's findings increasingly valuable, since consistency of the findings can be regarded as an indication of the convergent validity of the study presented here.

### 7.9.2. Results

Exhibit 7.15. summarizes the results of Graves, Marchand and Thompson (Study A), Johnes (Study B), and the present study (study C) regarding the main scale and input mix variables. Although the three studies have used different measures of inputs and outputs, the results are highly consistent.

Exhibit 7.15. Input-output Relations in three studies

| Input variables | Correlation with research performance | | |
|---|---|---|---|
| | Study A USA | Study B UK | Study C Netherlands |
| **1. Scale** | | | |
| (FTE) unit size | + | + | + |
| time spent on education (teaching load) | - | - | - |
| teaching/research assistance | + | @ | @ |
| secretary/faculty ratio | + | @ | @ |
| stock of library books | @ | + | @ |
| support services | + | @ | @ |
| **2. Input Mix** | | | |
| **human assets:** | | | |
| student/staff ratio | - | - | @ |
| Ph.D. student/staff ratio | @ | + | @ |
| number of (non PhD)graduates | @ | + | @ |
| average age staff | @ | - | - |
| research experience (during study) | @ | @ | + |
| **capital assets:** | | | |
| average salaries professors | + | @ | @ |
| average salaries assistant professors | - | @ | @ |
| external financing (privatisation) | @ | + | + |

Key: relationship with performance (+) positive (0) zero (-) negative (@) not investigated.

The international comparison learns that the univariate and multivariate findings regarding to the input variables in the present study are fairly valid. At an international level, evidence has been demonstrated regarding:

**Economies of scale** - (i) High performers in economics operate on a larger scale than low performers. Studies A-B show that they are larger in terms of their absolute unit size, whereas the present study C shows that they are larger in terms of full time equivalents (FTEs) for research. Besides, they have more research facilities - indicated by a higher degree of secretarial, teaching, research, and library support. The comparison suggests that high performers have reached their optimal size of plant. In general, the larger the department (unit) the more productive is the average member of that department (unit), up to a certain level (56 staff in study B). (ii) A high teaching load as well as an unfavorable student/staff ratio are serious constraints of scientific productivity.

**Input Mix** - (i) On average, members of high performing units are younger. This is not inconsistent with greater research experience (during the masters degree study).

Furthermore, it is consistent with the higher Ph.D. student/staff ratio, and the larger number of graduates in successful departments. Presumably, age in itself is not the explanation for high performance, but the combination of age, research experience (acquired at a relatively young age), research motivation (indicated by being a Ph.D. student in a field where the job market is favorable), and research incentives (younger staff members have more incentives to publish in order to gain promotion and to obtain a tenure position). (ii) Regarding the mix of capital assets, high performers seem to be more successful in the acquisition of external (secondary and tertiary) cash flows. The larger degree of external financing (which is often caused by senior researchers with a good reputation) is consistent with the younger average age of members of high performing units, since funded research often enables the employment of additional young, non-tenured researchers.

### 7.9.3. Interim Conclusions

Comparison of the present findings with those of study A and B is constrained by the differences in research design. A comparison, however, remains very valuable, since consistency of the present (explorative) findings with those of Graves, Marchand and Thompson, and those of Johnes can be regarded as a indication of convergent validity. Comparing the findings shows consistency of findings concerning economies of scale and input mix variables. Since the comparison groups consist of US and UK departments of economics, it may be argued that business administration has been excluded from the comparison. However, Cargile and Bublitz (1986) have conducted a study on factors contributing to published research by accounting faculties. The response to a questionnaire mailed to a sample of 840 U.S. accounting faculty members (208 usable responses) showed the importance of five facilitators: reduced teaching load, access to the computer, research abilities of fellow faculty members, high quality graduate students, and reduced number of committee assignments. Especially expanding the time for conducting research projects appears to be an important facilitator, as evidenced by the high rankings attached to reduced teaching loads and reduced committe assignments. Thus, it may be concluded that scale economies are no less important in at least one branch of business administration as compared to economics.

## 7.10. Concluding Remarks and Discussion

Assuming that the same set of incentives and constraints influence research productivity as in medicine, this chapter has made an attempt to explain why performance records differ among departments of economics. A large-scale evaluation of the performance of university economics in the Netherlands has been used for the classification of units in high and low performers. After formulating additional hypotheses, univariate and multivariate statistics were used to explore the research questions regarding competitive advantages in the scientific enterprise. The results suggest that economies of scale, economies of scope, and economies of atmosphere are captured in research units. However, when the relative contributions of these economies are inspected, the economies of scale variable and the input mix variable feature prominently. In contrast to the (organizational theory) literature, which suggests that atmosphere is a dominant characteristic of excellent organizations, the economies captured by atmosphere here prove to be rather marginal in comparison with scale economies. It may be speculated that low performers in economics operate at a suboptimal scale, i.e. they have not yet reached their minimal optimal scale of unit. The competitive advantage of the high performers is that they have already reached the minimum optimal scale of unit, that is the minimum unit (or project) size at which the economies of scale are fully realized by the research unit. Apparently, when the minimum optimal scale of unit is similar to all participants within a scientific discipline, operating on a suboptimal scale is a competitive disadvantage which is only partially compensated by economies of atmosphere. Although the scale of a research unit is the most important predictor, scale is obviously not a sufficient condition for high performance. The discriminant analyses have shown that it is rather the combination of scale and other predictor variables such as atmosphere, scope or communication which produced the most efficient prediction. The existence of more than one combination of predicted high performance seems to suggest that there is no one best way for quality control in university research. The next chapter of this book will discuss the consistency between the findings of study I and II. Furthermore, some implications for research policy will be discussed.

# 8

# Quality Control in Science[1]

## 8.1. Introduction

Medicine and economics are different disciplines. Since they deal with different subject matters, they differ in their technology and organizational structure as well (Whitley, 1984). In addition, they operate on different scale. Medicine is more capital and labor intensive, and resembles 'big science' more than economics. The previous chapters have reported results concerning determinants of scientific productivity in these disciplines. The present chapter summarizes the main results, and focuses on their consistency. When consistency between the findings of study I and II can be observed, despite the considerable distance between the disciplines, this supports the external validity or generalizability of the findings to other beta and gamma disciplines. As a result, the findings give suggestions for quality control in at least some of the beta (medicine) and gamma (economics) sciences. Exhibit 8.1. summarizes the main similarities and differences in the observed predictor-criterion relations.

[1] For their stimulating comments on the methodological limits and policy implications of the studies presented in this book, we owe thanks to C. van Dorp, Science Policy unit of the Netherlands Ministry of Education and Science, Zoetermeer, and A. van Heeringen, Advisory Council for Science Policy (RAWB) in the Netherlands, The Hague.

Exhibit 8.1. Predictor-Criterion Relationships in medicine and economics

| | Medicine (I) | | Economics (II | |
|---|---|---|---|---|
| Univariate / Multivariate Test | U | M | U | M |
| **scale** | | | | |
| human resources (c) | + | + | + | + |
| unit size (c) | 0 | 0 | 0 | 0 |
| FTE (unit) size | @ | @ | + | + |
| project size (ic) | 0 | 0 | + | 0 |
| time research (c) | + | + | + | 0 |
| time non research (c) | - | - | - | 0 |
| capital resources (ic) | + | 0 | 0 | 0 |
| research expenditures | @ | @ | 0 | 0 |
| **input mix** | | | | |
| age (ic) | 0 | 0 | - | - |
| human capital (ic) | 0 | 0 | + | + |
| interdiscipl composition (c) | 0 | 0 | 0 | 0 |
| tenure intensity | @ | @ | + | 0 |
| cash flow mix (privatisation) | @ | @ | + | + |
| **scope** | | | | |
| scope (25% criterion) | @ | @ | 0 | 0 |
| scope (10% criterion) | @ | @ | + | + |
| **atmosphere** | | | | |
| innovative climate (c) | + | 0 | + | 0 |
| publication climate (c) | + | 0 | + | + |
| work-related culture (c) | 0 | 0 | 0 | 0 |
| bureaucratic culture | @ | @ | - | - |
| normative culture | @ | @ | 0 | 0 |
| **management** | | | | |
| craftsmanship (ic) | + | + | 0 | 0 |
| leadership (c) | 0 | 0 | 0 | 0 |
| **control** | | | | |
| motivation (ic) | 0 | 0 | + | 0 |
| reward expectation (ic) | - | - | + | + |
| **communication** | | | | |
| within unit comm (c) | + | 0 | + | 0 |
| between unit comm (c) | + | 0 | + | + |
| international comm (c) | + | + | + | + |
| interdiscipl comm (c) | 0 | 0 | 0 | 0 |

**Key** - (c) indicates consistency of results in study I and study II; (ic) inconsistency in findings; univariate results indicate that predictor-criterion relationships are (+) positive, (0) zero or (-) negative; multivariate results indicate that the variable has entered a significant discriminant or regression function; (@) indicates that the predictor variable has exclusively been measured in study II. Multivariate results refer to discriminant rather than to multiple regression analysis (which was only performed in one of the disciplines).

How can we operationalize the concept of consistency? Two criteria have been used. Consistency in a strong sense is said to exist when all tests demonstrate similar findings in two studies, i.e. a positive, a negative or a zero predictor-criterion relation. This is the case, for instance, for the scale of human resources and for work-related culture. Consistency in a weaker sense is said to exist when the univariate tests show similar results in both studies, such as for publication climate and within-unit communication. The latter operationalization has been chosen because the multivariate results are rather tentative, especially in study II. Consequently, more emphasis is given to the consistency of univariate results. The added condition, however, is that the univariate results should not contradict the multivariate results, i.e. they should not have a reversed sign. When, for example, the univariate results of the studies are positive, and the multivariate results of one of the studies is negative (due to interaction effects), the results would be interpreted as inconsistent.

Assuming this operational definition of consistency, it appears that 13 predictor variables have a consistent influence, while 8 do not. Given the considerable distance between the disciplines, this finding may be interpreted as an indication of external validity. Studies on scientific productivity which were conducted in a large variety of disciplines in the U.S. and Europe confirm the generalizability of most of the predictor variables (Pelz and Andrews, 1966; Andrews, 1979). The next sections discuss three possibilities: (i) consistent predictor-criterion relations, (ii) consistent zero predictor-criterion relations, and (iii) inconsistent predictor-criterion relations.

### 8.2. Consistent Predictor-Criterion Relations

The variables that survived the univariate and multivariate tests in both disciplines are: human resources (+), and international communication (+). Consistent univariately significant variables are: time research (+), time non-research (-), innovative climate (+), publication climate (+), within-unit communication (+), and between-unit communication (+). Therefore economies of scale, atmosphere, and communication are the most robust variables in the present research model.

### 8.2.1. Economies of Scale

**human resources** - In contrast with high performers low performers in medicine and economics regard their human resources available to conduct research as insufficient. The difference in manpower levels between the disciplines - more than 4,000 medical scientists and less than 1,000 economists working in universities (CBS, 1988) - suggest that the minimum optimum scale of a unit will be lower in economics than in medicine. It has been suggested that a critical mass of 4-10 staff members is required to capture economies of scale in economics at the research group task level (VEW, 1986; Hare and Wyatt, 1988). Johnes (1988:175), however, has pointed out that there is evidence here of a significant non-linearity - at least at the departmental level. "In general, the larger the department the more productive the average member of that department is, up to 56 staff. Departments with more than 56 staff members are above the optimal size". Although the optimal number of full time equivalents may differ from discipline to discipline - and within the disciplines probably also from field to field, having critical mass seems to be a necessary condition for scientific productivity.

**time allocation** - High performers in medicine and economics spend more time on research (multivariately significant in medicine), and less time on activities like patient care (multivariately significant in medicine) and education (univariately significant in economics). These two findings are, of course, not independent. Having a large share of patient care or teaching loads proves to be a serious constraint. This latter findings is also consistent with international studies (Graves et al. 1982; Johnes, 1988). Given the tradeoff between time devoted to research and patient care/education, a purposeful allocation of time is critical for high performance in research.

### 8.2.2. Economies of Atmosphere

**climate** - Having an innovative climate implies that new ideas are taken seriously, even (and perhaps especially) when they originate from junior staff. Having a publication climate indicates that everybody manages to do research (being research minded is reinforced), and that dissemination of results in (international) journals is strongly encouraged. Having a favorable innovative and publication climate proves to be productive for scientific research. This finding is consistent with large-scale studies conducted in the U.S. (Pelz and Andrews, 1966) and Europe (Andrews, 1979).

### 8.2.3. Communication

In several respects, high performers are more 'extravert' in this sense that they interact with more colleagues from other units than do low performers. They have more within and between unit communications (univariately significant), and more international communications (multivariately significant). Low performers are more stimulated to make international contacts (study II), but high performers have more of them (both studies). The problem with communication, especially with international communication, is, of course, that it may be conceived as cause and effect of scientific productivity, since there are no high performers without frequent international contacts. As mentioned before, whether these contacts are a consequence of their high productivity or an input factor cannot be established from our cross-sectional study. Presumably, a two-directional causality (performance and communication reinforce each other) is the most plausible interpretation.

## 8.3. Consistent Zero Predictor-Criterion Relations

Variables which are not related to scientific productivity, neither in medicine nor in economics, are unit size (uncorrected for full time research equivalents), interdisciplinary composition and interdisciplinary communication, work-related culture, and leadership.

### 8.3.1. Economies of Scale

**unit size** - Since a rather crude measure of unit size has been used, the non-relationship between unit size and productivity may be a measurement artefact. Evidence for this assumption is given in study II where a correction was made for full time research equivalents. The new size variable - FTE unit size - survived the univariate and multivariate tests, thus showing the importance of economies of scale. This finding is consistent with the findings concerning critical mass and time spent on research mentioned above, and with the international literature concerning scientific productivity in economics (Graves et al., 1982; Johnes, 1988).

### 8.3.2. Input Mix/Communication

**interdisciplinarity** - Neither of the studies presented here revealed a relationship between interdisciplinarity and scientific productivity. In general, the research literature is rather ambiguous where the impact of interdisciplinarity on scientific productivity is concerned. Moderately positive (Andrews, 1979) and negative relations (Spangenberg and Nijhuis, 1986) have been found in empirical research. The present studies show that there is no

relationship between interdisciplinarity - neither as an input mix variable (interdisciplinary composition of the staff) nor as a throughput variable (interdisciplinary communication). This does not mean that only specialization is favorable, since study II shows that high performers capture economies of scope, indicating that a certain degree of product diversification can be effective. Economies of scope, however, are not necessarily captured by interdisciplinary teams. In fact, the second study showed that economies of scope are not correlated with interdisciplinarity.

Considering transaction costs, it may be argued that interdisciplinary science is more expensive than monodisciplinary science. The parties of the interdisciplinary contract have to find each other, develop a common language, and exchange information. Since they cannot rely on a common stock of knowledge, common competences, and common professional values, a time consuming investment has to be made before their work can become productive. Consequently, interdisciplinary teams have a cost-disadvantage as compared to monodisciplinary teams. Since their higher costs are not compensated by higher performance levels, it may be concluded that interdisciplinary units are less cost effective than monodisciplinary units. On the other hand, given the constraints of interdisciplinary work, the conjecture that interdisciplinarity is negatively related to scientific performance would be highly plausible. Thus, the non-relationship between interdisciplinarity and performance may indicate that interdisciplinary units compensate their disadvantages by realizing higher performance levels than monodisciplinary units.

Interdisciplinary cooperation is generally recommended because it minimizes duplication of costly research (Commissie Financieringsstructuur Onderzoek en Ontwikkeling, 1985), and because it is expected to contribute to technological innovation or to solving socio-economic problems such as interdisciplinary health problems and environmental problems in the long term (Ministerie van Onderwijs en Wetenschappen, 1988). These recommendations are not inconsistent with our findings, since we have demonstrated that interdisciplinarity is uncorrelated to scientific productivity - not to creativity or problem solving. Moreover, the research was conducted in two rather monodisciplinary sciences, medicine and economics, so that different observations may be made in multidisciplinary sciences such as biochemistry and neuropsychology.

### 8.3.3. Economies of Atmosphere

**work-related culture** - The zero-relationship between culture and performance may be an artefact, since the measurement instrument that was used to measure work-related culture has been developed to differentiate at the national level (Hofstede, 1980) - not at the

organizational level. When an adequate measure of organizational culture, the OCM, was used, economies of atmosphere showed up (study II). The finding that non-bureaucratic cultures are efficient when innovating activities are concerned is not only highly plausible (Mintzberg, 1979), but also consistent with well-known studies such as Burns and Stalker (1961) who found that 'organistic' (non-bureaucratic) performed better than 'mechanistic' (bureaucratic) organizations in innovating industries. Following the efficient culture hypothesis, it was conjectured in chapters 4-5 that high performers would capture economies of atmosphere. The studies presented here tend to confirm the hypothesis. However, as compared to economies of scale, the returns of atmosphere captured by high performers are rather modest.

### 8.3.4. Management

**leadership** - no support could be found for the hypothesis that leadership qualities are decisive for high performance. An explanation for this zero-relationship is that the agents here are professional scientists, who may find craftsmanship more convincing than personality traits in their leaders (study I). The latter finding (which was, however, not validated in the follow-up study) suggests that being excellent as a scientist is more important in university research management than having good leadership qualities. It does not follow from this that leadership is unimportant. Following Knorr et al. (in Andrews, 1979), who have demonstrated that leadership affects research climate (morale), and research climate affects scientific performance, it may be argued that research leaders who are able to stimulate the other members of the unit, provided that the leader is respected because of his or her professional craftsmanship, have an indirect impact on unit performance because they affect morale. The univariate relations found between management variables and predictor variables in the discriminant function of the studies presented here tend to support this interpretation.

## 8.4. Inconsistent Predictor-Criterion Relations

The only variable showing an (unexpected) negative predictor-criterion relation in the first discipline and a positive relation in the latter is the control variable 'reward expectation'.

### 8.4.1. Control

**reward expectation** - The control variable appears to be negatively related to scientific productivity in medicine, and positively in economics. High performers in medicine are aware that they can best serve their financial interest when they specialize in patient care rather than in research. When one makes a speculative attempt to explain the inconsistency, the following argument emerges: as a result of the difference in opportunity costs of scientific

research (clinical medicine: high as compared to patient care; economics: low as compared to education) medical researchers should behave like altruists to perform better, while economists can (fortunately) behave like profit-maximizers, because the incentive system in departments of economics is more aligned to scientific research than in university hospitals. An plausible, alternative explanation is that high performers in clinical medicine are not altruists, but non-pecuniary profit maximizers. They maximize personal benefits such as job satisfaction (associated with preferences for research activities), international recognition, reputation, and publication in the most outstanding journals at the cost of time spent on medical education and patient care.

Although the results with regard to reward expectation are inconsistent, the multivariately significant results in both of the studies clearly demonstrate that reward expectations affect scientific performance. The results remind us of the fact that any well-designed system of incentives has to take into account non-pecuniary as well as pecuniary interests, perhaps in particular in the field of science.

### 8.5. Research Policy Implications

Some preconditions are easier to manipulate than others. Following Franklin (1988), it may be concluded that straightforward means of improving project effectiveness include (not surprisingly) the provision of additional funding and manpower, and the supply of the time necessary to conduct high quality research . For research units working under their minimum optimal scale, this may be the only way to ensure that they will perform at an acceptable level. In addition, collaboration with foreign scientists has been shown to be instrumental in providing a fruitful research environment. On behalf of national research policy this section summarizes the practical conclusions that can be drawn from the findings. The obvious, overall conclusion is that 'organization matters'. Excellence in science is dependent not only on intellectual capabilities, but also on the research infrastructure. University research units may capture competitive advantages by developing economies of scale, and atmosphere. In addition, the outcomes appear to suggest that the scientific performance of research units can be enhanced by improving their (international) communication structure, and by designing an optimal incentive system for research. Finally, the results remind us of the fact that science is a distinctive craft. In order to operate successfully, technical craftsmanship should not only be selected for but also be encouraged in the supervision and the routines of staff members.

Of course, national research policy is an important framework within which academic research units operate, at least in the Netherlands staff levels and funds depend critically upon national budgetary mechanisms, for instance. Hence, the appropriate design of such mechanisms is a

crucial factor in fostering high performance. It should be kept in mind, however, that national policy can at best only facilitate high performance. The actual creation of (the factors conducive to) high performance is mainly located at the micro task level, i.e. the research group level (Hazeu, 1989). Accordingly, many of the significant relationships presented here can be relevant for national research policy but ultimately have to be crafted within the research unit itself.

### 8.5.1. Consistency with Research Policy

Universities play a vital role in creating and maintaining excellence in the scientific disciplines upon which the long-term competitiveness of national industries depends. The Netherlands has a large university sector, probably one of the largest in Europe in proportion to the size of the country. The governmental research expenditures in 1985 were 3,900 million guilders of which 1,800 million is spent on subsidizing university research (primary cash flow only). In the last few years, an impressive number of initiatives have been taken in the field of research policy, and still others in the field of implementation - cf. the report of the Commissie Financieringsstructuur Onderzoek en Ontwikkeling (1985), the strategic HOOP: Hoger Onderwijs- en Onderzoeksplan (Ministerie van Onderwijs en Wetenschappen, 1987), and the recent HOAK: Hoger onderwijs: autonomie en kwaliteit report (Ibid, 1988), which all emphasize decentralization (decreasing bureaucracy) and increased quality control in systems of higher education.

In general, the present findings are rather consistent with the latest R&D policy (Ministerie van Onderwijs en Wetenschappen, 1988b and 1989b). Thus, the studies here suggest the (latent) rationality in these measures and recommendations by attributing an efficiency function to some of the recommendations in an independent and statistical way. This is especially the case for the national science and technology review (OECD, 1986). The next sections selectively discuss some of the main OECD recommendations concerning university research. In general, the importance of the factors mentioned below has also been underlined by the policy reports mentioned above, and by research managers at various responsibility levels in the research pyramid (e.g. Borgman, 1988/89) and in various disciplines, e.g. experimental physics (Dynamus, 1987), clinical medicine (Schweizer et al., 1987), and economics (VEW report, 1986).

### 8.5.2. Scale Economics and Centers of Excellence

In their review, the OECD examiners stress the importance of economies of scale in university research. They have emphasized a certain division of labor among universities and more

coordination between research units. A vigorous move towards more specialization and concentration through the creation of centers of excellence is recommended. In addition, more opportunities should be offered for teamwork.

Differences between disciplines in critical mass required for research should, however, be taken into account as well. As Chandler (forthcoming) has pointed out for industrial enterprises, different production technologies have different scale (and scope) economies. Like industries, scientific (sub)disciplines will also differ in their minimum efficient size. In addition, the cost curve gradient may be steeper, and the penalties of producing below minimum efficient size may be more severe in 'big science' (e.g. physics) than in scientific disciplines which operate on a smaller scale (e.g. economics). It should be noted as well that critical mass is not a sufficient condition for high performance. The law of diminishing returns is applicable once the resources are in place and treated as fixed costs. Nevertheless, research units capturing economies of scale are expected to have a competitive advantage. Assuming that there is a minimum efficicient size for each (sub)discipline, future policy research may be more directed towards the assessment of the unique critical mass for each discipline, so that an optimum use is made of scale advantages.

### 8.5.3. Decentralization and Economies of Atmosphere

Stress is also laid in the review on the importance of decentralization which is understood as increased administrative and financial autonomy, and, consequently, increased flexibility. The OECD emphasizes the need for decentralized decision making which is associated with a non-bureaucratic atmosphere promoting flexibility and innovation rather than standardization. Of course, there are limits to such an atmosphere. The Commissie Financieringsstructuur Onderzoek en Ontwikkeling (1985) has argued that the research system has a shared and stratified responsibility structure (Hazeu, 1989). Consequently, an equilibrium has to be found between bottom-up and top-down planning. In the view of this commission, the organization of the research system is neither an anarchy of self-sufficient kingdoms in which only academic freedom reigns, nor a centralized rank-and-file structure in which the top decides and the bottom applies. If decentralization is associated with the existence of a non-bureaucratic culture in the unit, the findings presented here suggest that bottom-up planning is more advantageous in terms of the scientific performance of university research units than bureaucratic measures. To put it differently, scientific excellence is more likely to emerge in an innovative 'studio' type of environment than on an assembly line.

### 8.5.4. International Exchange in Science

Consistent with the findings presented here, the OECD suggests that exchanges between research units, particularly international exchanges, should be encouraged. In the Netherlands, an increase of international diffusion of results is recommended, because "a country which exports and imports the equivalent of half of its gross national product is by necessity a part of the international economy and exchange system. This implies that international developments have to be taken into account more than in other countries which are less dependent on international trade" (OECD, 1986: 7). Nowadays, it is recognized that an international outlook and international cooperation are of particular importance for a small country like the Netherlands which accounts for only about one percent of R&D efforts in the world. The Ministerie van Onderwijs en Wetenschappen (1989b: 12) states that "research contributes to the expansion of the world-wide reservoir of knowledge. Equally, it is essential that researchers remain alert and are able to tap developments in that reservoir. Generally speaking, if researchers are to function properly they must be part of an international network, be it formal or informal, of fellow researchers". Internationalization is a necessity for quality assurance (by the international Forum function of science) and to monitor interesting developments at an early stage. Moreover, it is recognized that some subjects are of such a nature (e.g. transnational environmental problems, the war against cancer or international finance) that they can only be studied properly in an international context. A strategic consideration is that, in order to compete with the USA and Japan, it is essential for Europe that there is a multinational pooling of scarce scientific and technological knowhow. Consequently, promoting an international outlook and strengthening international cooperation in academic research is one of the policy intentions of the Ministry of Education and Science. In this context, the Netherlands could possibly take Belgium as an example, where figures indicate that between 50% and 60% of publicly-funded research occurs in an international context (Ministerie van Onderwijs en Wetenschappen, 1988b: 24).

### 8.5.5. Market-oriented Incentive Systems

Finally, increased flexibility is recommended in reward systems. Excellence should be encouraged and mediocrity discouraged, for instance, by market-oriented incentive schemes, and the creation of new temporary posts which, moreover, offer opportunities for increased mobility between universities. The Wolfson commission has pointed out that increasing flexibility should not injure the continuity of high quality long-term research programs (Commissie Financieringsstructuur Onderzoek en Ontwikkeling, 1985). Nevertheless, there is increasing recognition of the competitive disadvantages of non-market oriented incentive systems, e.g. the buy-out of scientific potential by large companies or the brain drain to

outstanding U.S. universities which provide better salaries and, perhaps even more important, more autonomy and more satisfying facilities to conduct scientific research.

### 8.6. Concluding Remarks

The present chapter shows that economies of scale, atmosphere, and international communication are the most robust variables predicting scientific performance. The results with regard to reward expectation are inconsistent, but the multivariately significant results remind us of the fact that a well-designed system of incentives may be vital as well. Important variables which are not related to performance are interdisciplinarity and leadership. Since most of the results are rather consistent, despite the considerable distance between clinical medicine and economics, it may be argued that the findings are fairly well generalizable to other beta (natural) and gamma (economics and similar social sciences) disciplines. This claim is supported by a comparison of the findings here and other contributions, but should be placed in perspective by taking into account the shortcomings and strengths of the research methodology.

The present findings prove to be in line with the latest research policy, particularly concerning (i) concentration and increasing the scale of scientific research somewhat, (ii) increasing autonomy and decentralization, (iii) designing incentive schemes which take market developments into account, and (iv) internationalizing the scope of Dutch university research. This is, among other things, the case for some of the recommendations in the latest National Science and Technology Review of the OECD (1986). The studies presented here have not revealed the 'one best way to organize' scientific research. Furthermore, there are methodological shortcomings which have to be taken into account as well. Finally, none of these measures can effectively be implemented unrestrictedly or in a mechanistic way. Given the robustness of the findings, however, it may be said that a small set of variables have been identified which can be neglected only at the risk of low performance in (some of) the beta and gamma sciences.

# 9

## Summary and Discussion

The first section of this general discussion will summarize and discuss some of the main findings of this study against the background of the available empirical data on economies of atmosphere. The second section deals with the shortcomings and strengths of the study. The third section of this discussion provides some suggestions for further research.

### 9.1. Main Research Findings

This book has argued that decision makers rely partially on habits, operational routines, and rules of thumb which consist of fixed rather than flexible, rational responses. Although many of our decisions will be inferior to those a fully informed rational agent would have made, we often have no better alternative. Given scarce cognitive resources, to rely, partially, on rules of thumb and other (non-)choice decision rules may be the best possible solution. Some of these decision rules are provided to individuals by an atmosphere which affects their mental programs and behavior - both at the national and the organizational level. This study has focused on the economies and diseconomies of atmosphere, i.e. the profitable and harmful effects of atmosphere, especially at the organizational level.

The theoretical part of this study has been concerned with the economic rationale for atmosphere. The main questions explored are (i) whether atmosphere affect costs and performance; (ii) if so, what are the economic reasons for this; (iii) what are the costs of supplying an (in)adequate atmosphere? A review of the literature on economics and business administration revealed that atmosphere does matter. As a routine or fixed reponse, it can be a source of technical efficiency. However, from a dynamic (or quasi-static) point of view, it can also become a source of inefficiency. Several economic reasons can be given why atmosphere is associated with competitive (dis)advantages at the national, industry, and firm level of analysis. The reasons given depend on the theoretical perspective and the level of analysis. While the literature on welfare economics emphasizes atmosphere as a public good, the literature on strategic management centers on entry barriers, uncertain imitability, and

durable, superior economic performances of firms. While the literature on international management emphasizes the impact of national work-related values on GNP, the economics of organization focuses on the shirking problem (team theory), incomplete contracting and focal equilibria (agency theory), and the efficiency imperative: transactions should be so organized as to economize on bounded rationality, while simultaneously safeguarding against the hazards of opportunism (transaction cost economics). These are, of course, interpretations of the theories mentioned above. Only Williamson (1973) has explicitly dealt with the 'economics of atmosphere'.

What about the costs of supplying an appropriate atmosphere? Following the rather broad definition of atmosphere presented in this book (values, codes, information, competences), atmosphere is an unavoidable investment - you will always have one. The only alternative for a given atmosphere is an alternative atmosphere. When the switching costs of moving to another atmosphere exceed the benefits or when firms simply fail to ignore sunk costs (note that atmosphere is an irreversible, non-marketable investment), the firm is locked into the present atmosphere, and this may becomes a source of inertia and myopia. Since it 'takes ages and costs fortunes' to develop an alternative atmosphere, firms will only change their atmosphere when there are good reasons to do so. The amount of switching costs is dependent on the level of aggregation, i.e. higher levels have higher switchings costs and are therefore lower in the response times hierarchy. Consequently, implementing an alternative atmosphere is less difficult (and will take less time) for firms than for industries, and less difficult for industries than for nations - not to speak of networks of nations such as the European Economic Community.

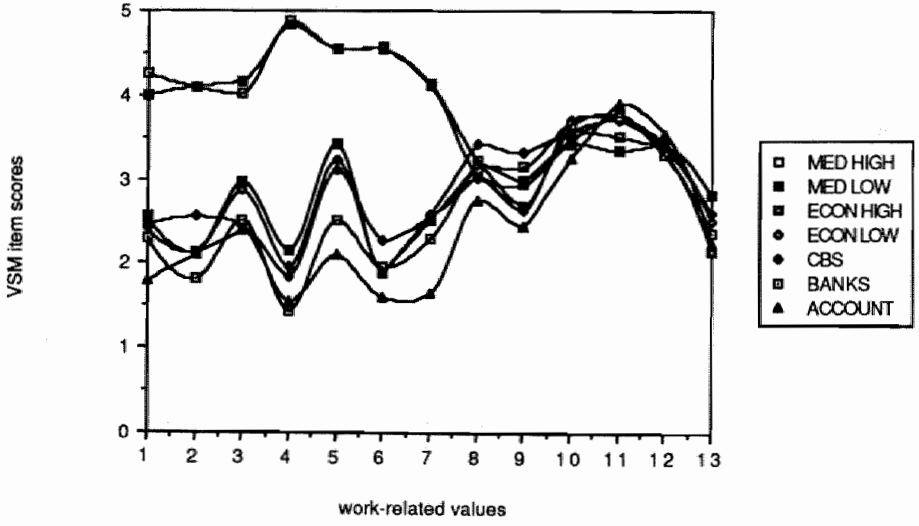
Demonstrating that there is an economic rationale for atmosphere does not necessarily imply that there is empirical evidence for economies of atmosphere. While the first Section of this book, (Section I), has focused on the economic rationale for atmosphere, the remaining parts reported on the design (Section II) and the findings (Section III) of the empirical studies aiming to test the economies of atmosphere hypothesis. As compared to the rich body of theory on this subject and the large number of conceivable hypotheses generated by the economies of atmosphere framework (chapter 1), the empirical studies have a somewhat restricted focus. In Simon's [1954] terminology, the tension between the theoretical (broad) and empirical (restricted) focus of this research project may well be conceived as an illustration of bounded rationality, because it shows that the capacity of the author to formulate and solve problems is very small compared to the size and complexity of the problems whose solutions are required. By selecting a narrow focus, the empirical studies have attempted to economize on bounded rationality at the cost of restricted generalizability.

What is the contribution of the empirical studies presented here to the existing body of knowledge? Implications can only be discussed concerning the organizational level, since the empirical studies ignored other levels of analysis. In my opinion, their main contribution is that they put the efficiency claims of much of the literature on corporate culture somewhat in perspective. Many authors believe that 'corporate culture', which is a catch-all term for a heterogeneous assortment of intangible assets such as values, beliefs, and rituals, plays a critical role in excellent organizations. Some conceive atmosphere as the most important condition when team performance is concerned. In contrast to this literature, the findings presented here show that the impact of atmosphere on the performance of research organizations is, in fact, rather modest - even in an organizational form which tends to favor economies of atmosphere (chapter 4: the efficient culture hypothesis). It is the interplay between economies of atmosphere and other (even more important) predictors such as economies of scale and international information flows which account for performance as measured by various qualitative and quantitative scientometric indicators (chapter 5) - at least in university research organizations.

Several reasons can be given why the empirical studies presented here failed to show the decisive role of atmosphere. First of all, an imperfect measure has been used to assess one of the dimensions of atmosphere. Obviously, the Value Survey Module (VSM) is not an appropriate instrument to assess work-related values at the organizational level. Second, standardized measures have been used to assess the other dimensions of atmosphere, i.e. the organizational culture module (OCM) and the climate measures. Only the climate measures were adapted to the specific work dimensions of university research units. Third, cross-section research has been carried out in existing units. Consequently, dynamic aspects were not observed. As a result, the alternative hypothesis cannot be excluded that atmosphere plays a decisive role in an early stage, while only playing a minor role in the mature stage of the unit's lifecycle which has been investigated in our analysis. Finally, comparisons have been made of high and low performers within the same discipline, clinical medicine or economics. This procedure has been selected in order to establish internal validity (comparing 'like with like') at the cost of minimizing the variance (in occupational culture) between the research units.

Exhibit 9.1 combines Dutch VSM data on clinical medicine (study I; Bally et al.,1987), economic departments in universities (study II), economic departments in the Central Office of Statistics (CBS) and banks (data collected by the author during study II), and accounting firms (Soeters and Schreuder, 1988). The figure is only shown to illustrate that the within-discipline variance, i.e. the variance between between high and low performers tends to be smaller than the between-discipline variance, i.e. the variance between clinical medicine and economics. The latter discipline is represented by the university departments of study II, the Central Office of Statistics (CBS), economics departments in a number of banks, and the average of Dutch and 'Big Eight' accounting firms. The lines between the items are meaningless, but they are helpful in observing global differences in the profiles of the two disciplines.

Exhibit 9.1. VSM trends within and between disciplines




Hofstede (1980) distinguishes four value dimensions: (i) Individualism is item 1, 2, 4, and 6; (ii) masculinity is items 3, 4 (double), 5, and 7; (iii) power distance is items 8, 9, and 12; (iv) uncertainty avoidance is items 10, 11, and 13. The dimensions are computed on the basis of formulas which are given in the VSM scoring guide (Hofstede, 1982). The weights of the items in the formulas are derived from the factor loadings of the original IBM study. Comparing the VSM scores of several organizations within the same country, however, is not a very fruitful approach, since the VSM was developed to compare country rather than organizational

scores. In addition, interpreting the differences in atmosphere at the item level would be pure chance capitalization. The figure is only given to illustrate that efforts to keep production technology constant by comparing high and low performers within the same discipline results in a restriction of variance in the professional atmosphere linked to these specific production technologies. The values and competences of high and low performers reflect more the places that they are trained at than the institutions they are at (personal communication, McLaughlin, University of North Carolina). Consequently, it may be conjectured that the relationship between atmosphere and performance would be stronger when predictor-criterion relations are examined in a combined sample consisting of clinical medicine and economics, thus maximizing the variance in atmosphere. However, such an approach would not be very convincing since it would be difficult to be interpreted given the heterogeneity introduced in the sample and the performance measures.

These are methodological explanations which may always be used as an excuse for not drawing firm conclusions. As I believe, performance differences can only be attributed to atmosphere in an exclusive way when other sources of efficiency have been shown not to provide a contribution. Given the complexity of the efficiency problem and the variety of efficiency sources, it is rather naive to capitalize exclusively on atmosphere when aiming for technical efficiency. The contribution to the 'economics of atmosphere' by this project may be summarized in three critical propositions, which may as well be conceived as conjectures for future research.

(i) From an empirical perspective, economies of atmosphere have less impact than is generally believed - although there is certainly an economic rationale for the existence of atmosphere from an analytical point of view.
(ii) It is the dynamic interplay between atmosphere and other sources of efficiency rather than *atmosphere alone which accounts for the variance in technical efficiency* between organizations.
(iii) Economies of scale tend to be more important than economies of atmosphere. Units working without sufficient 'critical mass' may not be able to compensate their scale disadvantage by developing a superior atmosphere.

### 9.1.1. An Example of Economies of Atmosphere

What is the rationale for economies of atmopshere? Perhaps the most intriguing (though debatable) result of one of the studies presented here is the negative relationship between reward expectation and performance in clinical medicine. It was conjectured that high performers would expect more pecuniary rewards for conducting research than for patient

care. This would not be surprising, since all members of high performing units, including the supervisors, spend more time on research than members of low performing units. In addition, they have more frequent working discussions with colleagues on research topics, and feel more responsible for their research task. This conjecture would be perfectly consistent with the neoclassical paradigm in which individuals are assumed to maximize their subjective expected utilities. If members of clinical research units were pecuniary profit maximizers, they would only do so in the expectation of a pay-off.

In contrast to this reasoning, the findings show that high performers expected significantly better opportunities for their career development in patient care rather than in research. Thus, they invest their time in research, although they are aware that patient care generates a much higher pecuniary return. What can be rationale for this behavior? It may be concluded that high performers in clinical medicine are dedicated scientists, i.e. they are intrinsically motivated to do research. For them, the game of science is a goal in itself. It may also be argued that they are dedicated human beings - driven rather by the motivation to increase medical knowledge (and indirectly, improve the quality of patient care) than by seeking their own narrow self interests. From this perspective, their behavior is altruistic rather than calculative in a narrow sense. High performers may truly want to promote causes which are not identical to their own welfare in a limited sense, and which they do not perceive as their own narrow self-interest.

Take as a contrast the low performers in clinical medicine who are more consistent with the limited version of the utilitarian image of man. From an orthodox maximizing perspective, their behaviors are much more 'rational'. They invest their time in patient care rather than in science. Moreover, they spend significantly more time on private patient care practice off-hospital (which is generally known to be more profitable in a pecuniary sense than in-hospital care) than high performers. In terms of individual incomes, the low performers are presumably better off than the high performers. When the mutual gains of team production are considered, it is the non-calculative attitude, the dedication to research, which increases the scientific performance.

Concerning rational behavior, the neoclassical paradigm can be applied more or less rigidly. As usual, the 'mainstream literature', represented by the institution of the microeconomics handbooks, tends to be more rigid, while the classics (from Adam Smith to Marshall and Hennipman) and recent journal articles describing well-designed choice theoretic models tend to favor flexible uses. Recently, a detailed argument in favor of the flexibility of the maximizing framework has been presented (Van Witteloostuijn, 1988). When maximizing models leave room for the introduction of 'non-economic' determinants of behavior in a

maximizing framework, it may be argued that high performers in clinical medicine focus on reputation effects rather than income effects. These effects may, of course, be interdependent, e.g. income effects may be a long term effect of international scientific recognition. Thus, the high performers in clinical medicine are guided by quasi-altruism or long term self-interest rather than true altruism. Finally, one may introduce science as a kind of l'art pour l'art in the utility function of the scientific utility maximizer or, equivalently, consider it as a means to satisfy higher needs. Hence, it is partly a definitional matter whether one wants to designate this behavior as rational or not. Stretching the concept of rationality, however, introduces the risk of circularity and non-operationality. For example, 'revealed preferences' are derived from behavior, whereas behavior is evaluated as rational when it is consistent with these very preferences.

Of course, these are ad hoc interpretations. But if they are correct, they suggest that the difference in mental programming (or in needs) between high and low performers does matter. Especially when the targets (maximizing research performance) and the incentive system (rewarding patient care efforts rather than research efforts) of the organization (university hospital) are not consistent, the 'folly of aiming at A and rewarding B', mental programming can help in generating investment decisions favorable to research despite the high opportunity costs of which all high performers are aware. This is, of course, but one case. The 'altruistic' or 'dedicated' mental programming is not necessarily a general trait of high performers in universities, since the second study showed that high performers in departments of economics expect the higher returns from research. Their behavior is perfectly rational in a more orthodox neoclassical sense. Consistent with their (realistic) expectations, and perhaps also with their intrinsic motiviation to conduct research, they spend most of their time on research.

### 9.2. Strengths and Shortcomings

An evaluation of this study enables both strengths and shortcomings to be distinguished. Before discussing the former, it is important to consider the main shortcomings.

1. First of all, the theoretical focus of the empirical studies is restricted. While the economies of atmosphere framework (outlined in chapter 1) centers on the impact of values, codes, information and competences on (production and transaction) costs and performance levels, the empirical studies were centered on the impact of values and practices on performance. Clearly, further research is needed to explore economies of atmosphere, but future empirical research will undoubtedly be constrained by other operationalization difficulties, especially concerning

'transaction costs'. This cost concept is very useful for analytical purposes, but is hard to use in empirical research.

2. Second, a cross-section design has been used; that is, most of the (independent) measures are taken at only one point in time. This approach enables a prediction of the sign of the statistical predictor-criterion relations. It is, however, well-known that it does not reduce uncertainty concerning the causal direction of the predictor-criterion relation which is often crucial for policy. Statistical association does not imply causation, though it may be a requisite. The use of longitudinal or quasi-experimental designs would be a solution. However, collecting longitudinal data is a costly enterprise, while quasi-experimental research is, in general, not feasible in real life organizations.

3. Third, the empirical studies represent an analytical approach - the research proceeds from a distance, through standardized questionnaires. As a result, the research is subject to Miller and Friesen's (1984: 18) criticism: "The detachment of the researcher from the context of the research precludes the collection and examination of anecdotal data. Typically, researchers end up with a set of general measures of a few rather abstract variables. How are they supposed to probe into causation and interpret these findings? Even if the findings do have some deeper meaning, will the researchers be able to find it?" Studies I and II have focused on testing for circumscribed, linear predictor-criterion relationships instead of searching for a multiplicity of rich, revealing patterns. In their case for configuration, the authors would suggest that the studies presented here should at least be complemented by well-designed case studies. However, costs have to be taken into account in the selection of the research method, since the case study is an extremely time-consuming activity. An alternative would be to develop a more sensitive questionnaire than we have used, on the basis of in-depth interviews with members of high and low performing groups. The interview procedure may also be used to complement the survey-method as has been done in the extended report of study I (Bally et al., 1987: chapter 9).

4. Other criticisms may center on obvious defects of the empirical studies presented here such as the low number of observations resulting in an unfavorable variable/observation ratio for multivariate analyses, especially in study II. In addition, criticism may be formulated regarding the low response rates, and the uncertainty with regard to the representativeness of the data. As a result, caution should be observed in generalizing the findings reported here. Moreover, there are undoubtedly important factors not considered in this study, and measurement imperfections may be pointed out with regard to some of the variables.

5. Regarding the policy implications, it should be mentioned that documents on research policy are generally written from a governmental point of view. Although consistency between our findings (which are based on analyses at the organizational level) and aspects of national research policy recommendations (which are based on the national level) may be observed, the findings presented here cannot be directly translated in national research policy recommendations. In fact, given the level of analysis, the findings are more relevant for the middle management level than for the policy maker. Since they prove to be consistent with at least some recommendations at the national level, they may have more value for the research manager, because they are likely to be supported by top management. Although national research policy is an important framework, the actual creation of high performance is mainly located at the micro level. Accordingly, many of the significant relationships presented here can be relevant for the national research policy level but ultimately have to be crafted by the members and the managers of the research unit itself.

Despite these shortcomings, there are a number of strengths in the study presented here.

1. First of all, it may be argued that there is a theoretical foundation for the selection of the central predictor variables, i.e. scale, scope, and atmosphere. While economies of scale and economies of scope have become well-recognized causes of technical efficiency in the microeconomic literature, Section I of this book has attempted to demonstrate that there is an economic rationale for the existence of economies of atmosphere as well, especially in certain organizational structures which are similar to the research unit because of uncertainty in the production technology.

2. Second, use was made of the best available national performance evaluations for the classification of research units in clinical medicine and economics. While most effectiveness studies center on subjective self-ratings, study I and II could rely upon a multitude of fairly accurate scientometric indicators. As expected, most of these performance indicators appeared to be convergent.

3. Third, multivariate analyses were restricted to the univariately significant variables in order to reduce chance capitalization. Furthermore, the multivariate procedure resulted in fairly accurate and efficient predictions, i.e. a small set of predictor variables explained a large amount of the variance in the criterion variable at the unit level of analysis. In addition, it is shown that different combinations of predictor variables may result in an efficient prediction, i.e. there is no one best way to organize scientific research. The predictor variables do not constitute a blueprint that should be followed in every case.

4. Since there is a large variance between the disciplines which were selected for the study, economics and clinical medicine, the external validity of the predictor-criterion relations could be examined. Despite the large differences between the disciplines, the comparison has shown rather consistent results. Consequently, the results may to some extent be generalized to other beta and gamma sciences.

5. Comparison of the findings of study I and II with international scientometric studies which are not affected by the low response/low number of observations problem reveals that the results are fairly consistent - even when totally different disciplines are involved. Recently, Franklin (1988) reported the findings of a large scale study in European Community countries. The research was conducted in 92 disciplines covering the mathematical, natural, life, and engineering sciences in the EC. It was based on a survey of 5,615 research scientists conducted in 10 EC countries. Analyses were performed on three levels of analysis: the individual level, the project level, and the disciplinary level. The two correlates of effectiveness which were least affected by aggregation are associated with two of the predictor variables which emerged from study I and II, i.e. time spent on research (one of the indicators of scale) and international communication. "(...) although we cannot yet speak about the causes of effectiveness, this chapter has certainly uncovered some features of the research scientist and his environment that are associated with research effectiveness in a non-trivial manner. One of these is an international orientation, which plays an important part in enabling us to predict effectiveness at all three levels of analysis with which we have been concerned. The only other variable to play a significant role at every level is the length of the working week. Longer hours lead to more effective research output, at discipline, individual and project level" (Franklin, 1988: 229). Picasso used to state that, like crafts, the arts are more associated with transpiration than inspiration. Given the importance of long working hours this may be true for scientific craftsmanship as well.

### 9.3. Suggestions for Continued Research

This book is, to some extent, an exploration into new territory. In particular, the territory that lies between neatly defined disciplines such as economics and psychology has been explored. Thus, it may provide synergy effects in a field where monodisciplinary efforts are more common. Since the game of science is, in principle, without end, (in contrast with the time of the analyst which is rather limited), further research is recommended. The main steps to be taken next, in my opinion, are listed below.

(i) Given the fact that only a limited number of hypotheses generated by the economies of atmosphere framework were tested, the impact of values, information and competences on costs

and benefits in a variety of public and private sector organizations should be explored empirically.

(ii) In order to increase our knowledge on (reciprocal) cause-effect relations in scientific organizations, scientometric studies are recommended using longitudinal or quasi-experimental designs. In order to increase our in-depth understanding of the dynamics of research organizations, well-designed longitudinal case studies are recommended.

(iii) Further integration and formalization (Kreps, 1984) of the concept of atmosphere within microeconomic theory is recommended. Many economists have already demonstrated the tangible impact of intangible assets such as information (Arrow, 1971), trust (Sen, 1983), honesty (Akerlof, 1979), reputation (Schelling, 1978), and altruism (Becker, 1976). Within a flexible maximizing framework, it is widely recognized that these 'noneconomic' factors contribute to the explanation of economic phenomena. Elementary trust relations between buyers and sellers are, for example, conceived as a necessary, not a sufficient, condition for the market mechanism to exist. Dishonesty and suspicion have been recognized as causing market failures in the market for lemons (Akerlof, 1971) and medical services (Arrow, 1971). Moreover, it is recognized that the exchange process itself can be a source of value. Whether they are paid for giving blood or not matters to blood donors. Whether they are monitored or not, and to what degree, matter to agents working in a professional organization. Similarly, whether a man pays a woman for sex directly (in cash) or indirectly (by renting an appartment for her and paying for meals, etc.) makes a difference to both sides (comment of an anonymous referee of Management Science). Integration of intangible assets such as atmosphere in neoclassical theory will, in the long run, enhance the explanatory power of the economic discipline and may as well contribute to the 'microfoundation of macroeconomics' to use a famous phrase in contemporary economic discourse.

(iv) Finally, further logical inquiry is encouraged regarding the rationality assumption in neoclassical economics. Analyzing atmosphere leads to the recognition that maximizing behavior does not exclusively entail maximization of self-interest in a narrow sense. The utility function can include other goals, values and commitments. Even within a predictive perspective (Friedman, 1953), there is little evidence that assuming self-interest maximization would yield the best predictions. The narrow self-interest maximization hypothesis is, for example, inefficient for prediction, in addition to being a bad description, in South East Asian countries such as Japan which has strong norms of behavior. Recently, it has also been recognized that a too narrow motivation structure of employees is counterproductive for Western organizations as well. Atmosphere as a set of values assumes that people may not relentlessly pursue their own goals. They may be guided by the recognition of interdependences

Following Adam Smith's Theory of Moral Sentiments [1759], Sen has argued that when goals of different people are partly congruent and partly conflicting, then the pursuit of individual goals in isolation may not be a sensible thing to do for people working in organizations and living in the society. This leads to the subject of habits, routines, and behavior according to norms which Adam Smith particularly emphasized: "These general rules of conduct, when they have been fixed in our mind by habitual reflection, are of great use in correcting misrepresentations of self-love concerning what is fit and proper to be done in our particular situation" (Sen 1989 in: Klamer, 1989: 144). The ultimate objective is that, given strategic interdependencies, all of us manage to achieve our respective goals better. This is what the economics of atmosphere is about: many systems flourish precisely because there are codes of conduct which may violate short term self-interest goals, at least to some entent. Thus, atmosphere may create a game which has a superior collective outcome when not only the narrow self-interest of each player is persuaded, but interdependencies are taken into account as well. Simple decency, a sense of duty, and regard for others are examples of values which cannot always be incorporated in an efficiency calculus, but ultimately are indispensable for our well-being.

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# Appendices

## 1: List of Interviews

Interviews were held with research managers working in (i) multinational firms, and (ii) large governmental research institutes, with (iii) agents from governmental research councils, and (iv) with (high performing) university professors. Most of the interviews were held in the period January-June 1986. The average length of an interview was 2.5 hours. The main topics discussed were: performance evaluation of R&D/scientific research, facilitators and inhibitors of R&D/ scientific research in the public and private sector, contribution of R&D to the company's welfare (only private sector).

(i) Industry

- Pannenborg, PHILIPS
- Kramers, AKZO
- Revallier, DSM
- Houwink, ORGANON
- de Flines, GIST BROCADES
- Beckers, SHELL

(ii) Large Governmental Research Institutes

- Kistenmaker, FOM
- Chang, FOM
- Le Pair, NTW
- Rörsch, TNO

(iii) Governmental Advisory Councils

- Van Bueren, RAWB
- Van der Spiegel, Ministry of Education and Sciences

(iv) University departments

- De Zeeuw, Agricultural University, Wageningen
- Allessie, Department of Physiology (RL), Maastricht
- Querido, (Emeritus professor) University Hospital Leiden
- Kapteyn, CentER/Department of Econometrics (KUB), Tilburg
- Does, Department of Medical Information and Statistics (RL), Maastricht

## 2: Questionnaire Scale Items

Chapters 5 and 7 have presented the operationalization of all variables that are measured by one item. The operationalization of the 'scale' variables that have been measured by more than one item are presented in the appendix. The operationalization of VAR 12 ( work-related culture) is given in Hofstede (1980: 419-422)
(* item study I; ** item study II; R = items were recoded in the data analysis)

**VAR 1: Human Resources**

De huidige personeelscapaciteit om het onderzoek met succes uit te voeren is ontoereikend (1-2-3-4-5) De huidige personeelscapaciteit om het onderzoek met succes uit te voeren is toereikend*

Het onderzoeksteam van de vakgroep is te klein om het huidige onderzoek met succes uit te voeren 1-2-3-4-5 Het onderzoeksteam is groot genoeg om het huidige onderzoek met succes uit te voeren

De vakgroep beschikt over een kwalititatief zwak onderzoeksteam (1-2-3-4-5) De vakgroep beschikt over een kwalitatief goed onderzoeksteam

**VAR 4-5: Time Research / Non-Research**

Hoeveel tijd heeft u het afgelopen kalenderjaar aan de volgende activiteiten besteed (totale werktijd is 100%?

| | |
|---|---|
| 1. onderzoek | ...% |
| 2. patientenzorg binnen de eigen instelling (academisch ziekenhuis)* | ...% |
| 3. patientenzorg buiten de eigen instelling* | ...% |
| 4. Onderwijs en training | ...% |
| 5. Bestuur en administratie | ...% |
| 6. Maatschappelijke dienstverlening (inclusief advieswerk)** | ...% |
| | ----- |
| | 100% |

**VAR 6: Capital Resources**

Het huidige budget van de vakgroep is ontoereikend om het onderzoek met succes uit te voeren (1-2-3-4-5) Het huidige budget van de vakgroep is toereikend om het onderzoek met succes uit te voeren

De vakgroep beschikt niet over een ruim vakgroepsfonds (bijvoobeeld vanuit de particuliere patiëntenzorg) dat voor onderzoek kan worden aangewend (1-2-3-4-5) De vakgroep beschikt over een ruim vakgroepfonds dat voor onderzoek kan worden aangewend*

**VAR 11 Innovative Climate**

In het algemeen heerst er een innovatieve sfeer en pioniersmentaliteit binnen de vakgroep (1-2-3-4-5) Er heerst een weinig innovatieve sfeer binnen de vakgroep (R)

Het onderzoek wordt door iedereen binnen de vakgroep met veel toewijding verricht (1-2-3-4-5) Het idee bestaat dat iedereen in de vakgroep alleen werkt om de kost te verdienen (R)

Aan bijna elk nieuw idee over onderzoek wordt gepast aandacht besteed (1-2-3-4-5) Aan zeer weinig nieuwe ideëen over onderzoek wordt gepaste aandacht besteed (R)

Nieuwe ideëen van junior stafleden worden even serious genomen als de ideëen van senior stafleden (1-2-3-4-5) Nieuwe ideëen worden alleen serieus genomen indien zij afkomstig zijn van senior stafleden (R)

In onze vakgroep worden zeer vaak onderzoeksbijeenkomsten gehouden (1-2-3-4-5) In onze vakgroep worden zeer zelden onderzoeksbijeenkomsten gehouden (R)

**VAR 12 Publication Climate**

In onze vakgroep komt iedereen aan onderzoek toe (1-2-3-4-5) In onze vakgroep komt niemand aan onderzoek toe (R)

In onze vakgroep worden iedereen aangemoedigd om onderzoek te publiceren (1-2-3-4-5) In onze vakgroep worden mensen niet aangemoedigd om onderzoek te publiceren (R)

In onze vakgroep wordt publiceren in internationale tijdschriften aangemoedigd (1-2-3-4-5) In onze vakgroep wordt publiceren in internationale tijdschriften niet aangemoedigd (R)

**VAR 14-15: Research Management**

Ik ben zeer tevreden met mijn directe supervisor m.b.t. zijn haar (...) (1-2-3-4-5) ontevreden met mijn directe supervisor m.b.t. zijn/haar (...):

**VAR 14: Craftsmanship Supervisor**

| | |
|---|---|
| professionele onderzoeksbekwaamheid (R) | 1 - 2 - 3 - 4 - 5 |
| kennis van het onderzoeksgebied waarop de vakgroep actief is (R) | 1 - 2 - 3 - 4 - 5 |

**VAR 15: Leadership Supervisor**

| | |
|---|---|
| persoonlijkheid en karakter (R) | 1 - 2 - 3 - 4 - 5 |
| leiderschapskwaliteiten (R) | 1 - 2 - 3 - 4 - 5 |
| de hoeveelheid onderzoek die hij/zij verricht (R) | 1 - 2 - 3 - 4 - 5 |
| ondersteuning van mijn onderzoek (R) | 1 - 2 - 3 - 4 - 5 |
| enthousiasme voor het onderzoek van de vakgroep (R) | 1 - 2 - 3 - 4 - 5 |

(supervisoren worden verzocht de bovenstaande vragen niet te beantwoorden)

**VAR 16: Motivation**

Ik ben liever een goede onderzoeker dan een goede arts*/docent** (1-2-3-4-5) Ik ben liever een goede arts*/docent** dan een goede onderzoeker (R)

In de vakgroep wordt onderzoek hoger gewaardeerd dan patiëntenzorg*/onderwijs** (1-2-3-4-5) In de vakgroep wordt patiëntenzorg*/onderwijs** hoger gewaardeerd dan onderzoek (R)

Mijn routine-patiëntenzorgtaken zijn interessanter dan mijn onderzoekstaken (1-2-3-4-5) Mijn onderzoekstaken zijn interessanter dan mijn routine-patiëntenzorgtaken * (R)

Ik verricht op vrijwillige basis meer overuren voor onderzoek dan voor routine-patiëntenzorg (1-2-3-4-5) Ik verricht op vrijwillige basis meer overwerk voor routine-patiëntenzorg dan voor onderzoek * (R)

Ik steek meer energie in mijn onderzoekstaken dan in mijn routine-patiëntenzorgtaken (1-2-3-4-5) Ik steek meer energie in mijn patiëntenzorgtaken dan in mijn onderzoekstaken* (R)

Ik heb de afgelopen maanden meer pogingen ondernomen om mijn onderzoeksprestaties te verbeteren dan mijn routine-patiëntenzorgprestaties (1-2-3-4-5) Ik heb de afgelopen maanden meer pogingen ondernomen om mijn patiëntenzorg te verbeteren dan mijn onderzoeksprestaties * (R)

**VAR 17: Expectation of Rewards (and Punishments)**

Als u **goede onderzoeksprestaties** levert, hoe waarschijnlijk is het dan dat (...)

1 = uitgesloten
2= vrij onwaarschijnlijk
3 = de kans dat dit gebeurt is 50%
4 = vrij waarschijnlijk
5 = vrijwel zeker

u waardering krijgt voor uw onderzoek
(bijvoorbeeld extra periodiek) 1 - 2 - 3 - 4 - 5

u promotie maakt in uw vakgroep (gesteld dat dit mogelijk is) 1 - 2 - 3 - 4 - 5

Als u **geen goede onderzoeksprestaties** levert, hoe waarschijnlijk is het dan dat:

u berispt wordt, of te horen krijgt dat u beter onderzoek moet
afleveren 1 - 2 - 3 - 4 - 5

uw kansen op een goede loopbaan in uw vakgroep afnemen 1 - 2 - 3 - 4 - 5

Als u uw **patientenzorgtaken*/onderwijstaken** **goed** uitvoert, hoe waarschijnlijk is het dan dat u:

waardering krijgt voor uw onderwijs
(bijvoorbeeld extra periodiek) 1 - 2 - 3 - 4 - 5

promotie maakt in uw vakgroep (gesteld dat dit mogelijk is) 1 - 2 - 3 - 4 - 5

Als u uw **routine-patiëntenzorgtaken niet goed** uitvoert, hoe waarschijnlijk is het dan dat u*:

berispt wordt, of te horen krijgt dat u beter werk moet afleveren 1 - 2 - 3 - 4 - 5

uw kansen op een goede loopbaan in uw vakgroep afnemen 1 - 2 - 3 - 4 - 5

**VAR 18-21: Communication**

Hoe vaak voert u inhoudelijke besprekingen over uw onderzoek met (...) 1-2-3-4-5

1 = dagelijks
2 = wekelijks
3 = maandelijks
4 = eens per kwartaal
5 = (minder dan) eens per jaar

**VAR 18: Within Unit Communication**

collega's van uw eigen vakgroep (R) 1 - 2 - 3 - 4 - 5
uw onderzoekssupervisor (R) 1 - 2 - 3 - 4 - 5

**VAR 19: Between Unit Communication**

collega's van Nederlandse medische*/
economische** vakgroepen (R) 1 - 2 - 3 - 4 - 5

collega's van buitenlandse medische*
/economische** vakgroepen (R) 1 - 2 - 3 - 4 - 5

**VAR 20: (Having) International Communication**

collega's van buitenlandse medische*
/economische** vakgroepen (R) 1 - 2 - 3 - 4 - 5

**VAR 21: Interdisciplinary Communication**

collega's van medische*/
economische** vakgroepen die actief zijn in
een ander onderzoeksgebied (R) 1 - 2 - 3 - 4 - 5

collega's van andere disciplines (bijvoorbeeld preklinische disciplines*
of wiskunde en gedragswetenschappen**) (R) 1 - 2 - 3 - 4 - 5

**VAR 20: (Stimulating) International Communication**

1 = volkomen mee oneens
3 = enigszins mee eens
5 = volkomen mee eens

Het bezoek aan internationale wetenschappelijke congressen
wordt binnen de vakgroep sterk gestimuleerd 1 - 2 - 3 - 4 - 5

Stafleden worden sterk gestimuleerd om gedurende lange tijd
in het buitenland onderzoek te doen 1 - 2 - 3 - 4 - 5

**VAR 23: Research Expenditures****

Onder onderzoeksuitgaven worden alle materiaal-, reis-, en personele kosten ten behoeve van uw onderzoek verstaan (uitgezonderd uw eigen bruto jaarsalaris)

Hoeveel heeft u persoonlijk het afgelopen kalenderjaar bij benadering uitgegeven (eerste, tweede en derde geldstroomonderzoek)

bruto jaarsalarissen student-assistenten* en ander
onderzoekspersoneel** fl .....

exploitatiekosten (druk- en portokosten, software, reiskosten) fl .....

*gemiddelde kosten per maand/eenheid student-assistent is fl 3250,--
**gemiddelde kosten per maand/eenheid onderzoeksassistent is fl 3850,--

Met hoeveel collega's uit uw eigen vakgroep deelt u de bovenstaande uitgaven?
(1 = 0; 2 = 1; 3 = 2; 4 = 3; 5 ≥ 4)

**VAR 24: Cash Flow Mix****

Hoeveel procent van uw totale onderzoeksuitgaven (=100%) is afkomstig uit de volgende financieringsbronnen?

de eerste geldstroom (rechtstreekse bijdrage van het Rijk aan de Faculteit) ...%

de tweede geldstroom (bijdrage van het Rijk aan de Faculteit via NWO: Ecozoek)? ...%

de derde geldstroom (bijdrage van de opdrachtgever, bijvoorbeeld contractonderzoek overheid of bedrijfsleven) ...%

**VAR 26-27: Organizational Culture**

Waar ik werk (...)

**VAR 26: Bureaucratic Culture****

spannen mensen zich zo weinig mogelijk in (1-2-3-4-5) doet iedereen altijd zijn/haar uiterste best

brengt elke dag nieuwe uitdagingen met zich mee (1-2-3-4-5) is elke dag zo'n beetje hetzelfde (R)

voelen mensen zich niet op hun gemak in onbekende situaties; ze proberen het nemen van risico's te vermijden (1-2-3-4-5) voelen mensen zich op hun gemak in onbekende situaties; ze vinden het niet erg om risico's te nemen

**VAR 27: Normative Culture****

ligt de grootste nadruk op het tegenmoetkomen aan de wensen van de opdrachtgever (bijvoorbeeld contract research) (1-2-3-4-5) ligt de grootste nadruk op het correct toepassen van de procedures (methodologie)

zijn juiste procedures (methoden) belangrijker dan resultaten (1-2-3-4-5) zijn resultaten belangrijker dan het volgen van juiste procedures (R)

houden we er hoge normen op na over de ethiek van het onderzoek, zelfs wanneer dit ten kosten zou gaan van resultaten op korte termijn (1-2-3-4-5) zijn we wat betreft ethiek en eerlijkheid in onderzoek eerder pragmatisch, niet dogmatisch (R)

**VAR 28: Individual Performance Index****

Hoeveel working papers (WPs) - bijvoorbeeld naar aanleiding van congresbijdragen - heeft u het afgelopen kalenderjaar geschreven? ..... WPs

Hoeveel artikelen (NTAs)heeft u het afgelopen kalenderjaar gepubliceerd in Nederlandse wetenschappelijke tijdschriften? ..... NTAs

Hoeveel artikelen (IJAs) heeft u het afgelopen kalenderjaar gepubliceerd in internationale wetenschappelijke tijdschriften? ..... IJAs

# Summary

Economies of atmosphere are defined as the joint, positive impact of a distinct set of values, (tacit) knowledge, and competences on the technical efficiency of a firm. The book is composed of three parts. The first Section (chapters 1-3) deals with the costs and benefits of atmosphere. In addition, it attempts to develop an economic rationale for atmosphere. Thus, it deals not only with the question whether atmosphere can affect costs and performance, but also why certain aspects of atmosphere would increase or decrease economic efficiency. These questions are explored with regard to the national and industry level and to the organizational level. The emphasis is on internal economies of atmosphere which are explored from various perspectives, including transaction cost economics, agency theory, and information economics.

When it can be demonstrated that there is an economic rationale for atmosphere, this does not imply that there is also empirical evidence for economies of atmosphere. The empirical Sections of this book (Sections II-III) are concerned with demonstrating empirical evidence. The impact of atmosphere on performance is compared with scale and scope in university research units. The university research unit is selected because it is a task environment where the central coordinating mechanism is generally conjectured to be atmosphere rather than (bureacratic) rules or (market) prices.

Section II (chapters 4-5) attempts to integrate three fields: (i) organizational theory providing a theoretical basis for the partitioning of the sample, (ii) organizational behavior supplying proxies of atmosphere (culture and climate measures), and (iii) university research management which provides scientometric measures of research output. Section III (chapters 6-8) reports the findings of two empirical studies. Study I explores economies of scale and atmosphere in clinical departments of university hospitals. Univariate and multivariate results are reported on the differential impact of scale, atmosphere, and other predictors such as input mix, management, control, and communication (chapter 6). Study II reports the findings of a study on the impact of scale, scope, and atmosphere on scientific performance in departments of economics (chapter 7). Both studies rely on large-scale, national performance evaluations which have used a variety of scientometric indicators. Comparing the predictor-criterion relations of study I (clinical medicine) and study II (economics) it appears that more than half of the predictor variables have a consistent impact

on scientific performance (chapter 8). Given the large variance between the scientific disciplines investigated here, the findings may therefore be conceived as fairly robust.

Three conclusions can be drawn from the empirical studies. First of all, although there is an economic rationale for atmosphere, economies of atmosphere have less impact than is generally believed. Second, it is the dynamic interplay between atmosphere and other sources of technical efficiency rather than atmosphere alone which accounts for the variance in performance. Third, economies of scale appear to be far more important than economies of atmosphere. Scale is a necessary, not a sufficient, condition for scientific performance. Units working with insufficient 'critical mass' are not expected to compensate their scale disadvantage by developing a superior atmosphere.

This study is a preformal attempt to explain the impact of atmosphere on (transaction) cost minimization and performance maximization. In addition, cross-section empirical evidence is given for the joint impact of scale, scope, and atmosphere on scientific performance. The final chapter (9) discusses the main shortcomings and strengths of this study. In addition, suggestions are given for continued research.

# Samenvatting

Deze studie sluit aan bij de recente belangstelling voor excellente ondernemingen, waarbij superieure financieel-economische prestaties worden toegeschreven aan kenmerken van de organisatie. In de economische literatuur worden verschillende bronnen van (technische) efficiency onderscheiden. In dit proefschrift staan schaalvoordelen (economies of scale), assortimentseffecten (economies of scope) en cultuureffecten (economies of atmosphere) centraal. Van 'economies of atmosphere' is sprake wanneer er kostenvoordelen uitgaan van de specifieke waarden, kennis (tacit knowledge) en competenties van organisatieleden. In het onderzoek staan de economische effecten van deze niet tastbare investeringen centraal.

Deze studie bestaat uit drie delen. In het analytische deel (Sectie I: hoofdstuk 1-3) wordt onderzocht of er een economische rationale bestaat voor de samenhang tussen cultuur en bedrijfseconomische prestaties. Definities van atmosfeer en efficiency worden gegeven in het eerste hoofdstuk. In de volgende hoofdstukken wordt ingegaan op economies of atmosphere op het nationale en bedrijfstakniveau (hoofdstuk 2) en op organisatieniveau (hoofdstuk 3). Het zwaartepunt ligt op het microniveau: de organisatie. Hierbij wordt gebruik gemaakt van de transactiekostenbenadering, de agency theorie en de informatie economie.

In de volgende delen (Sectie II-III) wordt vastgesteld of er empirische evidentie is voor economies of atmosphere. Hiervoor wordt gebruik gemaakt van een taxonomie die ontwikkeld is in de organisatie theorie (market-bureaucracy-clan) en van meetinstrumenten die ontwikkeld zijn in organisatie diagnoses (hoofdstuk 4). Voor de prestatiemetingen werd gebruik gemaakt van de grootschalige output- en impactmetingen verricht door de Raad voor Advies van het Wetenschapsbeleid en de Verkenningscommissie Economische Wetenschappen (hoofdstuk 5).

Het derde deel (hoofdstuk 6-9) beschrijft het onderzoeksdesign en de cross-sectie resultaten. Twee (multivariate) studies worden beschreven. Studie I vond plaats in Nederlandse academische ziekenhuizen onder vakgroepen die patiëntgebonden onderzoek verrichten (hoofdstuk 6). Dit onderzoek werd uitgevoerd in samenwerking met Y.W. Bally, R. Starmans, B.Breemhaar en F.J.N. Nijhuis. Studie II vond plaats in vakgroepen van Nederlandse Faculteiten der Economische Wetenschappen (hoofdstuk 7). De vergelijking tussen de bovengenoemde

sectoren geeft een indicatie van de robuustheid der bevindingen (hoofdstuk 8). Deze geven tevens een indicatie voor kwaliteitsverbetering in (enkele) bèta en gamma wetenschappen.

Op basis van de empirische gegevens kunnen een drietal conclusie worden getrokken. Ten eerste zijn cultuureffecten minder sterk dan de literatuur doorgaans suggereert. Zelfs in een taakomgeving waarin de productietechnologie relatief gunstig is voor het optreden van cultuureffecten (universitaire vakgroepen) zijn de effecten marginaal. Ten tweede worden wetenschappelijke prestaties niet uitsluitend bepaald door één (organisatie)kenmerk, maar door het samenspel van meerdere efficiencybronnen. Ten derde laat multivariate analyse van schaalvoordelen, assortimentseffecten en cultuureffecten zien, dat universitaire onderzoeksprestaties het meest gevoelig zijn voor schaalvoordelen. Het exploiteren van schaalvoordelen is een noodzakelijke, geen voldoende, voorwaarde voor het leveren van bovenmatige vakgroepsprestaties in de klinische geneeskunde en de economie.

Resumerend: in de eerste Sectie van dit proefschrift wordt getracht een economische rationale te ontwikkelen voor cultuureffecten. In Sectie II en III wordt vastgesteld of er empirische evidentie bestaat voor dit verschijnsel en worden de effecten op teamprestaties vergeleken met die van alternatieve efficiencybronnen. In het laatste hoofdstuk (9) wordt een samenvatting gegeven van de analytische en empirische bevindingen. Tevens worden de sterke en zwakke kanten van de studie beschreven en worden er suggesties gedaan voor toekomstig onderzoek.

# Curriculum Vitae

De auteur van dit proefschrift werd op 9 mei 1954 te Djakarta, Indonesië, geboren. Aan het Henric van Veldeke College te Maastricht werd in 1972 het HBS A diploma behaald. Tot 1976 studeerde hij beeldende kunsten aan de Stadsacademie te Maastricht en de Rietveld Academie te Amsterdam. In 1982 werd de studie Filosofie aan de Centrale Interfaculteit der Rijksuniversiteit Groningen afgesloten. In 1985 werd de studie Psychologie aan de Faculteit der Sociale Wetenschappen der Rijksuniversiteit Groningen afgesloten. Tijdens de studie werden assistentschappen vervuld aan de Rijksuniversiteit Groningen en de Technische Hogeschool Twente. In de periode 1982-85 was hij als wetenschappelijk medewerker/universitair docent werkzaam aan de Faculteit der Geneeskunde en de Faculteit der Gezondheidswetenschappen der Rijksuniversiteit Limburg. In de periode 1985-89 verrichtte hij promotie-onderzoek aan de Faculteit der Economische Wetenschappen der Rijksuniversiteit Limburg. Zijn postdoctorale scholing in de economie bestond, naast de éducation permanente binnen de Vakgroep Bedrijseconomie, ondermeer uit deelname aan cursussen van Bouma (grondslagen), Mintzberg (strategie en organisatie), Daems (industriële economie) Schreuder/Pennings (interne organisatie) en Hopwood/van de Poel (management accounting). In de periode november-december 1985 studeerde hij bij Triandis aan de University of Illinois te Champaign (U.S.A.). Vanaf 1986 voerde hij contract onderzoek uit - onder meer voor het Ministerie van O en W (kwaliteit patiëntgebonden onderzoek) en het Ministerie van WVC (kosteneffectiviteit intensive care units). In 1989 werd hij aangesteld als senior consultant bij Hay Management Consultants (Saatchi & Saatchi). Hij heeft daar een speciale verantwoordelijkheid voor de Europese markt voor intramurale gezondheidszorg.