ABSTRACT

This research draws from the fields of public management and economics to address one of the most important questions in the study of public service production: How efficiently do governments do what citizens want them to do? The project involves data collection and analysis to support three key objectives:

First, this work develops a valid model and measures of the influence of the behavior of public managers on the productive efficiency of local government agencies. Second, the conceptual model is applied to evaluation of a core government function: fire protection. With over 31,000 fire departments in the United States, more than 2 million fires annually, and an annual property loss approaching $10 billion, fire departments have received surprisingly little rigorous study.

Third, the empirical findings illuminate the viability of various administrative and policy options for the delivery of local public services. The fire service has recently come under a great deal of scrutiny from local government officials interested in improving management and developing cost-saving service delivery arrangements for emergency services. New options for fire departments include consolidation, combination workforces, new specialized technology, and even privatization. There is, however, little data or analysis available to inform these proposals.

This project contributes to public sector scholarship and practice by using both subjective and econometric research methods to reveal how environmental contingencies and managerial activities influence the cost of public services within a production function framework. It finds that environmental cost factors affect total expenditures on fire protection, both directly and indirectly through their influence on managers.

Evidence is revealed that chiefs perceive and respond to various pressures from within and outside of their departments, and that chiefs can be grouped into distinct categories according to the harshness of the production and management environment they face. Further, key administrative behaviors such as performance assessment, records management, and leadership style are demonstrated to affect the cost of fire protection to citizens. This work also yields suggestive findings about the cost effectiveness of various fire service resource choices, such as using volunteers and specialized equipment.

PUTTING OUT FIRES IN LOCAL GOVERNMENT:

MODELING AND MEASURING THE INFLUENCE OF MANAGERS ON PUBLIC PRODUCTION

WITH AN APPLICATION TO FIRE PROTECTION

by

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DISSERTATION

Submitted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy in Public Administration In the Graduate School of Syracuse University

August, 2000

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PREFACE

It is well known that a doctoral dissertation is an endurance event. This characterization describes particularly an author's experience, but is felt also by the author's family, friends, colleagues, and advisors. Certainly I would not have endured without the assistance, support, and guidance of a great number of people whose efforts helped both to move this project forward and to further my development as a scholar. This document is the cumulation of the consideration and contribution of many people who supported this effort in large ways and small, and I am grateful to them all. I would like to acknowledge a few by name.

Foremost, this project would never have come to fruition without the assistance of the fire chiefs and county fire coordinators in New York State who participated in this study –paid and volunteer professionals who took the time to complete written surveys in hope of further improving the quality of our nation's most dedicated and heroic profession. Several spent hours answering my questions in personal interviews, and to these I am especially grateful. In particular, I would like to thank Dennis Baron, Chief of the City of Cortland Fire Department and President of the Career Fire Chiefs' Association, without whose time and help this project would not have succeeded. In addition, I am grateful for the enthusiasm and support of John Button at the New York State Office of Fire Prevention and Control, Diana Robinson at the New York State Fire Academy Library, and Joseph Hilton, Jeffrey Madej, Steve Fountain, and Frank McCall at the New York State Comptroller's Office.

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CHAPTER ONE

INTRODUCTION

Fire departments are among the innumerable public agencies grappling with citizen demand to do more with less. Experiential evidence suggests that fire service missions are expanding disproportionately to available budgets (Bruegman, 1993; Hoetmer, 1996). As a result, local elected officials and fire service managers must strike a difficult balance between the quality and extent of the service they can provide and the financial burden they are politically willing and legally able to impose upon the consumers of fire protection. The service quality versus public cost dilemma is a particularly poignant set of tradeoffs in the fire service because of the inherent life safety issues. As Mikesell (1995: 252) points out, "A sticky problem occurs when public projects seek to reduce the loss of human life, as with...fire protection. Decisions can save or endanger lives: Life or death can rest on government allocation of resources to particular projects... Any decisions that deny resources to activities that have a lifesaving element have implicitly placed a value on life: They imply that the value is less than the cost of the rejected activity." To some extent, the life safety component of fire protection has shielded fire departments from the harsh scrutiny less glamorous public services must endure –citizens fear fire and are loath to circumscribe efforts to secure them from it. Recently, though, enhanced citizen awareness of the cost of fire protection, spurred by heated debates surrounding privatization and consolidation proposals around the country, has required fire service officials to defend the quality and justify the expense of their services.

Many local governments operate under a condition of fiscal stress: Even as constraints on public budgets tighten, citizen demand for public goods and services is growing –their expectations for more and better services are rising. In response, researchers and managers alike seek to measure the performance of public organizations, and to understand the causes of variation in performance, with a view toward enhancing the benefits derived from public resources. In short, we would like to understand how well governments translate resources into results, and whether productivity gains can be made in public organizations.

Both scholarship and practice in the field of public administration implicitly rest on the normative assumption that better government management leads to better public outcomes. It is the managers of organizations that provide public services who decide what resources to procure (at what levels and of what types) and how to deploy those resources, so managers logically seem to have a lot to do with public efficiency and effectiveness. Despite the intuitive appeal of this assertion –and its widespread acceptance and application– it has never been tested empirically. Thus, an important and unresolved issue central to the study of local government performance is how the actions of public managers and the nature of public organizations affect the quality, level, and cost of public services.

This dissertation seeks to give the normative assertion that management matters to performance positive purchase by making its ramifications for the production of public services conceptually explicit. It will accomplish this by asking three broad questions:

1. What is management?
2. How can management be operationalized in the context of public production?

3. How and why does management affect government performance levels?

To address these questions, this dissertation pursues the following strategy: It begins by evaluating the literature about local public production systems extant in the public management and public finance fields to identify the contributions of these fields to a common body of knowledge about the generation of public services and to reveal the open frontiers of this research terrain. It also defines management with regard to its decision-making functions within organizations, and develops a theoretical framework that specifies key aspects of management in operational terms. It then embarks on a multi-dimensional analysis of local public service organizations that evaluates the sufficiency of their structures and management systems to comprehend and meet citizen demand for a given level and quality of services.

This study argues that, despite compelling impetus to carefully specify the determinants of public performance levels, the role of public managers in public production has yet to be satisfactorily characterized or measured. This work therefore evaluates the influences on and impact of management in public production by pursuing two distinct lines of inquiry. First, management is considered from a subjective perspective through systematic analysis of how public managers perceive various influences in their organizational environments. This analysis is revelatory both of the rich context of managerial activity and of the power various independent influences have over managerial decision-making. A portion of the model developed in this study is therefore applied to examine how managers understand, evaluate, and respond to an array of pressures generated within and outside of their agencies. Following a line of research that seeks to systematically analyze the subjective characteristics of public managers values and priorities, systematic subjective analytical techniques are used here to typologize managers' perceptions of their decision-making environments.

The second avenue this work pursues is to consider managerial decisions and organizational characteristics objectively within an economic framework that represents the simultaneous determination of the demand for and production of public services. Here, the relationship between public management and government performance is examined by relaxing the usual economic assumption of perfectly efficient production technologies and explicitly including the ways in which the substance and processes of managerial decision-making and the structural characteristics of organizations affect public spending and outcomes. More specifically, this work develops and estimates a model of public service production that specifies how the characteristics of public organizations and the decisions of their managers influence the mix and deployment of human and physical capital that ultimately determine the quality and level of service a community enjoys. It does this by identifying fundamental dimensions of the nature of local government organizations and management raised by the field of public management and incorporating them into a refined version of the economic production/cost framework that others have developed.

The empirical vehicle for this study is the fire service in New York State, where fire protection is provided by the state's 1787 fire departments and 132,481 paid and volunteer firefighters (OFPC, 2000). The choice of the fire service as the object of academic study in the area of public production is compelling and worthwhile for several reasons. Fire protection is broadly accepted as a core public service –there is little equivocation that governments should ensure that this service is available to their citizens. Moreover, the fire problem is very widespread: About 2 million fires are reported in the United States each year, and direct property loss due to fires is estimated at $8.6 billion annually (NFDC, 1999). In 1997, there were over 59,000 fires in New York State (excluding New York City) causing an estimated loss of over $480 million (OFPC, 1999). As a result, the fire service, like other government services, has recently come under scrutiny with respect to the quality and cost effectiveness with which it is provided. In addition, fire departments are being called to provide more and different services. In fact, extinguishing fires is an ever smaller part of what fire departments do; they now spend most of their time engaged in other functions like providing medical aid, controlling spills of hazardous materials, handling terrorist threats, as well as supporting traditional community services such as marching in parades and getting cats out of trees.

The fire service also is a useful vehicle for analyzing public organizations and management in a production/cost framework because the production of fire protection involves an identifiable set of production processes. Essentially, in the vernacular of the profession, fire suppression comes down to "putting the wet stuff on the red stuff," which is accomplished using combinations of inputs (firefighters, trucks, and stations) to achieve a relatively well defined output (fire suppression) and outcome (community protection from loss of life and property due to fire). This description is overly simplistic –fire protection does involve a complex set of tasks and technologies, but it is a system that can be more clearly specified than other public services, suggesting that measuring the results of managerial activities may be more feasible for this service than for others.

In this light, research about the fire service is relevant to contemporary policy design because, despite the vast number of fire departments in the United States and the multi-billion dollar annual fire loss, the level of and influences on fire service efficiency and effectiveness are not well understood. Amazingly –the vital role fire departments play in communities throughout the nation and their amenability to study via production and cost models notwithstanding– fire departments have mostly been ignored in academic research. As a result, communities attempting to design optimal emergency services delivery systems do not have valid information on which to base their decisions. Similarly, fire departments do not understand what structural, managerial, or technological reforms will have the highest payoff in terms of better performance. This study can help rectify these weaknesses and improve fire protection decision-making.

Beyond its potential contribution to policymaking, this work is also theoretically useful because, while some factors that influence performance have been examined in limited ways for various local public services, a comprehensive model of government productivity has yet to be developed and tested. This project provides an opportunity to merge the perspectives and approaches of public economics and organization theory to better explain government behavior, and to add to the body of knowledge of both fields. Since this project aims to incorporate fundamental aspects of local government organizations and management into an economic production framework for public services, it stands with one foot planted firmly in each of two theoretically distinct, methodologically dissimilar fields of study: public management and public economics. The key advantage of a project that bridges these fields is the opportunity to capture the power each affords in the study of government performance. At once, public economics offers public management a well-established methodological framework for estimating the costs of public production, while public management offers economics insight into previously omitted factors of collective behavior that partially determine costs and outcomes, thereby helping to reduce bias and increase flexibility in existing estimation methods. In short, this study has great potential to enhance the ability of researchers and practitioners to understand the issue of ultimate interest in public service provision: how well government entities do what citizens want them to do.

This dissertation is organized as follows. Chapter 2 attempts to circumscribe the disparate body of knowledge surrounding public production systems. Chapter 3 then explores the fire service as a policy system and an empirical context. A theoretical model of the role of management in public production is developed in Chapter 4, and Chapter 5 presents the sampling procedure and data collection approaches. Next, in Chapters 6 and 7, empirical operationalization of this model is discussed, and two distinct research methods and sets of empirical findings are presented. Chapter 6 presents a subjective study that identifies and measures the influences managers perceive, and Chapter 7 specifies the functional forms implied by the model, and uses them to test the role of managers in the production system with regression analysis. Finally, Chapter 8 concludes the dissertation with a discussion of the theoretical and policy implications of the study.

CHAPTER TWO

A REVIEW OF THE LITERATURE ON PUBLIC PRODUCTION AND PUBLIC MANAGEMENT

The study of local public production revolves around two key questions: What goods and services should government provide (and at what quality and level), and how should it provide them? Positive theories of public production typically attempt to answer these questions by applying neoclassical economics in the context of government. Governments draft resources to generate public goods and services that are selected by a collective choice mechanism. The production of public goods and services is modeled using standard production functions whereby various factor inputs are marshaled via some specified technology to produce public outputs. Physical, social, and economic contingencies of the environment in which these outputs are deployed then ultimately determine the final nature of public outcomes.

Alternatively, the organizations that populate the public sector emerge as social units collectively activated to fulfill, but also to define, objectives held in common by several sets of actors, of which the citizenry is only one. Public organizations are thus conceptualized by organization theorists as dynamic entities with objectives beyond efficiently transacting in the market for public services. Public organizations, for example, take actions to ensure their survival, to meet the personal needs and desires of their members, and to uphold structures of values –in short, they operate strategically under political direction and executive guidance at the behest of a multitude of stakeholders to resolve multiple and conflicting objectives.

These divergent conceptualizations of the public production system reveal several fundamentally important dimensions for empirical examination. In particular, we would like to measure aggregate citizen demand for services to determine what government should produce and at what level. This challenge has prompted a long line of broadly accepted work that supports quantification of the appropriate level of public service outputs of a certain quality, or alternatively, of government spending. We would also like to be able to characterize and evaluate the technical nature of public production itself. This area of inquiry follows from work that argues that it is possible to identify optimality with regard to production possibilities and technologies, given environmental and factor cost constraints that are beyond the government's control. Furthermore, substantial prescriptive and descriptive work in the field of organization theory suggests that several dynamic structural dimensions of public organizations bear importantly on the nature of the public production process. Finally, classic bureaucratic theory and the emergent public management literature indicate that public managers serve important decision-making functions that shape the goals, strategies, and tactics public organizations pursue over time.

In short, the nexus between the public economics view of local service production and the characterization of public agencies provided by the fields of organization theory and management lies among an array of theoretical concepts that circumscribe how the creation of services in the public sector can be viewed and studied. While there are many complex aspects to the local public production system, this chapter will consider briefly four that seem most relevant, with a view toward establishing a foundation for the study at hand, and identifying gaps in the literature it may begin to fill. These areas are:

1. The justification for government activity, the character of markets for collective goods, and the complex nature of public outcomes.
2. The nature and estimation of citizen demand for public goods and services.
3. The unique organizational circumstances in which public production occurs and the role of management in public production.
4. The nature of effectiveness and efficiency in public organizations, and the standards and measures by which the performance of the public production system may be evaluated.

To elucidate these areas, the chapter is organized as follows. First, the nature of the production process and the unique challenges to the study of production posed by the case of public goods and services are presented. Next, the role of citizens, both as the consumers of public goods and as the voters that determine public budgets, is characterized and empirical efforts to evaluate their influence in the public production system are reviewed. In particular, the median voter model, on which much of the empirical work in this dissertation implicitly rests, is explained. Then, public organizations, as the locus of production tasks and technologies, are described, and some seminal views of public organizational behavior are presented. Next, approaches to evaluating the effectiveness of public organizations and the efficiency of public production processes are presented. Finally, the review turns to management as the vital set of decision processes on which the public production system centers and explains how management has been defined, characterized, and measured in several bodies of literature.

This chapter concludes that while several core elements of the public production system have received descriptive and analytical attention in a variety of literatures, disparities among theoretical constructs, methodological approaches, empirical measures, evaluation criteria, and policy foci have prevented these lines of inquiry from converging on and testing a general empirical model of the public service production system. This dissertation can thus be characterized as an effort to consolidate some of these lines of research into a theoretical framework that incorporates each key element, specifies the relationships among them, and permits these relationships to be tested empirically. The next chapter proposes this model.

2.1 The Nature of Public Production

Citizens' preferences about the outcomes of public policy are the philosophical standard against which public production is judged in a democracy. Governments respond to citizen desires by determining what public services they want, levying taxes to pay for them, and ultimately providing them. As Tiebout notes, though, a central problem of public finance theory is that "no market-type solution exists to determine the level of expenditures on public goods" (1956, 416). Understanding what determines the level of public services involves analysis of the citizen demand for public services, the political institutions that aggregate this demand and transmit it to public providers, the public spending that results, the service levels provided, and the outcomes voters seek. A central goal of local public finance research is to untangle the complex interrelationships between these dimensions with a view toward discovering the true preferences of voters, understanding how to satisfy voters efficiently, devising a concomitant tax system, and predicting the behavioral consequences of public policy.

According to the Musgraves' (1984) conceptualization, government activity is justified for a few purposes, among them allocation, which forms the core of public production. Allocation involves the shifting of purchasing power from private entities to government, on the grounds that there are occasions where public production provides more desirable results than private production, generally defined by circumstances where the market fails to produce efficiently. A special case of market failure relevant to this dissertation is that of public goods, characterized as being non-rival and non-excludable in consumption.[1] These qualities cause a problem of free-ridership: As soon as a public good is provided, individuals have an incentive not to reveal their true preferences for it, so that they may derive benefits from the good for which they do not pay. This problem of demand revelation means that choice mechanisms other than private market mechanisms must be used to decide how much of the good to produce, and thus government intervention in production is required. As intimated above, the main collective choice mechanism is political –citizens choose the level and type of services they will pay for through the binding decision of a vote. The government then collects funds for public goods from citizens via taxes and provides the goods at the chosen level. This allows Samuelson's (1954) condition for efficiency in the production of public goods to be met: social marginal benefit can be equated to social marginal cost.

Thus theoretically justified, it remains to characterize the results of government production activity. Unlike in private markets where clearly-defined goods are created and purchased by citizens who know what they are getting and how much they are paying for it, government production is often directed toward achieving less well-defined policy purposes, such as "improving the general welfare" or "making communities safe." These objectives are harder to formally specify and quantify than are private goods. Moreover,

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1 "Non-rival" means that one person's enjoyment of the good does not diminish another's. "Non-excludable" means that if the good is provided at all, it is either impossible or inefficient to prevent others from consuming it.

these policy results that citizens want are not necessarily the direct outputs of government production. This distinction between the goods and services government produces and the outcomes citizens demand was most notably conceptualized by Bradford, Malt, and Oates (1969).

Bradford, Malt, and Oates (1969) conceptualize public production as a two-stage process. In the first stage, resource inputs, I, are translated through a production function[2] into directly produced goods and services, which they term D-outputs, such that:

$$D = f(I) \qquad [2\text{-}1]$$

They explain that citizens are not primarily interested in D-outputs, however, but in the ultimate results or outcomes of government activities, which are influenced by exogenous socioeconomic factors, Z, of the environment in which these services are produced. These things citizens care about, called C-outputs, are captured in their individual utility functions along with the private goods they consume. In the second stage, then, the C-outputs are generated as a function of D-outputs and the nature of the environment in which they are consumed. As Ruggiero, Duncombe, and Miner explain, the overall process is appropriately represented by the public service production function which "shows the maximum level of services possible for various levels of discretionary inputs, holding environmental variables constant" (1995: 406), given as follows:

$$C = g\,[\,f(I), Z\,] = h\,(\,I, Z\,) \qquad [2\text{-}2]$$

[2] A production function is a mathematical equation that describes the relationship between the maximum attainable output, D, of a production process and a specific combination of inputs to (or factors of) production, known as the production technology, or the way in which the factors of production are associated. Typically production factors include labor, L, capital, K, and raw materials, M. Thus,

where the terms are as defined above. This production function provides the basis for analyzing the performance of a public production unit, if the factors of production, environmental contingencies, and desires of citizens (the C-outputs) can be defined.

2.2 The Demand for Public Services

This section focuses on how researchers have characterized citizen demand, the first hurdle along the road to understanding what determines public service levels. This section will first discuss the nature of individual demand for public goods and the mechanisms by which citizen preferences for public goods are registered and reconciled. Since conceptualization of demand turns on specifying and estimating a model of the process by which individual desires are translated into community demand, the discussion will then turn to models of public service demand and present the median voter model, the dominant contemporary estimation framework and the model assumed by this study. Finally, the discussion will acknowledge some of the limitations this model and, for completeness, identify departures from the median voter approach that appear in the literature.

2.2.1 The nature of the public market and collective choice

In a private competitive market, an efficient price- and quantity-setting mechanism operates whereby consumers' willingness to pay for a good and producers' willingness to provide it are completely transmitted by the market price such that the market clears. At the margin, the benefits derived from consumption of the good just

production functions have the general form: $D = f(L, K, M)$. Production functions will be discussed further in Chapter 4.

equal the costs incurred in its production. In the public setting, as in the private market, we would expect that an individual's demand for a public service depends on his income, the price of the service, the prices of alternative services, and his specific preferences. Thus, the conventional downward-sloping demand curve appropriately relates the "price" of public services to the quantity demanded. If it were possible to force consumers to reveal their preferences for a given public service and the cost to produce it were known, then the efficient amount to be produced could be calculated, and priced accordingly.

The price-setting mechanism for public services is, however, more abstract than in private markets. Public services are provided collectively so that, theoretically, the same quantity of each service is available for all citizens in a given jurisdiction to consume. Prices for public services depend on the tax system which determines each citizen's share of the total revenues needed to pay for a given service quantity. The price of an additional unit of a service that an individual voter faces is his tax price.[3] Since individuals face different tax prices, in addition to having different preferences and incomes, they have different demand for each service and across services. As mentioned above, these demands must be reconciled through some collective choice mechanism to determine what services will be provided in what quantities. Thus, estimating citizen demand for public services represents an important nexus between economic and political theory. As Ladd and Yinger note, "citizens' demand for public services reflects the same

[3] Following Ladd and Yinger (1989), a voter's tax price equals the resource cost of another unit of a public service multiplied by the voter's share, as established by the tax system. Other researchers define and calculate the tax price differently. Bergstrom and Goodman (1973) point out that voters' perceptions of their tax shares may be imprecise. In their estimation of demand, they treat individuals' perceived tax shares as independently distributed random variables with expected values equal to their actual tax shares. They show, however, that in large populations the independent errors in voters' perceptions cancel each other.

economic tradeoffs as the demand for private goods and services but is articulated in different ways" (1991, 216).

A prominent tool of collective compromise is majority voting, by which a process of pair-wise comparisons results in a victorious position that is selected by at least fifty percent plus one vote of total votes. As Fisher (1996) points out, this position is not chosen because a majority of voters prefer it, but because it is the only choice that could receive majority support. For a unique winner to exist under majority voting, the results of voting must be transitive.[4] This condition will be met if each voter's preferences are single-peaked,[5] which is consistent with a standard downward-sloping demand function for each voter. Majority voting also depends on selection among values quantifiable by a single, continuous, unidimensional parameter. Finally, pure majority voting requires that there is no agenda-setting involved –that is, all alternative values are equally available to receive support.

The key analytical characteristic of majority voting is that, under this selection method, a decisive median voter exists. That is, the voter whose preferences occupy the middle position in the distribution of preferences defines the winning coalition by voting with it, and the chosen alternative is the median of the desired outcomes of all voters. This attribute of majority voting is significant because, since the community votes as the person with the median income and tax share would, the median voter can be used to summarize community voting behavior.

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[4] Arrow (1951) demonstrated that if the results of voting were not transitive a paradox could result wherein no single result could gain majority support consistently.

[5] That is, each voter clearly prefers a single alternative and the strength of his preferences declines continuously with distance from that alternative.

Since the 1960's, the field of public finance struggled with how to explain local fiscal behavior. Early research into decisions about public services and tax rates attempted to explain variations in public expenditures as functions of the socioeconomic features of the population served and the level of intergovernmental aid.[6] Inman (1979) reports that these studies found a systematic relationship between local spending and a community's economic and demographic characteristics, but that these early approaches lacked a firm conceptual framework and depended on specifications that amounted to an *ad hoc* collection of variables. The likely trouble with the early multiple regression analyses was therefore that relevant variables were omitted, resulting in biased parameter estimates and incorrect conclusions about government fiscal behavior. The field of public finance advanced when researchers, following the work of Borcherding and Deacon (1972), Bergstrom and Goodman (1973) and others, began to focus on citizens' optimizing behavior and the rules for aggregating voter preferences by applying the median voter model to local government fiscal decision-making. Empirical constructs in which the median voter governs the community's demand for local services have dominated public finance research ever since.

The median voter model is a conceptual framework whereby community choices are explained in terms of the median individual's demand.[7] The model is based on neoclassical microeconomic theory, so the median voter's demand function is derived via an optimization process. Optimization occurs as the individual maximizes his

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[6] See Gramlich (1969) for a review.

[7] The median voter model is attributed to Bowen (1943), who conceptualized the budgetary choice process and proposed the assumptions on which the model is based, and Downs (1956), who applied economic theory to study of democratic institutions.

preferences for public and private goods and services, which are described by quasi-convex (to the origin) utility functions, subject to his budget constraint, which is composed of his income and the prices he faces. Price is given by tax share because citizens share the costs of public goods. As will be discussed below, the median voter model requires several strong assumptions to make it empirically operational. Nonetheless, the median voter model is appealing because it provides a positive framework for analyzing government behavior by making the link between individual demand functions and the community demand function explicit. As Inman proclaims, "In effect, we can bury politics in assumptions and use the *individual* utility maximizing model applied to the median income family to analyze *governmental* fiscal performance!" (1978: 46, emphasis in the original).

2.2.2 Assumptions and specification of the median voter model

In empirical applications, the median voter model is constrained in several ways described by Borcherding and Deacon (1972) and Bergstrom and Goodman (1973). First, analyses assume that governments provide a unitary, single-dimensional public service financed by a fixed tax structure that dictates each voter's tax share. The local government is the most common level of analysis because public service responsibilities are narrow, financing is less complex, and populations are more homogenous. Second, as mentioned above, voter preferences are single-peaked and voters are well informed and sincere. Voting is costless and is by majority rule. In most studies, all voters vote. Third, following Bergstrom and Goodman (1973), the median voter is defined as the voter with the median income. In studies where local property taxes are the revenue source, Bergstrom and Goodman have specified conditions under which this voter also has the median house value (key for the link to tax share). It follows from these assumptions that the output level for a given public service chosen by a community is that amount demanded by the voter with the median income and the median house value.

Two additional explanatory variables are usually included in the model. First, studies usually condition individual demand functions on a set of characteristics to control for probable systematic variation in voter preferences. Second, many approaches account for the impact of community population on the flow of public services of a given quality to citizens. Rubinfeld (1985) presents a common postulation of this function:

$$D_0 = D/N^g \qquad [2\text{-}3]$$

where D_0 = flow, D = observed output level, N = community population, and g is a constant between zero and unity. By incorporating a function like this into the model, researchers hope to measure congestion, or the degree to which consumption by one voter reduces its usefulness to others. A service is uncongested and a pure public good where $g = 0$ (an individual's consumption equals the entire flow of public services), a pure private good where $g = 1$ (an individual's consumption equals his per capita share of the good), or a mixed good where $0 \geq g \geq 1$. The value of g has been interpreted to indicate the degree to which gains from sharing the cost of public services exist in the face of the costs of crowding (Borcherding and Deacon, 1972; Bergstrom and Goodman, 1973).

The estimating equation for public service output demand is usually expressed in logarithmic form. Its general specification is:

$$\ln D = \beta_1 + \beta_2 \ln Y_m + \beta_3 \ln P_m + \beta_4 \ln N + \beta_5 \ln Z + \varepsilon \qquad [2\text{-}4]$$

where Y_m = the median income in the community, P_m = the tax price of the voter with the median house value (hopefully the same as the voter with the median income), and Z is the set of descriptive social and economic characteristics. In this form, the estimating equation yields three important parameter estimates: β_2 is the income elasticity of demand for the service, β_3 is the price elasticity of demand, and $\beta_4 = g(1 + \beta_3)$. Note also that the general form of the demand equation given by Equation 3 specifies a level of service output. Since public service output levels are difficult to measure, data are typically available only in terms of dollar expenditures. The link between service level and expenditure is cost per unit of services (Ladd and Yinger, 1991). The use of expenditures and measurement of costs each present problems that will be addressed below, but many authors assume that the expenditures of any municipality is an observation on the demand curve of the median income voter (Bergstrom and Goodman, 1973).

2.2.3 Applications and findings

The median voter framework has served as the point of departure for estimating government expenditure responses to citizen demand for local public services and for testing the hypothesis, articulated by Inman, that "governments will select their budgetary levels 'as if' to maximize the well-being of each jurisdiction's median income family" (1978, 46). Overall, public finance researchers appear to consider the model reasonable, useful, and convenient. Evidence consistently supports the model, though it is not always strong. Specification of the estimating equation and sample structure vary across studies, but most find income elasticities between 0.4 and 1.3 and price elasticities between –0.2 and –0.4 (Rubinfeld, 1985). A few key studies will be reviewed briefly to illustrate the consistencies and variations in specification, findings, and interpretation.

Borcherding and Deacon (1972) present one of the earliest applications of the median voter model to estimate the price and income elasticities of demand and the "publicness"[8] of the goods produced for eight public services using cross-sectional data aggregated at the state level. They use an estimation process similar to the general one described above, with per capita expenditure as the dependent variable. Their equations include public wage rates to proxy the marginal cost of public services via assumptions about the production function.[9] Also, they postulate that the median voter's demand function may be systematically related to either urbanization or land area or both, so they estimate four separate equations for each service. They find income elasticities between 0.2 and 1.0. They find negative price elasticities in many cases, but also frequently obtain positive values that are not statistically significant. Their results also show that inclusion of urbanization and land area variables did not have much affect on the parameter estimates for most services. Finally, most estimates of the degree of publicness are greater than unity.

Borcherding and Deacon conclude from their weak results on the price elasticities for some services that their measure of marginal cost is not a significant determinant of demand. They suggest that the presence of federal subsidies for these services may obscure the relationship between the tax price voters perceive and the true marginal cost of production. It may also be that their assumptions about the production function diverge too far from reality to permit reasonable calculation of the marginal costs of these services. This could be corrected to some extent by including non-labor inputs in

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8 "Publicness" is measured as the degree of divisibility in the consumption of a service, equivalent to *g* in equation 1 above.

9 They assume least cost production via a Cobb-Douglas constant returns function in which capital and labor are the only factors, both of which are available in perfectly elastic supply. Capital is perfectly mobile and its rental price is the same over all units, whereas labor is immobile and the wage rate can differ.

production cost calculations and by recognizing the possibility of variation in the quality of labor. Inclusion of costs in estimating equations is discussed further below.

Borcherding and Deacon find values greater than unity for the degree of divisibility in consumption obtained in this study puzzling. The authors use a device equivalent to Equation 2 above, so such values imply that the quantity of the public service captured by the median voter is much less than simply dividing the service equally amongst the population, as would be the case with a purely private good. The authors speculate that these results imply the existence of a form of coalition-building whereby a group positioned at the median has been able to secure the provision of services whose benefits accrue mostly to themselves, making collectivization efficient. This explanation is conjectural, especially given the arbitrary nature of the device used to measure publicness, but the results do demand model specifications that better address the interaction of political needs and economic realities. Some authors have made steps in this direction, as discussed below. An alternative interpretation of this result might be simply that diseconomies exist –that is, the costs of sharing certain public services outweigh the benefits of sharing the costs of these services.

A seminal and often-cited empirical application of the median voter model was published by Bergstrom and Goodman a year later, in 1973. They use multiple regression to estimate individual demand functions, and the form of their estimating equation is again similar to Equation 3 above. This study depends on data from 826 cities in ten states, aggregated at the state level. Overall, they find significant and positive income elasticities and significant and negative price elasticities. They also estimate a crowding parameter, akin to g in equation 2 above, for which they usually find values of one or greater. Finally, they include variables for the percent owner-occupied (for which they find a negative coefficient), employment-residential ratio (for which they find a positive effect), population change (for which the effect is negative), and percent of population over 65 (for which the coefficient is usually positive).

This study makes two important contributions to the literature. First, the authors carefully specify the assumptions sufficient to treat an observation on public expenditures as if it were the amount demanded by the voter with the median house value in the community. Second, the authors report results that lend strength to the median voter hypothesis and they offer useful, though untested, speculation about the effects they find. (In particular, they submit that citizens with high incomes are likely to vote for increased expenditures while low-income people would do the converse, which has implications for the level of public goods produced and the practicality of optimal allocation devices.) The details of their explanations will not be recounted here, but two points bear mention.

The first point concerns the issue of aggregation. Although the effects across states appeared similar, statistical test results did not support pooling the data across states. The authors suggest that better specification and measurement of the variables would permit pooled regressions. One source of variation that obstructs pooling is the likely variation in costs across states, on which public expenditures depend. In this model, the unit costs of public good are assumed to be the same in all communities, which is unlikely. Later studies attempt to account for variation in costs across locales.

A second point regards the finding in this study of values greater than unity for the crowding parameter, as Borcherding and Deacon (1972) found. From this, Bergstrom and Goodman conclude "that there appear to be no economies of scale to larger municipalities in the provision of public goods" (1973, 293). This raises the question of why these services are publicly provided, to which the authors propose the unsatisfactory explanation that scale economies to collective provision may exist for municipalities smaller than those included in their study. It would seem that if efficiency gains cease to exist as a municipality grows, communities would change their behavior, though inertia could result from weak signals about costs. It may instead be that other more powerful reasons for public provision than efficiency exist, such as fairness, equal access, the danger to democracy of placing coercive power in private hands or, following Niskanen's (1971) logic, the desire of bureaucrats to maximize their power and budgets. The role and motives of public officials in the budget-setting process has been addressed by Romer and Rosenthal (1979a, b).

A final example of a standard empirical application of the median voter framework is Inman's (1978) statistical test of the predictive validity of the hypothesis that the median income voter is decisive in budgetary politics. Inman adopts Bergman and Goodman's (1973) theorem, assumptions, and specification of a community's demand for local public services. Embedded in the specification is a "political shift term" that depends on the percent of a community's population in various subgroups, such that the median quantity demanded by a community equals the quantity demanded by the median voter times this term. Inman tests the hypothesis that the shift term equals one for each of 58 Long Island school districts. He finds that for most districts he cannot reject the null hypothesis that the shift term equals one and concludes that, within the confines of the Bergstrom-Goodman framework and acknowledging the constraints of his data, the median voter is generally 'as if' decisive in local school budgetary decisions.

Inman's results lend support to the usefulness of the median voter model in predicting local fiscal choices, but this piece is most valuable for his careful explanation and assessment of Bergstrom and Goodman's assumptions. Moreover, his concluding assertion that "politics becomes economics" (1978, 59) inappropriately discounts the influence of local political and bureaucratic institutions on budgetary outcomes. In fact, a main criticism of the median voter model is that other political theories better explain fiscal decision-making, though these do not offer the empirical purchase of the median vote model. Inman points the way toward other models himself with his evidence that the impact of voter participation on spending levels is tiny, from which he concludes that the only recourse for dissatisfied residents is to move. This suggests that other Tiebout-like approaches, where citizens express their demand by voting with their feet rather than with ballots, may lend important richness to assessments of public choice mechanisms.

2.2.4 Limitations of the median voter model

Public economists generally concur that the median voter model is a theoretically sensible and empirically convenient tool that produces consistent and useful results. The model is attractive because it permits social choices to be evaluated via the competitive behavior of a single individual. Furthermore, the model allows prediction of government spending outcomes, investigation of scale economies, and positive and normative evaluation of tax structures and expenditure levels. The model's constraints are stringent, however, which narrows the generalizability of results. This section addresses the most important and difficult limitations of the model and identifies research that has sought to escape these inhibitions.

Institutional factors. One of the most powerful criticisms levied against the median voter model is that public institutions are more complex than the assumption of pure majority voting allows. Even under direct democracy, it is well documented that bureaucrats alter decisions as they implement them, as discussed in a later section of this chapter. More often in the United States, voting is representative and elected officials respond to other pressures beyond voter demand, such as special interests, sources of campaign funds, patronage obligations, and their own desire for power. Structural dimensions, such as the form of government, and legislative constraints, such as tax and spending limits, further influence local budget decisions. Finally, the nature of politics makes the notion that governments behave as if to maximize the utility of an individual voter suspect. Some political science literature characterizes social choice as bargaining, not dominance. Finally, the incrementalist school of thought argues that expenditures are driven by small adjustments to preceding budgets.[10]

These criticisms stand in contrast to Inman's assertion that public service decision-making can be captured by modeling the behavior of a single individual and suggest that a better model of local fiscal decision-making would include the political actors, their resources, and the rules for collective compromise. Romer and Rosenthal (1979a), following Niskanen's (1971) notion that bureaucrats seek to maximize their budgets and have considerable power over the alternatives available to voters and legislators, develop an alternative model in which bureaus have monopoly power over the

[10] For discussion of incrementalism in administration, see Lindblom (1959). For discussion of incrementalism and the politics of the budgetary process, see Wildavsky (1975)

budget agenda.[11] The key finding under their agenda-setting model is that the level of expenditures depends on the reversion point.

Measuring output. As Inman (1979) points out, the conclusions that are drawn about the effect of fiscal policy on service output depend on how output is measured. Majority voting depends on a single commodity quantifiable by a continuous, unidimensional parameter (Fisher, 1996). Median voter models therefore typically use public expenditures as the dependent variable. While this measure meets the criteria necessary to operationalize the model, and is readily available, expenditures are really a measure of input, not of output. Moreover, a single input level may be consistent with a variety of service arrangements and combinations of outputs. The nature of public services, however, often makes it difficult to select meaningful, operational measures of output. The application of median voter models to local-level single-purpose governments helps this problem by narrowing the range of possible outputs.

Even operational measures of output would be troublesome, however, because they do not capture public service outcomes, which are what voters care about. As Bradford, Malt, and Oates (1969) conceptualize the problem, individual preferences are a function of the things of primary interest to citizens and of the level of other public goods and private consumption. In turn, as described above, what citizens care about depends on the services that are directly produced and environmental factors. Since expenditures

[11] Their framework is one of direct democracy referendum voting where, on a given ballot, voters can only choose between some institutionally defined reversion expenditure level and an expenditure proposal offered by the bureau. As in the median voter model, voting is by simple majority and voters seek to maximize their utility in trading off public expenditure and private consumption subject to their budget constraint. Voters choose between the budget proposal and the reversion level that option which maximizes their utility. The authors present various versions of their model among which the probability of voter turnout, the bureau's knowledge of voter preferences, and the number of elections possible in the budget process vary.

are determined by the service level multiplied by the cost per unit of services, to begin to address the criticism that expenditure levels do not equate to service outcomes a public service cost index is required to translate demand for outputs into demand for expenditures (Ladd and Yinger, 1991).

Influences on prices. A related problem is that equivalent expenditures do not translate to equivalent service levels. As Ladd and Yinger (1991) point out, resource costs, service responsibilities, and other environmental characteristics affect how much a city must spend to achieve a given service level. These vary across localities and over time. Similarly, the presence and structure of grants from higher levels of government and a community's ability to export its tax burden both influence the tax price facing voters. Thus, although the median voter's income and tax price are the two key explanatory variables for citizen demand and thus for public spending in the median voter model, factors influencing costs and prices must be controlled for by incorporating them into the model.

Ladd and Yinger (1991) use the median voter framework for an estimation process that accounts for several influences on public service costs and tax prices. Overall, they find that a city's resource and environmental costs have important influences on voters' tax prices and therefore the quality of services they demand. Cities do not, however, cut back much on service quality in the face of high costs; they raise taxes instead. Ladd and Yinger also find that the more a city can export its tax burdens to nonresidents, the higher the quality of its public services. Exportation of some taxes also has a flypaper effect. Finally, the greater a city's service responsibilities, the more it spends, though cities may be able to capture some economies of scope in service provision.

Ladd and Yinger's work represents an important step in estimating demand because it is able to capitalize on the power of the established median voter framework, but also accounts for a diverse array of important influences on city spending. Two difficulties arise as the median voter model is expanded in this way. The first is that while complex variations of the model gain accuracy, as more explanatory variables are included, it becomes harder to measure the magnitude of the effect of each variable. The second issue is the possible problem of endogeneity embedded in the model. It is possible that cities affect their own environments and that there is therefore feedback in the systems represented by median voter models, particularly those enhanced by inclusion of institutional, resource, and environmental cost variables. Usually, variables such as factor prices, grants-in-aid, the tax base, and population are assumed given. Inman (1979) points out, however, that changes in services levels may lead to future alterations in the socioeconomic composition of the community and ultimately of these "exogenous" variables. The importance and speed of such feedback is open to debate. Ladd and Yinger (1991) suggest that such effects are diminimous in the short term and, even in the long term, are small relative to national socioeconomic trends.

The nature of voting. Most empirical studies assume that all residents vote or that the tastes of non-voters are distributed identically to the tastes of voters. Hence, estimates of demand for the median voter are assumed to represent the aggregate demand of the entire community. There is evidence, however, that non-participation is correlated with income and therefore with demand, which would bias demand estimation upward.

Furthermore, aggregation of data for renters and homeowners implicitly assumes that renter and homeowner demands are the same. This is only likely if renters perceive that they face the same tax price as homeowners. If not, biased estimates of demand functions may again result. As Rubinfeld (1985) explains, the inclusion of percent renters as an explanatory variable does not solve this problem because it implies that renters and homeowners have the same price and income elasticities and that their demands are simply multiples of one another. Further confusion is introduced if voters do not vote their true preferences, but vote strategically or collude. One way to address the problem that patterns of demand are obscured by aggregation is to use micro-level data to estimate separately demand functions for different social and economic groups. Studies using micro-data have been done (for example, Gramlich and Rubinfeld; 1982), though they have not run separate regressions to compare these different socio-economic groups.

Spatial and temporal considerations. The median voter model overlooks the important influence of time on citizens' perceptions of costs and benefits. The practice of borrowing for public projects introduces disparities in preferences between the residents and politicians who benefit and those who pay. Thus, citizens may have different demands for public services that involve funding streams based on borrowing than for services financed from general or operating funds. The median voter model also ignores the reality that local governments impinge on one another to varying degrees. That is, communities typically are not isolated, self-sufficient entities, but part of a wide network of service providers. The lack or abundance of services in nearby communities is likely to influence a city's expenditure decisions. For example, voters may perceive that they can derive enough benefit from the positive externalities of a neighboring community that they do not demand similar services from their own local government. This suggests that a measure of a community's proximity to external services or demanders should be included in the model.

Other issues. Researchers must acknowledge three inherent truths of the median voter result that bear on the normative practicability of the demand functions it generates. The first is that the model ignores strength of preferences. The result of the majority voting process depends only on the order of voters' preferences. Second, the victory of a median position means that most voters will be dissatisfied with the result of the vote. Only the voter that occupies the median position will be perfectly satisfied. Third, the median voter result is unlikely to be economically efficient. Economic efficiency requires that the social marginal benefit (the sum of all individuals' marginal benefits) equal the social marginal cost. The median voter's desired amount, on the other hand, requires only that his benefit (the amount of services he receives) equal his cost (his tax price). These different criteria coincide only fortuitously.[12]

Departures from the median voter model. Evidence shows that the median voter model is a powerful framework for describing how governments respond to citizen demand and choose how much to spend to provide public services. It should be noted, however, that some authors doubt either the validity of the median voter model as a means of explaining local expenditure levels or the ways in which parameter estimates

[12] As Rubinfeld (1985) explains, economic efficiency is defined by Samuelson's (1954) condition that the sum of individual marginal rates of substitution equals the marginal rate of transformation, which means that an efficient solution requires that the preferences of the mean voter, not the median, determine the outcome of a majority vote. Only when the distribution of the marginal rates of substitution is symmetric is the median outcome efficient because then the mean and median outcomes are equivalent.

have been interpreted. For example, a study by Todó-Rovira (1991) reveals bias of local governments toward high-income individuals and argues that a major weakness of the median voter model is that it ignores individual heterogeneity. In this paper, Todó-Rovira estimates a model he proposes in earlier work in which public services provided are a weighted average of individual demands. He uses multiple regression to estimate a demand function for public expenditures for each of five services and for total local expenditures excluding education and public welfare and finds negative coefficients for the progressivity of taxes over all categories of services. He also finds a uniformly negative effect for the variance of income. From these results, he concludes that the available quantity of public goods is not likely to be either the median quantity demanded or the quantity demanded by the individual with the median income, but that governments aggregate demand in an income-weighted manner. He suggests that governments respond more to the preferences of high-income individuals in making budget decisions and offers the politically-driven explanation that "high income groups can '*deliver*' the largest number of votes and that politicians will cater to these groups to get the votes they '*control*'" (1991, 506).

This study is valuable as an alternative approach to median voter explanations of public spending. The results, if sound, are evidence that quantifiable parameters other than voter preferences can influence significantly the level of public services provided. Since local decision-makers have some control over some city characteristics, such as the nature of the tax structure, Todó-Rovira's results have important ramifications for the normative application of the positive results of expenditure studies. Nonetheless, despite some equivocation about the applicability of the median voter model, it has, under stiff constraints, has served as the dominant mechanism for estimating public demand on the basis of the neoclassical microeconomic approach of individual utility optimization and has permitted the field of public finance to draw some conclusions about what determines the level of local public services.

2.3 The Nature and Behavior of Public Organizations

Having established that citizens demand goods and services from governments, we now turn to exploration of how these collective economic goals are met. The mechanisms by which government employees are marshaled to generate the services citizens demand are public organizations. Organizations can be defined generically as "social entities that are goal directed, are designed as deliberately structured and coordinated activity systems, and are linked to the external environment" (Daft, 1998: 11). The precise nature and behavior of public organizations is addressed in broad and disparate literatures housed in the fields of sociology, psychology, economics, and political science, among others, and thus defies comprehensive review. Nonetheless, the definition cited above belies two key issues with respect to public production on which this section will focus: how organizations are structured and why they behave as they do.

This section also raises the question of organizational performance. The definition and explanation of the nature of organizational performance, and the assessment of the degree to which organizations perform effectively, persist as the thorniest theoretical dilemmas in the field of organization theory. One reason for this is that there is little agreement on how to characterize effective organizational performance –should it be in terms of goal attainment? Participant satisfaction? Organizational survival? In addition, even once a dimension of performance is chosen, the evaluation of effectiveness is problematic because measurement criteria and supporting metrics are not broadly established and agreed upon amongst organizational researchers. Finally, it bears mention that the dilemma of understanding performance in a rigorous and meaningful way is bound up with the debate over the differences between public and private organizations, so that efforts to develop a generic theoretical view of organizational effectiveness may crumble when the idiosyncrasies of sectoral context are considered.[13]

This section will present a few representative theories that illustrate the core of knowledge and thought about organizational structure and behavior with a view toward accomplishing two objectives: identifying important characteristics of organizations that should be included in an operational model of public production, and identifying limitations in the extant empirical study of how organizations influence policy performance. This discussion is organized as follows. It begins by exploring the concept of organizational structure, first in terms of its key dimensions and then with regard to explaining variation in structural features. Next, theories of organizational behavior are presented to help clarify the extent to which theorists consider organizational activity to be conducive to satisfying the economic needs of populations. Finally, propositions about the characteristics of effective organizations are enumerated, and their basis in empirical evidence is evaluated.

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[13] The public versus private debate concerns the extent to which all organizations are essentially similar along analytic dimensions (what Rainey, 1997, terms the "generic" tradition in organization theory) versus the extent to which the sector of society with which an organization is associated (in terms of its ownership and the types of services it provides) influences key characteristics. While this has been an important debate as has received considerable attention in the literature, it is tangential to the focus of this dissertation since all organizations under consideration are viewed as inherently providing a core public service. To the extent that research about private organizations informs the body of theory and evidence about public organizations, it will be cited here.

2.3.1 Organizational structure

The notion of structure forms much of the core conceptual basis for the study of organizations.[14] By structure, theorists refer to the arrangement of operational units within an organization, the allocation of power and discretion amongst these units, and the rules that govern the exercise of authority (Rainey, 1997; Hall, 1999; Daft, 1998). Structure lends coherence to the pursuit of collective action in several ways: It facilitates the accomplishment of primary work,[15] it induces individuals to conform their activities to the satisfaction of organizational objectives, and it bounds the terrain and population within which authority is exercised to concert action.

Empirical studies that evaluate the impact of various organizational forms indicate that organizational design –decision-making that defines structure– is directly relevant to policy outcomes. As Moe asserts, "choices about structure are implicitly choices about policy" (1990:127). Noll and Weingast elaborate: "political actors, in designing the administrative procedures of an agency and in selecting the problems which an agency's employees will be called to serve, create the set of normative values that an agency will seek to serve" (1987: 238). In other words, the way the components of an organization relate to one another influences the nature and results of organizational activity.

Research into structural forms of organizations initially gained momentum with Max Weber's (1947) theory of bureaucracy, which described in detail the components of

[14] Many definitions of the concept of organization make reference to structure. For example, Gulick (1937) asserts that "the theory of organization…has to do with the structure of coordination imposed upon the work-division units of an enterprise." Chandler and Plano define an organization as "a goal-seeking group of individuals who use a structure designed to help achieve its objectives" (1988: 216). Also, Daft's definition, quoted at the beginning of this section, refers explicitly to structure.

[15] Lynn (1987) explains that organizations have primary tasks that they must perform, else they will fail. These tasks are the source of legitimacy and meaning for the organization's employees.

an ideal-type organization designed for efficient, predictable operation. Later, Burns and Stalker (1961) and Hage (1965) developed typologies that included other structural forms. From these foundations, several streams of scholarship have converged on three main structural dimensions: complexity, formalization, and centralization (Rainey, 1997; Hall, 1999), each of which has received some descriptive empirical attention, as follows.

Complexity. Organizational complexity concerns the extent to which multiple hierarchical levels (termed vertical differentiation) and specialized sub-units (termed horizontal differentiation) exist within an organization. Many of the classic studies of complexity essentially involve counting units and other divisions to determine some level of complexity. For example, Blau and Schoenherr (1971) count sub-units, Strang and Baron (1990) count job titles, Pugh, Hickson, and Hinnings (1969) count job positions,[16] Meyer (1979) and Hage (1965) count individual occupational specialties, Rumelt (1974) counts departments, and Hall, Haas, and Johnson (1967) count organizational levels. Hall (1999) points out that various researchers have also distinguished geographic dispersion as an aspect of complexity, and some count the number of employees that work away from the headquarters office (Raphael, 1967).

Organizational complexity has consequences for the accomplishment of primary work. Frederick Taylor's experiments at Midvale (1894) and subsequent principles of scientific management (1911), Gulick and Urwick's (1937) science of administration, and Gilbreth's (1911) motion studies all reached conclusions about the positive value of specialization for efficient production. More recently, Jaques (1990) draws on several

[16] This study and that by Inkson, Pugh, and Hickson (1970) cited below are part of a three-part series of comparative studies across 52 English organizations about organizational structure and context

studies of organizations to assert that "Properly structured, hierarchy can release energy and creativity, rationalize productivity, and actually improve morale." On the other hand, that many of the federal government reform efforts under the rubric of the National Performance Review focus on reducing the depth and breadth of job titles in order to streamline federal bureaucracies demonstrates the common view that specialization and differentiation are not infinitely efficiency-enhancing. This is borne out in academic research. Blau and Schoenherr (1971), for example, measured complexity in 53 state agencies with over 1,000 local divisions, and provide evidence that higher levels of complexity make coordination of organizational resources and control of organizational activities more difficult.

Formalization. Formalization is, in essence, the means by which control over individual responses to contingencies is exerted. It is usually defined as the extent to which an organization's structural relationships and procedures are codified in written rules and regulations (Rainey, 1997), though they may also be established in unwritten behavioral norms (Hall, 1999). Empirically, some studies again rest on counting occurrences to evaluate organizations along this dimension. For example, Inkson, Pugh, and Hickson, (1970) assessed the extent to which organizations had written documentation of procedures. Blau and Schoenherr (1971) counted the number of words in civil service manuals, arguing that more words meant greater formalization.[17] On a different tack, Hage and Aiken (1969) measured formalization by asking employees

conducted by the Industrial Administration research Unit of the University of Aston in Birmingham during the 1960's.

[17] Blau and Schoenherr reported a mean of 18,400 and a standard deviation of 11,010 words, findings which correlated negatively with their measures of the degree of centralization. They conclude that

about their rule-following behavior. Rainey (1983), in a comparative analysis of public and private organizations, surveyed 175 middle managers, and found that public organizations experienced greater formalization.

Formalization guides activity, but its effects often are cast in a negative light; formal administrative rules and procedures are frequently disparaged as "red tape," or the morass of procedural restraints and requirements commonly associated with government activity. Despite their repugnance, formal procedures are acknowledged to have merit –as Dwight Waldo points out, "One man's red tape is another man's system" (1946:399). Bozeman, however, distinguishes between procedures that facilitate effectiveness and those that constitute red tape, "which entail a compliance burden for the organization but have no efficacy for the rules' functional object" (1993: 283). Some scholars have sought to operationalize and evaluate objectively levels of red tape and their consequences in detailed empirical studies. Baldwin (1990), Bozeman, Reed, and Scott (1992), and Bretschneider (1990), for example, reach similar conclusions that excessive rules constrain organizational flexibility. Oldham and Hackman (1981) surveyed 2,960 employees and found negative correlations between formalization and measures of employee satisfaction.

Centralization. Centralization refers to the locus of power and authority within an organization; the higher in the hierarchy power is concentrated, the more centralized the organization is said to be (Van de Ven and Ferry, 1980). The concept of centralization extends beyond simple decision-making activity, though, to include the issue of

formalization results in low centralization, a finding Price and Mueller (1986) note is not borne out in other literature.

discretion. As Hall (1999) points out, "If personnel at lower levels in the organization are making many decisions but the decisions are 'programmed' by organizational policies, a high degree of centralization remains." Empirical work focused directly on measuring the degree and independent effects of centralization in organizations is sparse, though normative arguments about the benefits of decentralized structures are frequently made. For example, Lilienthal (1944) argues that decentralization strengthens democracy on the basis of his experience with the Tennessee Valley Authority. Peters and Waterman advocate "simultaneous loose-tight properties" whereby firm central direction coexists with maximum individual autonomy (1982: 318). Osborne and Gaebler (1993) tout decentralization as the key to greater flexibility, responsiveness, effectiveness, innovation, and productivity.

2.3.2 Explanations for organizational structure

Many modern theorists have sought to explain why organizational structure varies. Two sets of answers to this question appear to emerge. Some theorists contend that the internal and external context of the organization drives its structure. Others focus on the strategic choices managers make about the design of their organizations. In practical terms, this is necessarily a blurry distinction. Strategic decision-making and contextual factors interact in complex ways, and are therefore difficult to isolate, even for purely expository purposes. Moreover, the direction of causality between strategy, setting, and structure is unclear. As Hall emphasizes, "organizational structures are a consequence of the simultaneous impact of multiple factors" (1999: 83). Moreover, structure is at once "constituted and constitutive" (Ranson, Hinings, and Greenwood, 1980: 3) in that it results from activities within and around the organization and also influences the nature of these activities. This section focuses on four factors that are important to understanding organizational structure. The issue of conscious strategic choice is left for the discussion of public management, below.

Size. Size is generally defined as the scale of operations in an organization (Price, 1972). Kimberly (1976) provides a helpful framework in which he refines this notion of size by specifying four dimensions to it: physical capacity, available personnel, discretionary financial assets, and volume of organizational outputs. There is some equivocation in the literature about whether these components are highly correlated, as Kimberly suggests, or whether they have divergent, independent impacts on structure (Price and Mueller, 1986). Moreover, while several studies have examined organizational size, their findings are difficult to evaluate comparatively because they use different conceptualizations and measures of size.

In general, organizational researchers seem to find that size and structure are positively related, though this relationship appears inconsistent across studies (Hall, Haas, and Johnson, 1967). Work flowing from the Aston Group, for example, indicates that as organizational size increases, complexity increases, and authority is less concentrated (see Pugh, Hickson, and Hinings, 1969, for example). Blau and Schoenherr (1971) in their study of 53 state agencies and Blau (1973) in his study of 115 universities use full-time personnel as a measure of size and find, like the Aston group, that complexity increases with size, though at a declining rate. Blau and his colleagues also claim that larger organizations enjoy economies of scale with respect to administrative functions, finding that as size increases, administrative overhead and intensity falls.[18] Other researchers are less confident that size determines structure. Aldrich (1972), for example, argues that size is endogenous, and that technology is the most significant influence on structure. Beyer and Trice (1979), in a study of federal agencies, discovered that size and differentiation are more highly correlated in agencies doing routine work than in those doing non-routine work, also suggesting that technology is a powerful explanatory factor for structure.

Work Processes. Organizational work processes are at the heart of public production. Work involves tasks (defined pieces of effort) and technology (sets of activities by which resources are systematically transformed). Many theorists posit a correlation between types of work processes and structural characteristics. One early benchmark set of work is Woodward's (1958, 1965) investigation of British industrial firms in which she found that various structural elements, including number of organizational levels, spans of control, and administrative overhead, depend powerfully on the nature of the technological approaches used in production. Moreover, Woodward concludes that organizational effectiveness is affected by the "fit" between an organization's technology and its structure.

Two seminal theories have been developed to characterize work processes, and much subsequent empirical investigation has drawn on these two frameworks. One is Thompson's (1967) categorization of the relationship between technology and structure

[18] Administrative overhead is the size of the component of the organization devoted to administrative activities. Administrative intensity is the extent to which an organization allocates resources to the management of output, rather than to the direct production of output, in activities such as coordinating the work of others or ensuring compliance with directives. For a more thorough discussion, see Price and Mueller (1986, Chapter 3).

according to the nature of interdependence among workers or organizational work units. Thompson describes three types of technology: "Pooled" or "mediated" technologies, where units incorporate sets of tasks and are fairly independent from one another, "long-linked" or "sequential" technologies that resemble assembly lines, and "intensive" or "reciprocal" technologies characterized by high interaction and mutual adjustment. Pooled technologies tend to be governed by standardized rules and procedures, whereas sequential technologies work better according to schedules and plans, and reciprocal technologies depend on continuous communication and close coordination. Tehrani, Montanari, and Carson (1990) conducted a meta-study of organizational structure based on Thompson's typology and found support for his propositions; interestingly, though, these associations were stronger in smaller organizations. Rainey (1997) also reports that Thompson's models aptly describe the progression of technologies adopted by the Social Security Administration and concomitant structural changes over time.

The second theoretical construct of note is Perrow's (1973) differentiation amongst work processes according to the frequency with which exceptions to normal procedures arise and the degree to which it is possible to analyze these exceptions rationally. On this basis, Perrow defines a continuum of technologies ranging from routine, where there are few exceptions and those that arise are readily analyzed, to non-routine, where many hard-to-analyze exceptions arise. Perrow suggests that routine technologies lend themselves to organizational structures that involve standardized rules and procedures and little delegation of discretion. Non-routine technologies, on the other hand, demand more flexible structures, with less standardization and less concentrated power.

Van de Ven, Delbeq, and Keonig (1976) found support for Perrow's proposals in their analysis of government agencies. Two oft-cited analyses, those by Hage and Aiken (1967) and Lawrence and Lorsch (1967), also find a positive correlation between the extent to which work processes are routine and the degree of formalization and centralization in organizations. Interestingly, Miller *et. al.* (1991) find this relationship in small organizations, but not in large ones. Like Tehrani, Montanari, and Carson's (1990) study cited above, the work of Miller *et. al* suggests that size and technology interact in their relationship with structure. This supposition is also borne out by Ouchi (1977), who finds that both size and the nature of tasks are related to the operational control mechanisms organizations employ. Moreover, as with the relationship between size and structure, the direction of causality between technology and structural characteristics is unclear: Glisson (1978), for example, argues that division of labor and formalization of procedures determine routinization.

Culture. An organization's culture is an aggregation of the behaviors and beliefs that underpin its activities. Much apart from the raft of faddish managerial prescriptions that hype cultural archetypes as objects of active emulation,[19] organizational culture is the object of a growing body of careful theoretical and empirical work that seeks to capture the influences on and patterns of shared values among members of organizations. Schein

[19] Culture is embedded in the lexicon of managerial prescriptions. As examples: Consulting firms frequently advertise their ability to facilitate cultural change in organizations. Peters and Waterman (1982) advocate a "culture of excellence." The Total Quality Management movement promotes a culture of "empowerment." Reinventing Government (Osborne and Gaebler, 1993) describe an "entrepreneurial" culture at length. Vice President Gore, following Philip Howard, supports a culture of "common sense" (1995). On this score, Edgar Schein notes in the preface to his book on organizational culture, "...many scholars and consultants wondered whether the use of culture as an explanation of various organizational phenomena was a fad that would wane once managers discovered that cultural manipulation was not as easy as they might have thought. But the faddish side of culture has not waned..." (1992: xi).

offers a comprehensive definition of culture as "A pattern of shared basic assumptions that the group has learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems" (1992: 12). This definition is instructive because it implies that culture is entangled with the structural dimensions and work behaviors of organizations, and that it is both emergent and influential with regard to organizational arrangements and work processes.

As a causal construct, culture is thought to affect people's preferences about organizational relationships. Empirical work about culture is difficult to encapsulate, however, because of its diversity and disparity –as Martin notes, "the literature remains theoretically unintegrated –in a state of conceptual chaos" (1002:v). Generally, recent studies have tended to focus on assessing cultural variation along an array of dimensions (see, for example, Wilkins, 1989; Hofstede, Neuijen, Ohayv, and Sanders, 1990; Schein, 1992). Some attempt to relate measures of culture to performance (Kotter and Heskett, 1992).

Perhaps the aspect of culture most germane to questions about public production is the issue of how members of organizations arrive at consensus about organizational goals and the extent to which these goals, and the means by which the organization will meet them, are clear or ambiguous. Schein (1992) describes development of consensus around clear goals as a key element of the organizational problem-solving cycle that comprises culture. He draws on case studies of two organizations to explain that shared assumptions about goals "concretize the mission and facilitate the decisions on means"

(1992: 56). In turn, consensus about means then generates regularity in terms of structural and work relationships that become inculcated as operational patterns. What is apparent from Schein's description is that the relationships between culture, goals, technology, and structure are complex, but that dissensus and ambiguity make it harder for organizations to make technological decisions. Schein also makes the important point that an organization's culture in large part emerges from the efforts of the organization to adapt to its external environment.

Environment. The external environment within which an organization operates is a vital consideration in the study of organizations because it generates the social and economic needs organizations arise to fulfill, embodies the resources that will be available to the organization, and mediates the impact the organization's activities or outputs will have on society. Most modern research programs about public organizations and production explicitly acknowledge the importance of the environment to organizational forms. For example, Chubb and Moe, in their seminal work on politics, markets, and schools, argue that "schools are largely explained by the types of environments that surround them. Different types of environments produce different types of schools" (1990: 19).

The recognition that organizational structures evolve through interaction between organizations and their external environments belies a conceptual perspective that has undergirded organizations theory since the mid-twentieth century, when biologist Ludwig von Bertalanffy (1968) put forth his general systems theory. The premise of systems theory is that "systems...are truly understandable only in terms of the interplay among their constituent systemic elements and their relationship with the larger environment"

(Harmon and Mayer, 1986). Much of early organization theory considered organizations as essentially closed systems (for example, Taylor, 1911; Barnard, 1948; and Simon, 1945). In closed systems, resources are presumed to be forthcoming to the organization, which is primarily concerned with establishing a stable and efficient internal equilibrium. More contemporary theory recognizes that organizations are realistically open systems, systems that continuously exchange energy with their surroundings. This perspective has given rise to three important concepts: "equifinality," which says that a given end state may be attained from an array of initial conditions and as the culmination of many distinct processes, "feedback," by which an organization's structure responds to signals "about the environment and about its own functioning in relation to the environment" (Katz and Kahn, 1978: 26), and "differentiation," or the process by which organizations develop specialized structures, throughput processes, and sub-systems for addressing unique complexities in their environments.[20]

On the foundation of the view that organizations interact with their environments, many researchers have studied the effects of environmental characteristics on organizational structure. For example, Emery and Trist (1963) use case analysis to extend systems theory and typologize what they term the "causal texture" of organizational environments, asserting that the more turbulent environments are, the more organizational forms become decentralized and complex. This type of theoretical framework gave life to an approach to organizational analysis known as contingency

[20] Katz and Kahn (1966) and Thompson (1967) are credited with translating the natural sciences view of open systems into a comprehensive theoretical framework and set of testable propositions for examination of organizations. Thomson articulated the argument that exposure to the environment prompts the development of organizational structure because organizations seek to remove as much uncertainly as possible from their technical cores.

theory. Contingency theory holds that "the best way to organize depends on the manner of the environment to which the organization must relate" (Scott, 1981: 89).

Two exemplar works give empirical traction to the contingency approach. Burns and Stalker (1961) looked at electronics firms and found that more dynamic environments demanded more flexible, decentralized organizational structures. Lawrence and Lorsch (1967) studied organizations in three industries and found that instability in the environment prompts high-performing organizations to adopt more differentiated structures. Over time, however, contingency theoretic propositions have proved difficult to establish consistently as contradictory results have emerged. For example, Hawley and Rogers (1974), Yarmolinsky (1975) and Rubin (1979) refute Burns and Stalker's (1961) findings, demonstrating that similar environments or technologies may lead to different structural outcomes.

Another criticism that has been leveled at the main stream systems and contingency analysts is their failure to identify the political and institutional influences of the environment that bear particularly on public organizations (Rainey, 1997; Perry and Kramer, 1983; Wamsley and Zald, 1973). To some extent, the advent of an "institutional" school of thought within the broad field of organization theory offers a general framework than can account for the particular nature of public organizations and may help explain the distinct, but common, organizational forms that arise in government settings. In its recent iteration, "new" institutionalism suggests that bureaucracies are socially constructed reflections of the "myths" of their institutional environments rather than of the demands of their work activities (Meyer and Rowan, 1991).[21] Meyer and Rowan elaborate: "The delegation of activities to the appropriate occupations is socially expected and often legally obligatory over and above any calculations of its efficiency" (1991: 44).

The implication of the presence of powerful institutional environments is that individual organizational structures may fulfill purposes that thwart efficiency to achieve other ends, such as legitimacy or survival. Moreover, organizations engaged in similar activities (participants in the same organizational "field") tend to become structurally similar ("isomorphic") in order to adhere to political mandates or social expectations, or to reduce uncertainty through mimicry, or in response to competition (DiMaggio and Powell, 1983; Powell and DiMaggio, 1991). Thus, appearance objectives supercedes performance goals as the structural influence. Moreover, an organization's primary work may itself reflect many other influences than service demands (Lynn, Heinrich, and Hill, 1999).

2.3.3 Organizational behavior

The discussion thus far demonstrates that organizations are dynamic systems, and thus emerge through an iterative decision-making process. Political economics explains how public organizations evolve based on the notion that they are endogenous –as Lynn, Heinrich, and Hill explain this view, "formal structures are dependent variables, the products of public choice" (1999: 8). Many theorists from the field of political economics have sought to explain why organizational actors are induced to take certain

[21] The term "myth" here refers to a prevailing ethos or lore about an organizational practice, which may be unrelated to evidence about the effectiveness of that practice.

actions. This section will consider three classic theoretical approaches to organizational behavior on which the field has traditionally drawn to disentangle the forces that drive organizational action and to identify operational components for study. These are: principal-agent theories, which center on dyadic exchange relationships, and resource dependence and transaction cost models, which involve competitive or cooperative alliances within and among organizations and between organizations and their environments. As each of these perspectives is not monolithic, but comprised of a host of sub-theories, the general thrust of each will be described with reference to a few exemplar theorists and applications. The implications of each approach for organizational performance also will be addressed.

Principal-Agent Theories. Principal-agent theories are an especially important set of conceptual and formal models because they generate prolific hypotheses that many scholars attempt to test. They developed out of economic research into relationships that facilitate risk sharing among individuals (Eisenhardt, 1989). Agency theory arose as a depiction of the relationship between two parties in which one contracts for or delegates work to the other, thereby relieving the former of the risks inherent in carrying out the work and the latter of the risk of responsibility for the profitability of the work (Arrow, 1985). Though originally formulated to describe interactions between private organizations, the most famous extension of this theory in a public organizational context is the set of formal models of bureaucracy originally developed by Niskanen (1971, 1975) that attempt to predict bureaucratic behavior under specific sets of assumptions about rational actors who endeavor to maximize their utility within dyadic exchange relationships. In Niskanen's model, the legislature is cast as a unitary principal who seeks to ensure that its agent, the self-interested budget-maximizing public bureaucracy, acts to fulfill the principal's policy goals.

The essence of efficient exchange defined by principal-agent relationships can thus be viewed from two organizational perspectives. On one hand, the principal's performance rests on the degree to which the agent is coerced or induced to fulfill the principal's goals and the cost that the principal incurs in exerting control over the agent's behavior via various mechanisms (such as monitoring, evaluation, or provision of incentives). On the other hand, the agent's performance rests on the degree to which it can derive maximum benefit from the relationship in terms of its own desires. It may do this in ways that subvert the principal's goals (and thus the principal organization's effectiveness) by shirking work responsibilities, misrepresenting (and thereby maximizing) the resources required for contract fulfillment, or overstating incentives that must be provided to motivate performance. Conversely, effective performance on the part of the agent may coincide with fulfilling the behavioral contract and achieving the outcome desired by the principal. Later theorists, most notably Hammond (1986, 1990), Moe (1984), and Bendor and Moe (1985) have given mathematical formulations to the model that permit empirical measures of these opposing dimensions of performance, such as size of budget, degree of oversight required, value of incentives provided, and attainment of policy outputs and outcomes.

Agency relationships present fundamental obstacles to achieving the maximum possible net level of effectiveness because there are several cases where the exchange may benefit one organization and not the other. Moreover, in most cases, principal-agent models demonstrate a bias against the principal's ability to be effective. For example, Miller and Moe (1983) point out that the dilemma of goal inconsistency or conflict can thwart the principal's success because the agent and principal may pursue divergent objectives. In addition, Knott (1993) notes that the principal typically lacks information about the agent's abilities, preferences, and behavior and therefore is constrained in its ability to ascertain whether the agent seeks to and actually has fulfilled the contractual relationship as understood by the principal, giving rise to two agency problems: "adverse selection" (resulting from imbalances in the perceptions of risk between the two organizations) and "moral hazard" (when the principal unknowingly induces the agent to work against the principal's goals). The principal must overcome these information asymmetries in order to choose the best agent, know whether the agent's behavior conforms to the principal's intent, configure incentives and sanctions that will induce the desired behavior on the part of the agent, and thereby achieve effective performance. These obstacles to performance are difficult for the principal to surmount, however, because it is too costly for the principal to fully specify and direct the actions of the agent, and instead provides broad behavioral guidance, leaving the agent to design operational details. In short, then, the obstacles to effectiveness inherent in agency relationships are both external (goal dissensus and political constraints) and internal (resource and information shortages).

In sum, the implication of agency models for production by public organizations is that relationships between policy-makers and bureaucracies are fundamentally troublesome because policy-makers lack information about public agencies' abilities, preferences, and behavior, which do not necessarily align with the principal's desires. The agency problem arises when policy-makers cannot fully specify and direct the actions of the agent, but instead provide broad guidance, leaving public organizations to design programmatic details. Agency theory thus focuses concern on how to control and direct bureaucracies to accomplish desired outcomes. As Lynn states, "Authoritative decision makers in the legislature, the courts, and numerous executive offices all vie for control over what governmental organizations do, how they do it, and the results they produce" (Lynn, 1996: 217-218). In most cases, sub-optimal outcomes are presumed to result in public production settings because public bureaucrats are self-interested and have no inherent incentive to pursue productive efficiency or to satisfy citizen preferences.

Principal-agent models have met with sharp criticism, largely because the predictive power of the models is very sensitive to changes in the character of assumptions involved, which are often untenable (Worsham, Eisner, and Ringquist, 1997). Terry Moe claims that the most serious difficulty of the postulated principal-agent relationships is that they portray government bureaucracies "as black boxes that mysteriously mediate between interests and outcomes." (1987: 475). Moe (1991) asserts further that institutional arrangements and organizational factors are of prime importance.[22] In short, the models' descriptive and explanatory power is diminished because the rich complexity within public agencies is ignored and bureaucracy is instead treated as a rational, homogenous monolith.

A variation on the principal-agent relationship that accounts for managers and employees would yield a more accurate and productive portrayal of bureaucratic behavior

[22] One important example of this is that institutional arrangements often incorporate multiple principles –the problem is not that public agencies lack direction, but that they are subject to direction from too many sources, and this direction is often inconsistent and conflicting.

and influence. Though agency theory does place the abilities, preferences, and actions of the agent center stage, these receive attention predominantly as obstacles to the principal's ability to achieve its objectives. Agency models focus on the principals, never subjectively on the agents. Thus agency studies imply that public managers obstruct elected officials' ability to meet citizen desires, rather than asking how managers' perceptions of their environment interact with the pursuit of the goals of elected officials. Incorporating the management variable is admittedly a tall order for agency theory, particularly in its form as a mathematical model, and will certainly complicate the empirical assessment and interpretation of principal-agent relationships. Nonetheless, it is ultimately necessary, and this study can contribute to this effort by developing a more sophisticated conceptualization of management and its role in the public policy process.

Resource dependence models. Resource dependence is another economics-based conceptualization of organizational behavior. The resource dependence model is primarily attributed to Aldrich and Pfeffer (1976) and Pfeffer and Salancik (1978). These scholars assume that no single organization is able to generate all of the resources it requires or to perform all functions necessary to sustain the organization. Organizations therefore must depend on other entities in their environments for some resources and functions, such as raw materials, finances, personnel, technology, and products and services. Organizational managers attempt to minimize the uncertainty associated with resource availability and to absorb the interdependence wrought by the organization's resource needs, making strategic decisions that permit the organization to both adapt to and manipulate the environment and the other organizations within it.

In the resource dependence model, effectiveness is defined as the extent to which the organization is able to choose from among alternative relationships with other organizations those which provide adequate and stable sources of resources. Effectiveness is constrained by distinct internal and external factors. Externally, the organization not only faces uncertain contingencies and competition from other organizations that threaten its ability to garner the resources it needs, but it must also operate within the broader legal, economic, and political norms and parameters that condition its relationships with other organizations. These limitations may reduce the amount and type of resources available or may refute some methods of obtaining them. Internally, the organization must grapple with structural and power arrangements that constrain and direct the process of decision-making. For example, organization policy and formalism may limit an organization's strategic and tactical flexibility. Dominant organizational sub-units may control the types of resources an organization seeks and may broker particular relationships with other organizations, limiting the range of an organization's activity and possibly causing it to make choices that are advantageous to certain powerful organizational elements, but are sub-optimal from an organization-wide perspective.

Empirical research based on this conceptualization tends to ask whether organizations are able to obtain the resources they need to sustain their activities. An early piece by Yutchman and Seashore (1967) conducted a survey of insurance companies by which they assessed factors assumed to be correlated with an organizations ability to exploit resources, such as business volume, derived statistically from measures of activities such as sales. Molnar and Rogers (1976) used 110 government agencies to study the levels of resource exchange between organizations (in terms of inflows and outflows of things such as equipment, funds, and personnel). They found inflow and outflow levels to be positively correlated, and concluded that more effective agencies were better able to establish resource exchange relationships with the organizations in their environments.

Transaction cost models. Transaction-cost economics describes another view of the exchange of goods and services first based on Coase's (1960) conceptualization of firm behavior and the evolution of hierarchy as a means of controlling resource allocations, and later developed in Barney and Ouchi's (1986) specification of the dimensions of organizational economics. The transaction-cost model was more precisely specified in the work of Williamson (1985). In this view, organizations are conceptualized as rational, opportunistic actors that enter into transactions in an essentially free marketplace. As markets are increasingly characterized by complexity and uncertainty, the trust and visibility on which organizational exchange relationship are founded become difficult to sustain and transactions become more costly as enhanced monitoring becomes necessary. To minimize their costs, organizations modify their relationships by subsuming as many transaction relationships as possible under hierarchical control that facilitates direct supervision, auditing, and other mechanisms to control deviations from an optimal exchange. At some point, however, empirical evidence shows that the internal obstacles to exchange within hierarchical systems may grow to exceed the costs that were inherent in interaction with the external marketplace (Eccles and White, 1988). As a result, organizations may select new relationships with resource providers via subcontracting or outsourcing (Lindberg, Campbell, and

Hollingsworth, 1991). Thus, the nature of effective performance shifts as transactions vacillate between intra- and interorganizational, though the key measurement criterion is cost minimization from the perspective of the subject organization in relation to others in the marketplace.

2.4 Evaluating the Performance of Public Organizations

The preceding discussion charts key aspects of the body of knowledge surrounding organizations. From this, we would like to be able to discern implications for performance. Two key indicators of government performance –the success with which with which governments use inputs to generate outputs and outcomes– are the efficiency and effectiveness of public decision-making units. As Hatry and Fisk (1992), Lovell (1993), and others point out, information about efficiency and effectiveness can support assessment of the efficacy of governmental fiscal policies, bolster development of improved production processes, and guide estimation of future resource needs. Analysis of performance can also enhance the accountability of bureaucrats and elected officials to their constituents by providing evidence about the degree to which public funds are utilized optimally. Finally, performance data can be used to test predictions of performance founded on economic or organizational rationales, enabling scholars to refine the body of theory that underpins our knowledge of government behavior. Thus, we would like to be able to identify and assess the ramifications of organizational structure and organizational behavior –and the interaction between these– for efficient production and effective outcomes.

These introductory comments rest on two related concepts: effectiveness and efficiency. These terms are often used interchangeably in the literature, but they are distinct. Effectiveness refers to the extent to which an organization is able to generate acceptable outcomes. As Pfeffer and Salancik clarify, "effectiveness is an *external* standard of how well an organization is meeting the demands of the various groups and organizations that are concerned with its activities" (1978: 11, emphasis in the original). Efficiency, on the other hand, is an *internal* standard that relates the level of resources used to the level of outputs produced. As such, efficiency is at the core of what managers, who have primary responsibility for coordinating organizational operations, are expected to accomplish.[23] A key component of the distinction between effectiveness and efficiency is the basis by which organizations are judged. Effectiveness, as Pfeffer and Salancik (1978) point out, is a sociopolitical question. That is, effectiveness concerns what organizations produce and whether they ought to produce it. Efficiency is an economic question; it ignores what organizations produce, and concerns only how well organizations produce what they produce.

The purpose of this section is to clarify these concepts, elaborate on their measurement, and discuss extant empirical findings. The discussion will begin by considering effectiveness and reviewing some approaches to assessing organizations against this criterion. Next, since this dissertation focuses on the influence of organizational factors and managers on public production processes, the remainder of this

[23] This is not to reestablish the politics-administration dichotomy of the classical public administration literature by suggesting that managers do not fill important explicit or implicit policy-making roles. Rather, the point is that much of management concerns causing an organization to work well –to choose, obtain, maintain, and deploy a mix of resources that is optimally suited to accomplishing public

section will be devoted to a more detailed discussion of efficiency, including a more precise definition, key measurement considerations, the unique challenges presented by the public sector case, some important approaches to measuring efficiency, and some significant applications and findings present in the literature. Finally, it will identify some possible causes of inefficiency in public organizations raised in economic literature and orient them around potential focuses of future research. This discussion will not present a comprehensive review of the public finance literature on public productivity; rather, it will draw on key studies to illustrate concepts and approaches, and to present critical findings.

2.4.1 Organizational effectiveness

Measuring organizational effectiveness is arduous because most approaches focus on the extent to which some form of policy goal or set of objectives is achieved –these constructs are notoriously vague, multiple, and conflicting, they are interpreted and prioritized differently by different actors, and they differentially affect a variety of constituents. As Milgrom and Roberts point out, "In the general sense, the value maximization criterion does not describe how organizations behave. Organizations then may serve a variety of conflicting individual interests, rather than maximizing a single overall organizational objective. This is particularly true of public organizations…" (1992: 50). The difficulty of goal- or objective- based measures of performance is further exacerbated by the fact that, even when goals are clearly identifiable, outcomes are

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aims. Indeed, most modern government reform efforts center on the issue of efficient government operation.

commonly confounded with environmental factors, as illustrated by Bradford, Malt, and Oates (1969) and others.

Innovation. One body of work that seeks to characterize organizational behavior that actively pursues performance improvements is the literature about innovation, a diverse set of theories and studies that captures a wide array of models of organizational flux, transformation, change, and reform. In general terms, most varieties of innovation theory focus on departures from existing ways of operating that alter the interactions between and the distribution of power among organizational sub-units. The issue of effective performance in this setting thus concerns the degree to which internal organizational structures, exchanges, and functions can adapt to the demands of the change.

The most common formulation of innovation theory is the classical diffusion model described by Rogers and Kim (1985). This model is comprised of four key components: the characteristics of the innovation, the nature of the communication channels which will convey the substance of the change, time, and the characteristics and responses of the sub-units that will be affected by the innovation (including individuals and groups within the organization or the larger system that is changing). Diffusion applies these components to describe the process by which approaches to problems and perceptions of innovations become uniform across the system (organizational sub-unit, organization, or industry) that is undergoing change. Diffusion theory interacts with the work of other scholars who develop its components. For example, Zaltman, Duncan, and Holbek (1973) provide a generic multidimensional, conceptualization of the attributes of innovation that affect their adoption and utility in organizations. Hage and Aiken (1970) identify key organizational characteristics and relationships that are correlated with high levels of innovation, such as highly decentralized power and low formalization.

Several theorists also conceptualize step-wise processes by which innovation is initiated, communicated, and implemented. Typically these change processes follow one of two forms: incremental or radical. As Meyer, Goes, and Brooks (1992) describe these processes, incremental change involves a series of continuous progressions that tend to leave broad organizational relationships intact by developing a new product or technology within one part of the organization through preexisting structures and management processes, whereas radical change transforms the entire organization dramatically and rapidly in terms of its structure, management processes, technology, and tasks. Where incremental change may be prompted by shifts in the organization's environment, the locus of the dynamic is internal organizational interactions. Radical innovation, on the other hand, is normally driven by turbulence in an organization's environment and has implications for both intra-organizational relationships and the organization's relationship with other organizations in terms of resource availability and product and service markets.

There are both external and internal obstacles to performance in the context of innovation. The dominant external challenge is the uncertainty that arises from environmental turbulence. Organizations confront new demands on systems for communications and transportation of resources that must occur in an ever-more highly linked and broader scale environment. Markets for resources and services are larger and barriers to exchange are fewer, but they are also faster-paced and less predictable. This turbulence is thus likely to thrust interorganizational relationships into flux and threaten the organization's ability to sustain them. Internally, the key obstacle to performance can similarly be described as instability. Several dimensions of intra-organizational relationships must maintain or regain equilibrium, including power structures, perceptions of roles, formal and informal communications systems, and work and administrative processes. In addition, instability often surfaces as obstructive behaviors such as resistance to change, which can quickly dampen an organization's ability to perform effectively.

The measurement of innovation in organizations typically has been approached through study of specific innovations and by asking employees to report their own willingness to innovate (Price and Mueller, 1986). Moch and Morse (1977) take the first approach and study the structural determinants of the use of new medical and administrative technologies in 485 hospitals, and find that adoption of innovations occurs more frequently in large, specialized, differentiated, decentralized hospitals, except when the innovations do not satisfy the interested of front-line decision-makers. Lewis-Beck (1977) uses a variant of the second approach to studying innovations. He uses informed observers in 32 Peruvian hospitals to report on the extent to which new equipment and techniques were used. He finds that influence over decisions is positively correlated with adoption and that hospitals in more "modern" settings had higher adoption levels.

Effective Organizations. The nature of effective organizations has, itself, also been the object of theoretical and empirical attention, but, as Rainey and Steinbauer note, "In the literature on organization theory, the topic of effectiveness is complex and inconclusive in certain ways, and it involves an unresolved diversity of models..." (1999: 9). One key trouble with studying effectiveness is that, as the literature reviewed above reveals, organizational performance levels are the product of complex interactions among a web of structural, behavioral, and environmental factors. As a result, many researchers have taken the approach of studying high performance after it has occurred with a view toward identifying the characteristics of successful organizations. For example, Gold (1982) examined ten successful organizations and found common characteristics among them. Peters and Waterman (1982) observed management in what they identified to be the sixty-two best-managed American companies, selected based on a set of performance and reputation indicators. They then summarize the common nature of these organizations and their management. Denhardt (1993) interviewed outstanding public administrators of the 1980's and distilled five management approaches. Riccucci chose six successful high-level federal bureaucrats; she provides and analyzes detailed profiles of each, and identifies "several ingredients to effective exeucratic performance" (1995: 228). In a similar vein, research into student and school performance has led several education researchers to identify several characteristics of effective schools on the basis of small sample case studies into high-performing schools.[24]

The case study tradition has yielded a rich view of individual cases of organizational behavior. Nonetheless, the accumulation of "success stories" about organizational effectiveness does not give us traction on the question of how we can recognize the preconditions for high performance when we encounter them. In other words, the theoretical challenge is how to make effectiveness *ex ante* rather than *ex post* by developing and testing predictive models of the organizational performance system.

[24] Some authors have done the service of consolidating the characteristics of effective organizations found in these many studies. See, in particular, Rainey and Steinbauer (1999) for a detailed review of the

Some authors have begun to consolidate finding about effective organizations into theoretical frameworks and sets of propositions. This is a helpful step. As Druckman, Singer, and Van Colt (1997) contend, "Research is more likely to address practical issues if it is guided by a conceptual framework that specifies relationships among the various influences on organizational performance" (quoted in Brewer and Selden, 1991: 1). Table 2-1 summarizes common claims about effective organizations and schools. What is notable in this exhibit is the high degree of congruence between these largely independent bodies of literature.

Researchers have begun to test the heretofore speculative propositions about effective organizations empirically using quantitative techniques and larger, more representative samples. For example, Brewer and Selden (2000) follow Rainey and Steinbauer in developing a model to predict organizational performance. They test their model using Merit Systems Protection Board data about employee perceptions of performance in the 23 largest federal agencies, and confirm some aspects of existing views of effective organizations. In particular, they find that various elements of organizational culture, including efficacy, teamwork, concern for the public interest, and protection of employees, are positively related to perceived organizational performance.

Two studies from the effective schools literature are also of particular note here. Zigarelli (1996) collapses the accumulation of effective schools propositions into six constructs, and tests the independent effects of each on student achievement. He uses data from the National Educational Longitudinal Study coupled with survey data for a

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literature on effective government organizations, and Purkey and Smith (1983) for a review of the literature on effective schools.

Table 2-1. Propositions About Effective Organizations and Schools.

Effective organizations attributes:*	Effective schools attributes:**
1. A clear mission.	1. Clear goals and a planned, purposeful program of courses that maximizes time devoted to academic learning.
2. Defined outcomes, a focus on results, and a competitive stance with respect to performance.	2. High expectations for student performance, rigorous standards, order, discipline, and homework.
3. A task design that incorporates both extrinsic and intrinsic recognition and rewards for performance.	3. School-wide recognition of academic success.
4. Consistent, sustained, effective leadership that has high autonomy.	4. Strong leadership by the principal and principal autonomy.
5. Empowered employees that participate in decision-making and operate in teams.	5. Collaborative planning and teacher participation in decision-making.
6. Communication with stakeholders, attentive and interested constituencies, and favorable public support.	6. Parental support and cooperation.
7. Emphasis on training and effective development and utilization of technology and human resources.	7. Quality teachers and school-wide staff skills development.
8. Supportive, delegative, and attentive oversight authorities.	8. District-level support.
9. Shared values and a sense of community.	9. Staff stability, teacher satisfaction, collegial relationships, and a sense of community.
10. Flexibility to adjust to new conditions and restructure processes to meet customer needs.	

* Adapted from Rainey and Steinbauer (1999), Popovich (1998), Hale (1996), Gold (1982)
** Adapted from Purkey and Smith (1983), Lezote (1989), Chubb and Moe (1990), Zigarelli (1996)

sample of many thousands of students, parents, teachers, and administrators. He identifies the most important characteristics of effective schools to be an achievement-oriented organizational culture, principal autonomy in personnel decisions, and high employee morale. He also finds no evidence that teacher empowerment, teacher quality, many principal management functions, and the quality of relations between the administration and the school matter to student achievement. Chubb and Moe (1988, 1990) attempt to explain why some schools achieve conditions conducive to efficiency while others do not. They appeal to and extend the effective schools and organization theory literature to test organizational and institutional differences between public and private schools. Their regression analysis rests on survey data from over 20,000 students, teachers, and administrators in a nationwide sample of about 500 schools. They find that private schools have simpler, less constraining environments, stronger leadership, clearer goals, stricter requirements, and more teacher participation, autonomy, and satisfaction than do public schools. They conclude that the commonplace array of political institutions of democratic control create a context within which public schools are driven to adopt structures that are overly bureaucratic, inefficient, and stifling to student achievement.

2.4.2 Productive efficiency

A body of literature has developed around techniques for evaluating the economic performance of governmental decision-making units, prompted by the perception that public sector performance lags that of the private sector. The basis for these analyses is the measurement of technical and cost efficiency, which, in turn, rest on the properties of the public production process. In evaluating public production, two questions of interest to researchers, managers, and voters are whether governments utilize factor inputs optimally and whether governments produce services as cheaply as possible, given the demands of voters and environmental factors. If not, we would like to be able to identify and quantify the causes of sub-optimal performance that public decision-makers can control, while accounting for those they cannot.

Productivity, as a measure of the relative amounts of output and input involved in a given production process, is a helpful means for comparison across production units. A more useful measure of a certain unit's performance, however, is given by the notion of efficiency, which is the difference between observed and optimal values of a unit's output and input. While the field of economics distinguishes several types of efficiency, two are of particular utility in assessing productive performance: economic efficiency and technical efficiency. In the former case, the optimum is defined in terms of the behavioral goal of the production unit. Economic performance is then measured by comparing the observed and optimum levels of the goal, in terms such as cost, revenue, or profit, subject to the relevant constraints, such as quantities or prices (Lovell, 1993).

Technical efficiency is more narrowly focused on optimality with regard to production possibilities and has been the basis for many recent studies of the performance of individual decision-making units. Koopmans (1951) defined technical efficiency as the condition where, for any combination of inputs, a production unit cannot produce more of any output, holding all other outputs constant. Alternatively, for any combination of outputs, a technically efficient unit cannot use less of any input, holding all other inputs constant. The pioneering work on technical efficiency was done by Farrell (1957) who, following the work of Debreu (1951) and Koopmans (1951), developed an index of technical efficiency that compares inefficient and efficient production units by measuring "the maximum equiproportional reduction in all inputs consistent with equivalent production of observed output levels" (Ruggiero, Duncombe, and Miner, 1995: 404).

Some scholars, prominently Färe and Lovell (1978), have noted weaknesses in Farrell's measure, such as its dependence on restrictive assumptions that limit its application and the dual nature of its interpretation (as either the ratio of minimal to actual inputs or of actual to maximal outputs) that can lead to different inferences, and have introduced modified measures of technical efficiency. Others have pointed out that, since equiproportional reductions may not take up all of the slack[25] in all inputs, the Farrell index does not necessarily measure efficiency as Koopmans defined it (Ruggiero, Duncombe, and Miner, 1995). Nonetheless, scholars acknowledge that "virtually all subsequent work on technical efficiency is based to some extent on Farrell's seminal work" (Färe and Lovell, 1978: 151).

As Blanchard and Duncombe (1997) point out, however, technical efficiency does not ensure that output levels are achieved at the lowest possible cost. Technical efficiency ignores relative resource prices and thus a technically inefficient unit could spend less than a technically efficient unit by using a cheaper mix of production factors. Using Farrell's conception, all technically efficient production methods for a given level of output can be represented as an isoquant, the slope of which is the marginal rate of technical substitution among the factors of production, typically capital and labor. When considered in conjunction with knowledge of the market prices of the factors of

[25] According to Bessent and Bessent, slack is "the amount by which an input could be reduced with no associated reduction in output if the unit being evaluated were as efficient as the most efficient unit or units in the set of units being compared" (1980: 63). In mathematical programming, slack inputs are those not fully utilized in the solution when the constraints have been satisfied. Thus, in general terms, slack implies the presence of excess resources.

production, represented as an isocost line in the case involving two factors, the least cost production method can be found when the output produced per dollar of one input equals the output produced per dollar of all other inputs, or the point at which the isoquant is just tangent to the isocost line. If this condition does not hold, production costs can be reduced, or production levels increased, by reallocating inputs. Thus, cost efficiency occurs when there is no way to combine inputs to produce the same output at lower cost given relative resource prices, and provides the most comprehensive measure of productivity (Blanchard and Duncombe, 1997).

In summary, then, productivity varies as a result of differences in production technology, the environment in which production occurs, and the efficiency of the production process (Lovell, 1993). While the larger issue of how a government's overall expenditures are associated with outcomes is important, the question of particular interest when analyzing the generation of public services is whether and how the individual decision-making units can improve their levels of productivity. The answer generally depends on what the contribution of each of these determinants to the level of productivity is and on the extent to which the decision-making unit can alter these components. That is, if the level of productivity is sensitive to the choice of technology, the government may be able to realize gains in outcomes by altering the way in which services are produced. On the other hand, if the government faces harsh environmental constraints, it may be able to do little to improve its outcomes even if it can choose a better technology or enhance its efficiency.

Some theorists, most notably Baumol (1967), assert that governments can do little to change their production technology. That is, public services tend to be inherently labor-intensive. For example, it is difficult to replace medics, teachers, or park rangers with machines, and thus public production technologies are generally static. Baumol's claim does not, however, preclude the possibility of improvement in the quality of public services, nor does it imply that improvements do not involve technical advances –a fire engine today is much more sophisticated than a fire engine of 1920 and allows its crew of firefighters to accomplish a wider range of more complex tasks.[26] Bradford, Malt, and Oates (1969) assert, though, that technical advances in the public sector often do not offer large cost savings. This is because the public sector must rely heavily on labor –fire suppression still depends to a large extent on firefighters, even as they employ ever more advanced and expensive equipment. In effect, more sophisticated technology increases quality, but rising wages translate into higher public spending when governments cannot offset the increasing cost of labor with gains in productivity through cost-saving technological improvements. As Bradford, Malt, and Oates conclude, the effect Baumol's hypothesized constraints on public production is that "increasing expenditures appears to be the price of simply standing still" (1969: 202).

Some authors explicitly recognize the role of discretion in productivity and distinguish between the determinants of productivity that governments control and those they do not. For example, following Bradford, Malt, and Oates (1969), Ruggiero, Duncombe, and Miner (1995) develop a model of public production in which they distinguish between discretionary and fixed inputs. Then, public production units are evaluated only in terms of the input levels they can determine by controlling for variation in the favorability of the environments they face. That is, when these authors estimate

[26] Today's moves toward electronic commerce may pose a striking counter to Baumol's assertions.

the efficiency of a given unit, that unit is compared only with other units that face at least as harsh a production environment. This approach explicitly acknowledges the fact that, even with identical input mixes, public decision-making units confronting harsh environments may not be able to produce outcomes as positive as those facing more benign environments.

Given that public production environments are essentially fixed and technology is constrained, the place where governments may be able to act to improve productivity is through improving managerial efficiency. To reveal this potential, it is necessary to quantify the components of the public production process, including inputs, outputs, and outcomes, as well as environmental characteristics, measurement of each of which presents challenges. The following sections address the dimensions and techniques of the measurement of efficiency to serve as a foundation for understanding how managers may influence it.

2.4.3 Measurement considerations

As has already been intimated, public production poses important measurement challenges. As Levin laments, "In the production of government services, outputs are often diffuse, incentives are demonstrably unrelated to productivity, production functions are uncertain, and standard operating procedures reign supreme" (1997: 304). Expanding on this sentiment, three key considerations underpin any measurement effort that surfaces in the literature. The first point is that objects of measurement must be clearly identified. This criterion is particularly troublesome in the case of public services, where it can be difficult to distinguish between what governments do and what citizens care about. Making this distinction is crucial, though, because, as Bradford, Malt, and Oates (1969) note, the data required to measure the direct outputs of government activities may not be relevant to measuring the outcomes of concern to citizens. Moreover, the trends in the productivity of these two types of output may be very different. That is, if a city's environment becomes less favorable to service outcomes, a government may be able to continue at its current level of cost and technical efficiency with respect to direct outputs, but might find the results citizens desire much harder to attain.

The second consideration in measuring the productivity and technical efficiency of public services is that the objects of measurement must be carefully specified. As Färe and Lovell note, "if the notion of technical efficiency is to have empirical context, it must be based on a proper measure, or index, of the technical efficiency of a production unit" (1978: 150). As will be discussed below, several types of indices have been developed, but each rests on the quantification units of inputs and outputs in a way that is operational.

Inputs are somewhat easier to quantify than outputs because they are discreet factors, such as people or trucks, and they have prices that are generally known. The main difficulty of measuring inputs arises in deciding how the overall level of each input ought to be allocated across the multiple outputs to which it could contribute. If the choice of inputs excludes or undervalues those that are most important, if these inputs have an inconsistent influence on outcomes, or if there are high correlations among them, statistical estimates will be of limited utility (Hanushek, 1986). When prices are used to measure quantity of input, researchers confront the additional problem of how to attribute costs borne over periods of time that do not coincide with the time during which services are produced. Thus, accurate allocation of input prices can be difficult, which makes analyses that do not depend on monetary standards attractive for public sector applications (Ruggiero, Duncombe, and Miner, 1995). Furthermore, Hanushek (1986) points out that most measures of inputs are contemporaneous, so, for cumulative processes such as education, the estimated effect of inputs is likely to be biased.

The greater measurement challenge, however, comes in quantifying outputs. Many authors note that this task is especially arduous in the public, rather than the private, sector because pricing mechanisms that register the value of particular outputs rarely exist (Hatry and Fisk, 1992; Duncombe and Yinger, 1997; and others). Often bundles of inputs are used as numerical surrogates for outputs, such as the use of "equivalent teacher hours" in education finance research (Blanchard and Duncombe, 1997). Similarly, the amount of spending is frequently used to reflect government services. Interpretation of results based on these proxies is ambiguous, however, unless measures account for service quality, productive efficiency, and environmental costs (Hanushek, 1986; Ruggiero, Duncombe, and Miner, 1995; and Duncombe and Yinger, 1997). Moreover, these measures are unsatisfying because it is not always clear that they capture a significant portion of an organization's activity or that they relate directly to the amount and quality of final organizational outputs (Hatry and Fisk, 1992).

Some governmental services are uniquely difficult to measure because they involve prevention activities, such as fire, disease, or crime prevention. In these cases, only the incidence of *non*-prevention is directly observable; the level of prevention is hard to discern. For example, the number of fires, cases of illness, or crimes that occur can be counted, but those events that do not occur because the fire department prevented them are difficult to distinguish empirically from those that did not occur for other reasons. Proxies, such as number of building inspections or educational programs conducted, are often used to represent prevention outputs, but the relationship between the proxy and the result is hard to specify (Hatry and Fisk, 1992). While it seems unthinkable (and politically untenable) to withhold a public service in order to measure the baseline incidence level of a preventable event, this technique is often used in the evaluation of the effectiveness of drugs through placebo studies. This approach is sometimes approximated for services such as public safety by measuring incidence before and after the intervention of a prevention program or across communities that differ only in the presence or absence of a prevention program. While such data are frequently reported by governments –witness, for example, the proclaimed success of gun control programs in New York City– the rigor of these studies is questionable, and parallel academic studies of productivity are rare in the field of public finance.

The third consideration in measuring public performance is the requirement to account for key factors that affect comparability across units and across time. Hatry and Fisk (1992) note that public services may appear the same along many descriptive dimensions, such as type of service, number of clients served, or method of delivery, but may vary in quality, such as timeliness. Also, as Bradford, Malt, and Oates (1969) point out, the quality of public services changes over time, so that a heart attack victim might receive better care today that he would have ten years ago, even with essentially the same mechanism of service delivery.

Finally, as mentioned above, many authors point out that public service levels vary with the physical and socioeconomic characteristics of the environment in which services are produced and consumed. Thus, for example, the fire suppression efforts of two identical fire companies will vary according to factors such as the average age, construction, and height of the buildings they protect. Environmental considerations also extend to the more subtle effects of urban versus rural settings, such as the possibilities for economies of agglomeration and the likelihood of congestion. In the end, it can be difficult to discern whether output levels vary because of differences in quality or environmental constraints, and, while most recent studies attempt to control for these circumstances, bias may result if important factors are omitted.

2.4.4 Efficiency measurement techniques

Despite the plethora of measurement dilemmas that plague research into public production, several sets of techniques have been developed to evaluate performance. This section will not present an exhaustive or technical discussion of these procedures, but will highlight three key approaches and their strengths and weaknesses.

One possible set of methods is the range of econometric models that use least squares regression techniques to find the expected performance levels of decision-making units. This allows comparison of the relative effects of the explanatory variables on some measure or set of categories of performance. In these models, dummy variables may be used to categorize producers and their environments. The key strength of these techniques is that they are stochastic and so attempt to sort out "noise" from the influence of the predictor variables. The main limitation of the econometric approaches is that they are parametric and thus interpretation of results is sensitive to (mis-)specification of the functional form (Lovell, 1993). Moreover, regression techniques focus attention on central tendencies, which seems inappropriate when the research interest is in identifying extremal outcomes –those units that have the greatest amount of output given input

(Bessent and Bessent, 1980; Lovell, 1993; Meier and Keiser, 1996). Specialized regression techniques, such as quantile regression or substantively weighted least squares regression, may be more successful at distinguishing high performers and identifying the managerial factors affecting their output levels, but these methods have not been applied to the question of technical efficiency.

A second set of approaches involves calculation of productivity indicators that relate inputs and outputs in rational form. For example, partial factor productivity measures the relationship between output and a single input, typically labor in the public sector. A more comprehensive measure that accommodates multiple inputs and outputs is total or multi-factor productivity, which depends on the construction of input and output indices. The input index is often developed by weighting the amount of each resource by its factor share (Blanchard and Duncombe, 1997). The natural choice of weights for the output index would then be market prices, which are not typically available for public services, making this approach difficult for evaluation of public production.

A third and increasingly popular set of techniques for measuring technical efficiency centers around the estimation of production frontiers using a mathematical programming procedure called Data Envelopment Analysis (DEA), attributed to Charnes, Cooper, and Rhodes (1978). DEA relies on the notion of Pareto efficiency to permit comparison of decision-making units with respect to their use of inputs and outputs. As explained by Bessent and Bessent, " a [decision-making unit] is not efficient in producing its output (from given amounts of input) if it can be shown that some redistribution of resources will result in the same amount of this output with *less* of some resource and *no* *more* of any other resource. Conversely, a firm is efficient if this is not possible" (1980: 60). DEA distinguishes the units in a set that make the most efficient use of resources (in other words, those that produce maximal output for minimal input) by identifying those whose performance is not dominated by any other's –those that are on the "best practice" frontier. Inefficient units (those that either use more inputs to produce the same output as other units or use the same input to produce less output than other units) are enveloped within this frontier.

The linear programming model is solved for each unit to generate an inefficiency value and its reciprocal, the efficiency value. Thus, for units not on the frontier, the degree of relative efficiency is measured, so that DEA provides an estimate of how much an inefficient organization deviates from the efficient ones. It is important to note, however, that relatively low efficiency values can be explained by relatively low output levels, relatively high input levels, or both. To aid in interpretation of the inefficiency value, therefore, the levels of outputs and inputs can be compared to other units in the set, slack resources can be identified, and opportunity costs[27] can be calculated (Bessent and Bessent, 1980).

The main advantage of DEA is that it allows flexibility in the structure of the production model because it easily handles multiple outputs and is nonparametric, making it particularly useful in public sector applications. On the other hand, DEA identifies only relative efficiency. Since the true "best practice" production frontier for complex public services cannot be known, DEA cannot generate absolute measures of the

[27] Bessent and Bessent (1980) define opportunity cost in this context as how much efficiency would be improved by a one-unit decrease in an input (outputs and other inputs constant) or by a one-unit increase in an output (inputs and other outputs constant).

level of efficiency (Ruggiero, Duncombe, and Miner, 1995). Moreover, DEA does not treat measurement or random error as statistical noise. All deviations from the frontier are therefore attributed to inefficiency, perhaps inappropriately (Lovell, 1993). Furthermore, as Ruggiero, Duncombe, and Miner (1995) acknowledge, measurement error may create outlier units that appear more or less efficient, resulting in over- or underestimation of the efficiency of other units.

2.4.5 Efficiency measurement: Applications and findings

Many earlier public sector cost analyses simultaneously estimate cost and demand functions using spending as the dependent variable to reflect service outcomes. Such analyses implicitly rest on two key assumptions. The first is that the cost environment does not vary across service providers. The second is that public services are provided efficiently –that is, decision-makers minimize costs subject to voter demand and production technology. Therefore, in these studies, observed spending is interpreted as the level desired by the median voter for the quality and quantity of services provided. This approach is troublesome because the likelihood that these two assumptions hold is low and thus the link between spending and performance levels is indeterminate. As Hanushek comments in his discussion of the economics of schooling, "...if schools are not operating efficiently, the interpretation of expenditure differences becomes totally ambiguous, because expenditure variations need no longer be directly correlated with variations in school quality" (993: 37). More sophisticated studies of the cost of public services recognize that the characteristics of the environment can affect the translation of resources into outcomes and control for an array of socioeconomic, demographic, and physical factors (see, for example, Ladd and Yinger, 1991; Duncombe, 1992). Efficiency measurement further enhances models of the relationship between spending and performance.

Recently, efficiency measurement through DEA has found application in studies of school finance that attempt to specify the relationship between the characteristics of educational production and student performance. Two studies are particularly noteworthy for their innovative approaches. The first is the work of Ruggiero, Duncombe, and Miner (1995) that seeks to demonstrate that measures of technical inefficiency vary according to the specification of the production function. Overall, this study applies a modified DEA model to New York public school districts and finds that eleven percent of these districts were inefficient in the use of all inputs with an average inefficiency of sixteen percent, and another third of the districts were inefficient in the use of at least one input, indicating the presence of slack resources. These results differ markedly from results obtained applying a conventional DEA model.

The important methodological contributions of this piece are twofold. First, it develops a DEA model of education production that explicitly operationalizes the relationship between the production environment and the production frontier. On the grounds of the theoretically (Bradford, Malt, and Oates, 1969) and empirically (Duncombe, 1992) established notion that production units with more favorable environments should be able to produce at least as much output as those with less favorable environment given the same input levels, this DEA application derives separate production frontiers for each level of environmental harshness. This approach permits the calculation of each production unit's minimum inefficiency level relative only to other units that face no more favorable environments. In addition, this study provides not only the traditional Farrell (1957) efficiency measure, but also measures of further input slacks that are not resolved through the equiproportionate reductions on which Farrell's measure depends, thereby giving an overall measure of inefficiency for each input.

Thus, this work advances evaluation of public productive performance in two important ways: it makes the distinction between discretionary inputs (that public decision-makers can control) and exogenous socioeconomic factors (that public decision-makers cannot control) operational in the production function and it merges the Koopmans and Farrell notions of efficiency. It therefore takes an important step toward addressing Hanushek's (1986, 1993) critiques that research into education production fails to address how performance outcomes vary in response to differences in school programs or operations and that the assumption of efficient production undermines analyses. As the authors acknowledge, however, a weakness of the modified DEA technique applied in this study is that it is vulnerable to the same limitations of conventional DEA models in that it is nonstochastic and thus measurement error in combined with true inefficiency to comprise the apparent level of inefficiency.

A second benchmark application of efficiency measures in analyses of public service performance is the study of the efficacy of school aid programs in improving educational outcomes by Duncombe and Yinger (1997). This work uses simulations to compare the influence of expenditure-based foundation aid formulas on educational outcomes to that of outcome-based programs and concludes that states could design aid programs that would dramatically boost outcomes, but not without accounting for costs and increasing funds through the state budget or local property taxes. The analysis also reveals important lessons about the role of efficiency in the function of aid programs, including providing evidence that increased aid can undermine the achievement of educational objectives by lowering productive efficiency. In short, this work confronts Hanushek's argument that "increased expenditures by themselves offer no overall promise for improving education" (1986: 1167) and, by controlling for efficiency and estimating the relationship between spending and outcomes, provides evidence that spending can matter in educational performance.

Aside from its important policy implications, this research expands the methodological realm of public-sector DEA applications by incorporating an efficiency measure into the simultaneous estimation of cost and demand equations and thus into the construction of cost and outcome indices. This approach provides operational recognition of the ideas that, on the supply side, productive inefficiency can lead to higher spending (outcomes and costs constant), and, on the demand side, it can effectively raise the price of outcomes (all other determinants of demand constant). The authors make the important point, though, that their DEA variable reflects the relative level of a district's spending holding outcomes constant. Spending levels are not driven solely by inefficiency; the direction of spending toward other outcomes or the presence of higher costs will also drive the value of the DEA variable down. Furthermore, since the DEA index reflects productive inefficiency, costs, and omitted outcomes, its inclusion in the cost and demand equations helps reduce the potential for biased estimates of the coefficients in these equations.

2.4.6 Causes of inefficiency

Valid quantification of the level of inefficiency in the production of public services begs the question: What causes public decision-making units to be inefficient?

Ruggiero, Duncombe, and Miner (1995) note that most of the economic, organizational, public management theory that informs discussion of this question flows predominantly from the work of two scholars. Leibenstein, who in 1966 developed X-efficiency theory to explain why firms may deviate from the optimal production frontier in their operations,[28] and Niskanen (1971, 1975), who developed principle-agent models reviewed above, both provide some conceptual economic basis for understanding the inception and endurance of technical inefficiency in public organizations.

As described above, the field of organization theory typically categorizes the influences on an organization's behavior according to the organization's size, its structure, its technology and processes, and its external environment. This framework is apropos here as much of what Leibenstein and Niskanen, and others that followed them, predict can be described as testable hypotheses along these dimensions. Taking them in order, the size of government is likely to affect its efficiency because, as Ruggiero, Duncombe, and Miner summarize it, "smaller organizations are easier to manage and monitor and are more responsive to their principals" (1995: 417). The issue of how size and efficiency are related underpins the opposing effects of potential economies of scale in production (Duncombe and Yinger, 1993) and potential costs that arise from the multiple controls that infuse large bureaucracies. This tradeoff is fertile ground for research given the current interest in consolidation of local governments.

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[28] Leibenstein's (1966) concept of x-efficiency is an alternative to allocative efficiency standards. X-efficiency asserts that incentives, motivation, information, adaptability, and other organizational dimensions have greater implications for efficiency than does the marginal allocation of inputs. Levin has applied Leibenstein's concept to the case of school productivity with his assumption that "greater efficiency gains in educational production can be derived from dramatic organizational changes that from tinkering with reallocations of existing school inputs" (1997: 303).

Public organizations tend to be structured as rigid, scalar, multi-layered hierarchies. Contemporary reformers and theorists (see, for example, Downs, 1957, and Ostrom,1972) alike view these structures as inefficient because they demand relatively high maintenance which diverts resources from service-provision, they are resistant to the influence of citizen desires because of their inherently complex and vertical communications and decision-making systems, and they involve a high level of managerial "overhead," which represents essentially fixed costs. Understanding the interaction of structure and efficiency could lend valuable insight into the potential efficacy of public sector reform efforts such as delayering.

Organizational technology and processes have been discussed from a service production function perspective above, but this area also includes the nature of leadership, power, and incentives in a given organization. For example, labor contracts may include performance incentives, such as merit pay, that are in conflict with performance disincentives, such as tenure, and may influence organizational efficiency (Hanushek, 1986). Informal motives may operate as well. For example, Ruggiero, Duncombe, and Miner (1995) suggest that self-interested bureaucrats might favor the use of certain inputs over others in an effort to enlarge their physical plant, budget, or bureaucracy, resulting in an inefficient level of factor intensity. Again, research into this relationship would be valuable to understanding where public spending can have the largest impact on generation of outputs, with the recommendation to, as Hanushek puts it, "stop requiring and paying for things that do not matter" (1986: 1167).

An organization's external environment is arguably the most complex influence on its efficiency because it can be characterized along several potentially important operational dimensions. Three seem particularly relevant. Several theorists cited above (Emery and Trist, 1963; Lawrence and Lorsch, 1986; and Chubb and Moe, 1990) postulate that the complexity, heterogeneity, and number of problems inherent in an organization's environment affect the degree to which it employs bureaucratic controls and thus its efficiency. In addition, socioeconomic factors have been shown to be important to other aspects of public service provision and may influence efficiency. As Ruggiero, Duncombe, and Miner hypothesize in their exploration of education production, "residents of districts with higher community wealth may exert less external pressure on school officials because of greater tolerance for inefficiency associated with larger resources" (1995: 418). Finally, public choice theorists assert that competition in public service production imposes pressure on public officials to be more efficient. Competition may arise either from the presence of private producers or from the existence of referenda in which voters express their preferences for the level of public expenditures across a range of services. Evaluation of each of these proposals can help clarify the theoretical basis of productive efficiency and could also inform decisions about revising production arrangements through instruments such as privatization, managed competition, or contracting.

A scan of the literature suggests that there has been almost no empirical testing of these hypotheses. This is possibly because of the limitations of empirical techniques for measuring efficiency. Also, existing theory couches the influences on organizational effectiveness in abstract terms that are hard to translate into discreet, quantifiable variables. The results of exploratory empirical analyses conducted by Ruggiero, Duncombe, and Miner (1995) are telling, though. They report that the relationships between various organizational characteristics and efficiency levels can be contrary to the expectations outlined above and are difficult to interpret with reference to existing theory. As they surmise, "how efficiency manifests itself within public organizations is more complex than simple theories of bureaucratic behavior would suggest" (1995: 423). This statement amounts to a compelling call for more empirical formulation and analyses of existing hypotheses as well as further theory development.

2.5 The Nature and Functions of Public Management

With key dimensions of the organizational setting and the issue of organizational performance outlined, the question of who makes organizational choices and decisions arises. We now turn to a discussion of public management as the central force by which organizational resources are marshaled to accomplish public production in an attempt to address the issue of how management functions and systems may affect performance. Exploration of the nature, role, and impact of public managers is necessarily based in a broad literature that is entangled with, but extends beyond, the organization theory literature. This section first briefly reviews two particularly relevant and important lines of scholarship: classical views of the bureaucracy and studies of policy implementation. The perspective on public managers each propounds will be summarized here, with a view towards illuminating key gaps in traditional perspectives that warrant more careful and sophisticated specification of public management. Then, this section will turn more specifically to the functions of public managers as defined and addressed in contemporary scholarship. This discussion will serve as the basis for the operationalization of the concept of management presented in Chapter 3. Finally, empirical studies that seek to measure management will be reviewed.

2.5.1 Traditional views of public bureaucracy

The behavior of public bureaucracies in the production of public services has received conjectural and theoretical attention in the public administration literature since Woodrow Wilson first proclaimed that "It is the object of administrative study to discover, first, what government can properly and successfully do, and secondly, how it can do these proper things with the utmost possible efficiency and the least possible cost either of money or of energy" (1887). Continuing on Wilson's trajectory, the classical public administration orthodoxy purported that there is a clear distinction between policy-making and operations. The administrative apparatus was thus seen as neutral and straightforward. Bolstered by the canons of efficiency embodied in Scientific Management, the business of public management was rendered a technical problem[29] in which the execution of the state will was distilled to the optimally efficient translation of men and materiel into outputs (Goodnow, 1900; Gulick and Urwick, 1937; White, 1958). Notably, however, the early public administration literature rested to a large extent on supposition and ideology, with little empirical analysis or evidence to substantiate claims about bureaucratic efficiency.[30]

Policy analysts in the 1960's and 1970's, while recognizing the fallacy of the neutral administration construct and the need for better analytical comprehension of

[29] Gulick (1937) proposed the ungainly acronym "POSDCRB" as the answer to the question of what the executive should do. He resolved the technical problem of administration into seven component functions: planning, organizing, staffing, directing, coordinating, reporting, and budgeting.

executive processes, still considered public management as a relatively unimportant influence in the policy performance system beyond proficient service as a vehicle for implementation. Standards of rationality and economic efficiency dominated the field of policy analysis, and thus the relative amounts of inputs and outputs, measured in terms of cost and utility, were the focus of attention. To the extent that public bureaucracy got any attention in policy analysis, it was through limited and simplistic inclusion of organizational size and structure related variables such as size of budget, number of personnel, or degree of centralization or decentralization (Peters and Heisler, 1983).

In a parallel line of work, some researchers began to examine the policy process more directly. Several reviewers have noted that this literature evolved through a few stages characterized by distinct views of the role and impact of the public bureaucracy in policy execution and program performance (Goggin, 1986; Linder and Peters, 1987; Matland, 1995). Consensus is generally that the early "first generation" implementation literature focused on the barriers to effective implementation that arose as a result of pathological bureaucratic behavior. It is full of descriptive, despairing accounts of failed policy processes –failed, not as a consequence of poor policy design or ignorance about unforeseen policy effects, but because of imperfect administration. Pressman and Wildavsky (1973) and others of this era essentially argued that, in the transition from policy adoption to service delivery, the public bureaucracy has the ability to shape, distort, and sometimes redefine policy goals in powerful, unpredictable, and often undesirable ways. Similarly, Hood (1976) characterized the hierarchical administrative

[30] In a famous call for more positive study of administration, Herbert Simon (1946) decried the administrative "principles" set forth in the early public administration literature as "proverbs," calling them unscientific, ill-defined, atheoretical, and self-contradictory.

apparatus as an obstacle to the success of government policies. Early implementation analyses thus recognized that management does influence outcomes, but there is little in their case analytic findings that specifies precisely how in a way that supports prediction.

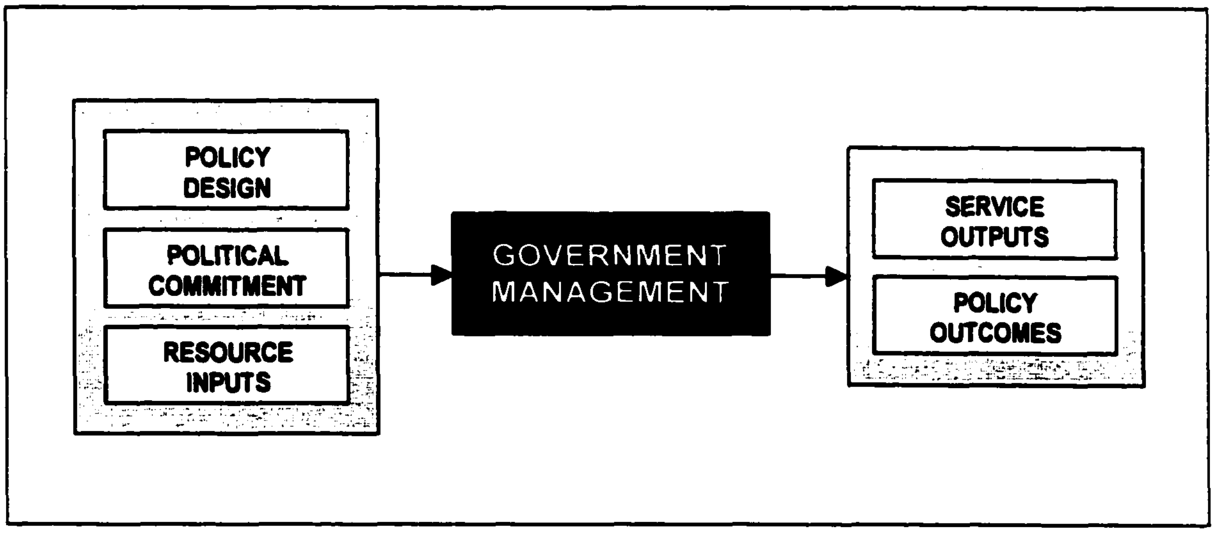
Later "second generation" theorists, most prominently Mazmanian and Sabatier (1983), examined implementation comparatively in an attempt to explain variability in terms of differences in the policy content, differences in organizational capacity, and differences in the qualifications of operational-level personnel. These studies acknowledged that an adequate understanding of policy implementation depends to some extent on recognizing the behavior, motives, and abilities of the responsible public bureaucracies. On this foundation, the emerging "third generation" implementation literature moves ahead to portray public management as focused on managing across organizational boundaries, or managing networks, which poses significant challenges for implementation (O'Toole, 1996; Provan and Milward, 1995). New perspectives suggest that the establishment of a common purpose and clear communication by public managers are important to creating a condition of "goal alignment" that supports implementation, but that these are difficult aims to effect (O'Toole and Montjoy, 1984; O'Toole, 1996; Provan and Milward, 1995; Schneider and Ingram, 1997; Meier and McFarlane, 1996; Hogwood and Peters, 1985).

In sum, the operational relationship between policy and performance in both the classical public administration literature and the early implementation literature has been seen as a "black box," depicted in Figure 2-1.[31] This black box houses the administrative

[31] This classic model and an appeal to develop a more sophisticated specification of it is presented in Ingraham and Kneedler (2000).

apparatus that intervenes between policymaking and results. Resources are input into the box and programs and services emerge from it as outputs. Inside the box, public organizations and managers mysteriously transform the inputs into the outputs in a way that ultimately defines the outcomes of policy. Thus, in this model, public management is an assumed process that has yet to be carefully specified –while both early and newer views of implementation give credence to the notion that the actions of managers are influential, neither explains the determinants of those actions or specifies the causal patters associated with certain outcome levels. In short, most theorists assert that the behavior of bureaucrats is central –for example, Kettl claims that "Public management matters, and it matters because the quality of public management shapes the performance of public programs" (Kettl and Milward, 1996: 1)– but few examine why.

Figure 2-1. The Classic "Black Box" of Public Management.



Some scholars have hinted at the need to reveal the contents of the "black box." For example, Goggin *et. al.* assert that "a sophisticated understanding of organizational capacity and its subtle influences on policy implementation would require descriptions of virtually the whole gamut of administration, from financial management to motivation, from information systems to affirmative action plans and their impact on the workplace" (1990: 120). Along these lines Lynn (1996) asks: If management does shape policy, what is it about management that is important? Is it individual action, most specifically leadership? Is it the institutions and the powers they hold, in which individuals are set and act, that are most influential in shaping impact? What kinds of relationships and influences are most significant? To address these questions and the limitations of the classic literature, we must first clearly define what management is and then explore its impact on organizational structure, behavior, and performance.

2.5.2 Toward an operational definition of management

Management –particularly "good" management– as a concept or construct suffers from a similar dilemma to that of obscenity in the 1964 Supreme Court case *Jacobellis v. Ohio*, where Justice Stewart commented "...perhaps I could never succeed in intelligibly [defining it]. But I know it when I see it..." (378 U.S. 184, 197). This is not to imply a substantive similarity between management and obscenity; only to illustrate that both are matters of context, perspective, and application, and thus are difficult constructs to operationalize. This dilemma is apparent in the literature, which offers an array of definitions of management, descriptions of the role of managers, and lists of managerial functions. Three themes recur with respect to notions of management, however: that management, performance, and strategic judgment are interrelated, that management is fundamentally concerned with choices about the level, mix, and deployment of resources in an organization, and that management is contingent. Each of these will be considered in turn, and then a synthesis will be offered that allows management to be cast in operational terms to facilitate empirical study.

Management and effectiveness. Does management matter to public performance? As Lynn notes, "The problem of governance in democratic regimes is to choose arrangements that consistently lead to effective organizational, policy, and program performance" (1997). This statement implies what most public management scholars and public managers themselves believe: that effective management is positively related to effective performance. As Lynn (1997) also points out, this statement is putative, not proven. Nonetheless, most definitions of management make reference to the purpose of promoting positive outcomes. Swiss (1991), for example, defines management as the coordination of people and resources in order to achieve policy outcomes. Drucker (1974) concurs, defining management as the control of an enterprise with respect to performance, specifically with respect to controlling productivity, social impacts, and social responsibilities.

Not only are managers viewed as responsible for upholding organizational performance, but they have a central role in defining the essence of what the organization is designed to achieve. That is, they help define the organization's purpose and mission, and determine how the organization will meet these over time. This is the essence of strategic planning and goal-setting reserved for policy-makers under traditional models; under contemporary conceptualizations, the boundary between policy planning and operational planning is permeable. Management thus includes the exercise of strategic judgment to ascertain the organization's current performance (Cohen, 1993; Cohen and Eimicke, 1995), develop consensus on goals and priorities (Schein, 1992), devise operational plans to meet those goals (Allison, 1983), monitor achievement of goals (Lynn, 1997), and impose remedial strategies to improve performance (Lynn, 1997).

A conceptual dilemma here arises with the question of the difference between leadership and management. Many scholars have examined and attempted to characterize this distinction (see, for example, Behn, 1991; Wolf, 1997 and 1998), arriving at the general notion that "Management is often distinguished from leadership as the task of setting up control structures and SOP's while leadership involves stimulating organizational change by articulating a vision and inspiring a sense of mission..." (Kotter, 1990: 107). In part, the discussion in this chapter suffers under the implicit assumption that management is monolithic. In fact, it may be that there is a unitary leader/manager (particularly in smaller or more hierarchical organizations), but organizations typically include multiple loci of discretion and authority. Some managers fulfill roles that are more akin to the description of leadership cited above, while others perform functions that are essentially administrative, making specific decisions that direct, control, and monitor organizational activities on the basis of broad policies that emerge from the strategic planning process. In short, this dissertation focuses on management holistically, and includes in management the strategic functions often associated with leadership.

Management and efficiency. O'Toole says that "Management refers to the set of conscious efforts to concert actors and resources to carry out established collective objectives" (1997: 7). Drucker (1974) says that the administrative job of the manager is to optimize yield from resources. Here the management literature agrees: a fundamental managerial function is to acquire, arrange, deploy, direct, and coordinate resources in a way that makes the organization's strategic objectives operative. In short, managers choose the production technologies organizations employ. This job makes three key demands on managers. First, they must obtain, maintain, and sustain the organization's resource base (O'Toole, 1997). Second, they must create an organizational structure that defines the relationships among the resources and facilitates communication of information (Thompson, 1967; Mintzberg, 1972; Schein, 1992). Third, they must motivate individuals to provide essential services that will achieve organizational objectives by prescribing and providing incentives for appropriate behavior (Barnard, 1948 ; Drucker, 1974; Lynn, 1997; O'Toole, 1997).

Management of an organization's production technology is commonly facilitated by use of management systems. A management system is a distinct set of administrative procedures that supports managerial decision-making by allowing a manager to communicate performance standards, to collect information on organizational performance, to coordinate routine activities, and to control the use of resources. The main purpose of a management system is feedback: the system provides information about organizational activities that managers can use to make subsequent decisions (Swiss, 1991). Common examples of management systems include financial, capital, human resources, and information technology management systems (Ingraham and Kneedler, 2000).

When the question of a public organization's potential ability to yield outputs or outcomes arises, the term "capacity" often appears (see Honadle, 1981; Gargan, 1981; Malysa, 1996; Waugh, 1999). Recently capacity has been used in association with public management to describe "government's intrinsic ability to marshal, develop, direct, and control its human, physical, and information capital to support the discharge of its policy directions" (Ingraham and Donahue, 2000). To borrow an analogy from physics, management capacity is akin to an administrative version of potential energy (which refers to the available power an entity has for activity as a result of the arrangement of its systemic components). In considering the role of managers in determining an organization's productive efficiency by making choices about how it obtains and deploys resources, "management capacity" can be more carefully defined as an organization's institutionalized ability (typically embodied in its management systems) to gather and analyze knowledge about organizational processes, activities, and performance that facilitates coherent decision-making.

The question that discussion of the concept of capacity prompts is what is the optimal level of capacity? While the literature does not address this issue formally, some empirical work has sought to measure the management capacity of public organizations. In particular, the Government Performance Project[32] seeks to develop comprehensive measures of the performance of government management systems. From 1999 data about 29 city governments, Donahue, Selden, and Ingraham (2000) were able to compare the characteristics of human resources management systems, to quantify the level of management capacity governments derived from these systems, to control for the political context, and to measure management outcomes. They test hypotheses about the

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[32] The Government Performance Project (GPP) is a major research initiative of the Alan K. Campbell Public Affairs Institute at the Maxwell School of Citizenship and Public Affairs at Syracuse University in partnership with George Washington University, *Governing* magazine, and *Government Executive* magazine. The GPP is a five-year effort, funded by the Pew Charitable Trusts, to rate the quality of management in state and local governments and selected federal agencies in financial management, human resources management, capital management, and information technology management based on an explicit set of crietria. To accomplish as comprehensive an evaluation as possible, the GPP relies on

influences of capacity, government structure, and labor-management relations on some human resources management outcomes, and find that management capacity can be quantified and that it does have an independent impact on management effectiveness.

Management and the environment. As described above, much of contemporary organization theory focuses on the requirement that an organization be able to survive in and adapt to its external environment. Further, some of the public economics literature demonstrates that the extent to which external forces are harsh or benign in their effect influences organizational effectiveness (see, for example, Ladd and Yinger, 1989; Duncombe, 1991 and 1992; Duncombe and Yinger, 1993 and 1997). Public management theorists recognize that an important managerial function is to facilitate interaction between the organization and its external constituencies, given local conditions. Management is therefore viewed as contingent by modern theorists (Lynn, Heinrich, and Hill, 1999; Rainey, 1997). As O'Toole explains, "Different structural contexts carry logical implications for whether and how public management matters; and for which kinds of managerial moves are likely to be efficacious or merely epiphenominal –not to mention perverse" (1997: 2).

Many authors assert that the job of the manager is to shield the technical core of the organization from disruption by environmental forces (Thompson, 1967; Peters and Waterman, 1982; Schein, 1992). Some note that organizational environments may pose both threats and opportunities, and that the job of the manager is to buffer the organization in the former case and exploit the environment in the latter (O'Toole and

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a multi-method data gathering effort that includes a substantial written survey, collection of archival documentation, and extensive follow-up interviews with government actors and external stakeholders.

Meier, 1999; Rainey and Steinbauer, 1999). O'Toole and Meier (1999) have developed a formal model of the impact of public management that hypothesizes that hierarchy and management are substitutes for one another with regard to stabilizing the organization and protecting it from environmental shocks. Their model represents a nonlinear relationship between management, organizational structure, and the environment in which outputs depend, in part, on a reciprocal relationship between management and hierarchy that interacts with the environment.

One additional and important influence on managerial decision-making is how managers *perceive* the environmental conditions they face. The issue of perceptions receives short shrift in the public management literature, which fails to address adequately the need for rigorous, systematic, self-referential examination of the roles and goals of managers as they work to generate public services. As Goggin (1986) points out, researchers tend to explain the performance of implementation efforts in terms of the nature of the policy itself, the capacity of responsible organizations, and the qualifications of public managers. The managers' view of the implementation environment is strikingly absent from this list of independent variables. As a result, the determinants of public performance are only partially contemplated by the lines of reasoning thus far presented.

Some limited work has also been done to reveal how public managers view their role and to ascertain the nature of managers' motivations and values. There has recently developed a promising line of research that takes on the limitations of existing conceptualizations of the public bureaucracy that ignore, mischaracterize, or over-simplify the preferences and motives of public managers. Following a broadly articulated sense that public service is a higher calling, and that response to this calling is driven by an altruistic desire to serve the larger public interest, the core of this work is comprised of several studies that focus empirically on public service motivation.[33] These studies, the most notable example of which is Perry's development and test of a construct by which to assess public service motivation (1996), seek to examine systematically managers' conceptions of their incentives and preferences. Rather than the pure self-interest assumed by public choice proponents, there is evidence that public mangers are compelled to act for many unselfish reasons (Brewer, Selden, and Facer, forthcoming).

Along a similar line, some scholars have attempted to identify the specific nature of public managers' beliefs about their administrative roles and responsibilities. Interestingly, Selden, Brewer, and Brudney (1999) find evidence that may reveal an "agency problem" among some groups of public administrators –that is, some administrators are clearly not responsive to elected officials, just as Niskanen's view suggests, though this may turn out to be because they hold the goals of politicians to be inconsistent with the public interest. Nonetheless, this and other work show that it is possible to identify and measure the values of public managers, and, in so doing, the multi-dimensional nature of bureaucratic preferences is revealed: The bureaucracy is not monolithic, nor are bureaucrats inherently self-interested. Such discoveries can improve and enhance models of the bureaucratic process put forth in the implementation and public bureaucracy literatures.

While extant studies may begin to address some of the fundamental limitations of the public bureaucracy and implementation literatures, they have not focused directly on

[33] Public service motivation is defined by Perry and Wise as "an individual's predisposition to respond to motives grounded primarily or uniquely in public institutions" (1990).

the issue of how managers actually perceive their decision-making environments, a vital link in understanding the relationship between managerial activity and public production. Nonetheless, this trend in the literature of modeling and measuring administrative values and motives suggests a path toward a better understanding of how and why public managers influence the production of public goods and services. Although this has not been their direct target, these studies do raise a crucial point: Purely objective scrutiny of bureaucratic structures and procedures, and the assumptions such examinations must make, forego the rich understanding that systematic analysis of the subjective characteristics of bureaucratic activity can provide. The nature of public bureaucracies is fundamentally driven by the dispositions, perceptions, and worldviews of the people within them. Thus, to understand and be able to predict the actions of public managers, study must focus on why managers act as they do, which, in turn, rests on how they perceive, evaluate, and respond to the pressures in their decision-making environment.

2.6 Conclusion

Overall, the state of scholarship surrounding public production does suggest an emerging empirical relationship between the study of policy implementation by public agencies and the refinement political economics models of organizations, such as the array of formal models of bureaucracy. At this stage, however, the progress and convergence of these fields is hampered by limited treatment of the role and impact of management on the performance of public systems. No doubt the importance of public management has not simply been overlooked. Rather, it is likely that in the absence of sound and useful measures of management and of the linkage between management and performance, these factors have been omitted.

CHAPTER THREE

EXPLORING THE EMPIRICAL CONTEXT: THE FIRE SERVICE CASE

This dissertation contemplates how public managers and the characteristics of the organizations they manage affect the outcomes of local public production. The empirical setting for this study is the fire service in the United States, a multi-component system that provides corporate and individual members of society with protection from loss of life, health, and property due to fire.[34] The core of this nation-wide protection system is comprised of this country's 31,114 local fire departments, which provide an array of life safety services to community-level jurisdictions.[35] In this capacity, fire departments responded to 18,753,000 emergency service incidents in the United States in 1998[36] (an average of 51,378 calls for help per day), suggesting that the mission of fire departments is an important local function. Nonetheless, as Duncombe notes, "Despite the importance of fire protection as a local function, little research on the production and costs of fire services has been carried out" (1992: 180). This assertion still holds.

[34] The fire protection system may be considered to include at least the following: private citizens who take action to protect themselves, fire departments, elected policy makers at all levels of government, regulatory and oversight bodies at all levels of government (such as OSHA and FEMA), insurance companies, private vendors (producing an array of monitoring, alarm, and suppression systems, public education materials, firefighter training materials, trade publications, etc.), and national nonprofit organizations (such as the National Fire Protection Association, who are geared mostly toward research, analysis, and education, and who also promulgate nationally-accepted operational standards).

[35] Unless otherwise noted, the figures cited in this chapter are drawn from National Fire Protection Association (NFPA) reports for 1998, which rely on national survey data, and from detailed data reported to the United States Fire Administration through the National Fire Incident Reporting System (NFIRS), the world's largest national annual database of fire information. For further explanation of the NFPA survey data and methodology, see NFPA's (1999) "Fire Loss in the United States During 1998). For further explanation of the NFIRS system, see FEMA's (1997) "Uses of NFIRS."

[36] Of these, 9.4% were fires, 58% were emergency medical and rescue, 10.4% were false alarms (malicious and accidental), 1.6% were hazardous materials, 3% were other hazards and emergencies, and 13.5% were service calls (such as lock-outs, water problems, etc.).

This chapter is designed to frame local fire protection as both a service production system and a policy arena in a way that facilitates interpretation of the analytical findings of this study and provides a basis for conclusions about production and policy. To this end, the discussion defines and describes the fire protection services fire departments provide, explains how these are accomplished by an array of organizational arrangements operating within contingent environmental contexts, explores some policy debates that rest on clear understanding of the fire protection system, and presents the limited, but important, literature that has examined key aspects of the production of fire protection.

3.1 The Fire Protection Sector

At least since 23 BC, when Augustus Caesar established a body of 600 slaves to watch for and fight fires in Rome, communities have formally recognized the need to organize a force to guard themselves against the threat of fire (Coleman and Granito, 1988). The slaves of ancient Rome were poorly motivated to risk their lives for their masters, and were eventually supplemented by companies of volunteers. In 6 AD, these companies were supplanted by a corps of 7,000 career firefighters, who were paid from the public treasury and organized into battalions much as modern fire departments are today (minus the horses).

Many centuries later, in 1752, Benjamin Franklin is credited with forming the first formal American fire company, a volunteer organization known as the Philadelphia Contributorship for the Insurance of Houses from Loss by Fire. Interestingly, America has not moved as quickly from volunteer to paid firefighters as did ancient Rome. Today, nearly 75 percent of the nation's 1,082,500 firefighters are volunteers. No other core public service relies to such a great extent on donated professional expertise and time.[37] As Brudney (2000) remarks, "Given the tremendous growth of the U.S. since colonial times in land mass, urban areas, population, resources, transportation, communication, and governments, it may be surprising to find that at the dawn of the new millenium much of the U.S. continues to entrust this vital public service to the care and expertise of citizen volunteers."

Regardless of whether it is produced by paid or unpaid professionals, fire protection is generally viewed as a "core" public service that should be provided by government. That is, municipal governments should ensure that some agency, whether a public department or some other entity in a formal relationship with the government, produces the service, which generally involves fulfillment of two related missions: fire suppression and fire prevention. Fire suppression is the act of extinguishing fires to forestall loss of life and property. Almost exclusively it is fire departments that put fires out, using a mix of specialized personnel, vehicles, tools, equipment, and water to disrupt the chain reaction that supports combustion by removing heat, fuel, or oxygen. Fire prevention, on the other hand, comprises a series of co-produced activities designed to keep fires from starting and to mitigate the effects of those that do occur. Among other things, fire prevention activities include the private installation of hazard detection and alarm systems, building inspections and code enforcement by fire department personnel or other state and local public officials, and public education programs conducted by the fire department and/or an array of other public, private, and non-profit organizations.

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[37] Thompson (1993) reports results from a 1990 survey that show that the average volunteer in his sample responded to 150 calls for help, contributed 240 hours of work, and participated in a minimum of 50 hours of training in a single year.

That fire protection is usually considered to be a core public function is distinct from the question of whether or not it is a public good. Intuitively, the answer to this question depends on several contextual attributes and thus varies by locale. Firefighting in rural communities, for example, is a radically different endeavor from firefighting in crowded cities. In sparsely populated areas where a fire involving one person's property is unlikely to threaten another's property, fire protection might be considered a common pool resource, or even a private good, because it can be consumed exclusively by one individual who could be successfully compelled to pay a price for protection through normal competitive market mechanisms.[38] On the other hand, in a municipal area where there are many multi-family dwellings very close together, a fire may impinge on several property owner's interests at once. Moreover, once one person pays to have fire protection, others derive some amount of benefit for which they have no incentive to pay. In this case, fire protection is more accurately viewed and addressed as a public good.

Empirically, the question of how to categorize fire protection has been discussed by a few scholars. Brueckner (1981) estimates a variation on Equation 2-3, above, and finds that fire protection exhibits congestion properties close to those of a pure public good, and that it exhibits increasing returns to scale in consumption. Ahlbrandt (1973), on the other hand, argues that fire protection is at best only quasi-public on the grounds that it is excludable because service flow can be targeted toward the individual consumer, but that it is not rival because service demand does not usually exceed capacity. The difference between Brueckner's and Ahlbrandt's perspectives may, in part, be explained

[38] In fact, parts of this country are protected by fire departments on a subscription basis. Typically, subscribers in these areas either pay a nominal annual fee, for which the fire department will respond to

by the fact that Brueckner examined cities with populations over 30,000, while Ahlbrandt looked at both large municipalities and at communities as small as 900 people. Ahlbrandt does point out that what is really provided by governments in the case of fire protection is often not fire suppression itself, but the right to consume fire suppression. Thus he acknowledges that "since one individual's right does not diminish the rights of other citizen-consumers, fire services may be considered a public good in the context of the institutional arrangement through which it is provided" (1973: 2).

3.2 The Fire Problem

Before exploring the nature of the agencies charged with producing fire protection, it is useful to consider the nature of the hazard against which the fire service protects us and the resources it uses to do so. Examination of national trends yields some perspective on the field of fire protection. Three sets of trends are considered in this section: changes in outcomes, inputs, and spending. These trends are represented in Table 3-1, which shows figures for the United States for the ten-year period 1986-1995, Table 3-2, which shows percent changes in these figures over the same period, Figure 3-1, which depicts some key trends over this period graphically, and Figures 3-2 and 3-3, which shows trends in workforce composition.

3.2.1 Outcomes

Fire departments respond to a fire of some type about every 18 seconds in the United States, and structure fires occur once per minute. In 1998, fire departments

any fire that occurs on a given piece of property, or they pay a much higher "per response" charge only when a fire occurs and the owner requests help.

Table 3-1. National Trends in Fire Protection.

	1995	1994	1993	1992	1991
Spending on protection*	17,000	16,556	16,664	15,642	15,441
Firefighters	1,098,850	1,073,600	1,055,050	1,058,300	1,033,600
Paid	260,850	265,700	259,650	253,000	261,800
Volunteer	838,000	807,900	795,400	805,300	771,800
Loss from fires*	9,316	9,659	10,821	10,693	9,095
Structure fires*	6,587	7,959	8,625	9,078	7,485
Residential fires*	3,475	4,221	4,610	4,170	4,184
Loss/fire	4,528	4,104	4,591	4,589	5,207
Loss/structure fire	12,080	10,128	11,823	11,845	13,189
Loss/residential fire	7,666	8,134	9,420	8,532	10,255
Loss/capita	33.87	32.40	34.78	35.36	42.16
Fires	1,965,500	2,054,500	1,952,500	1,964,500	2,041,500
Structure	626,995	632,786	624,800	642,392	651,239
Residential	448,134	454,045	452,980	459,693	467,504
Fires/1,000 pop.	7.48	7.89	7.58	7.70	8.10
Civilian deaths in homes	3,640	3,425	3,720	3,705	3,500
Deaths/100,000 pop	1.39	1.32	1.44	1.45	1.39

	1990	1989	1988	1987	1986
Spending on protection*	15,392	14,625	15,201	14,623	13,349
Firefighters	1,025,650	1,020,700	1,040,750	1,060,000	1,045,950
Paid	253,000	250,600	252,500	243,200	237,750
Volunteer	772,650	770,100	788,250	816,800	808,200
Loss from fires*	10,630	9,016	8,965	8,432	8,900
Structure fires*	8,589	7,609	7,387	6,409	7,574
Residential fires*	4,794	3,922	4,267	3,693	3,435
Loss/fire	4,505	5,056	4,440	4,146	4,101
Loss/structure fire	11,807	13,126	11,797	10,742	8,866
Loss/residential fire	9,210	8,355	8,798	7,877	6,509
Loss/capita	36.46	43.32	44.26	39.87	38.80
Fires	2,019,000	2,115,000	2,437,000	2,330,000	2,272,000
Structure	633,966	691,605	731,100	740,940	742,944
Residential	454,275	499,140	523,955	535,900	533,920
Fires/1,000 pop.	8.09	8.57	9.97	9.62	9.46
Civilian deaths in homes	4,050	4,335	4,955	4,570	4,855
Deaths/100,000 pop	1.62	1.76	2.03	1.89	2.02

Source: National Fire Protection Association reports for 1998 and from National Fire Incident Reporting System data reported to the United States Fire Administration

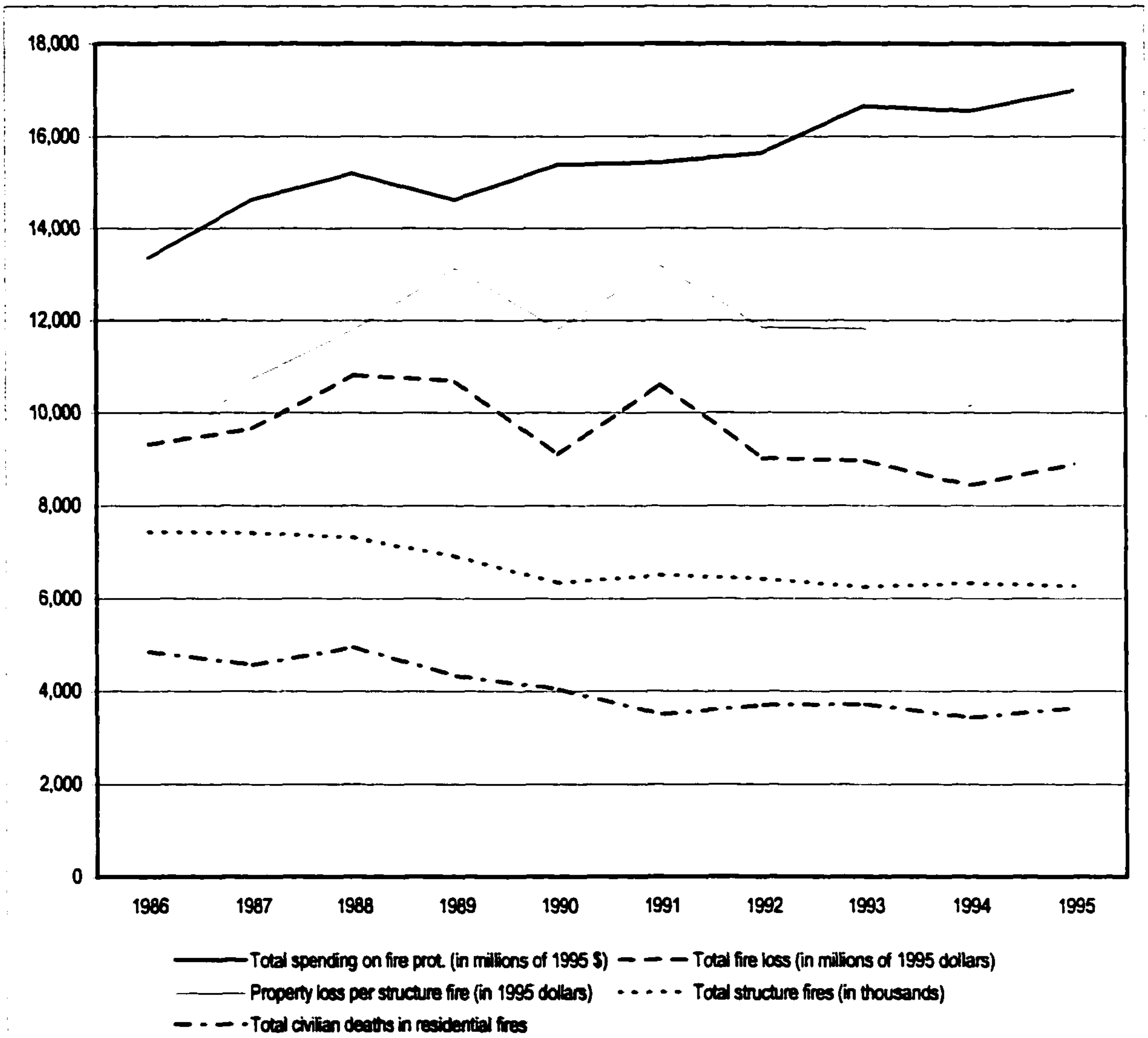
*In millions of dollars
All figures are annual totals
All dollar figures are in constant 1995 dollars

Table 3-2. Percentage Changes in Fire Protection (1986-1995).

	Percent Change 1986-1995
Spending on protection	27.35
Firefighters	5.06
Paid	9.72
Volunteer	3.69
Loss from fires	-4.47
Structure fires	14.99
Residential fires	-1.14
Loss/fire	10.43
Loss/structure fire	36.25
Loss/residential fire	17.78
Loss/capita	-12.70
Fires	-13.49
Structure	-15.61
Residential	-16.07
Fires/1,000 population	-20.94
Civilian deaths in residential fires	-25.03
Deaths/100,000 population	-31.48

Source: National Fire Protection Association reports for 1998 and from National Fire Incident Reporting System data reported to the United States Fire Administration

Figure 3-1. National Trends in Expenditures and Fire Loss.



Source: National Fire Protection Association reports for 1998 and from National Fire Incident Reporting System data reported to the United States Fire Administration

Figure 3-2. National Trends in Paid Firefighters.

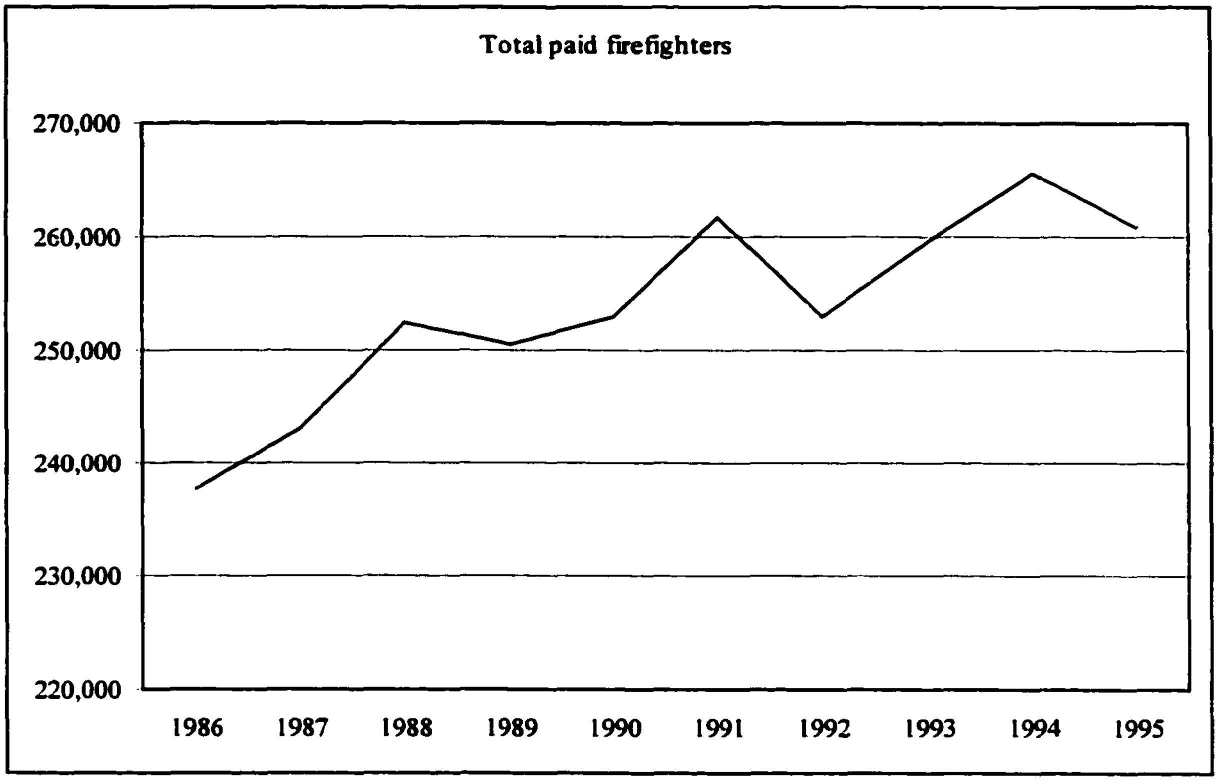
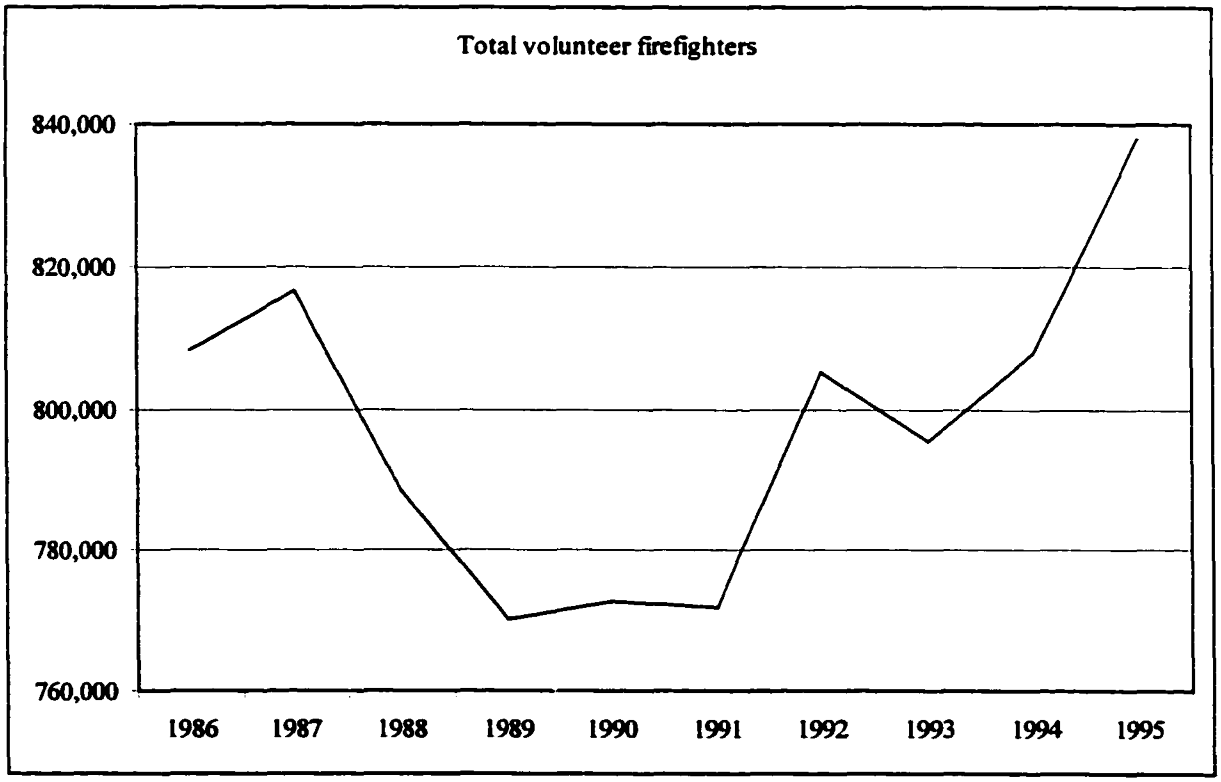


Figure 3-3. National Trends in Volunteer Firefighters.



Source for both figures: NFPA reports for 1998 and from NFIRS data reported to the USFA responded to 1,755,500 fires, of which 29.5 percent were structure fires, and of these 74 percent occurred in residential buildings. It is estimated that loss attributable directly to fire in 1998 amounted to over $8.6 billion, over half of which was residential property loss.[39] In addition, 4,035 civilians died in fires that year across the nation. Of these deaths, 3,220 occurred in homes. To put this in perspective, citizens die in house fire once every few hours.

Over time, the number of structure fires that occur and the number of civilians who die in residential fires annually have both declined steadily, as Figure 3-1 shows. Total fire loss has also fallen overall, but not as smoothly or to as large an extent. (Table 3-2 shows that from 1986-1995, the number of structure fires fell by over 15 percent, but total losses only fell by about 4.5 percent.) Moreover, property loss per structure fire has fluctuated dramatically, but has never fallen below its 1986 level in real terms, and in 1995 was up by over 36 percent.

3.2.2 Inputs

As explained above, the mainstay of the fire service in the United States is its more than 31,000 fire departments. Of these, 6.5 percent have only paid personnel, 72.8 percent are all-volunteer agencies, and the remaining 20.7 percent have combined paid and volunteer workforces, though these staffs are typically dominated by volunteers. Volunteer departments protect most of the country's land area, while paid or mostly-paid departments protect 59 percent of the population (since 75 percent of paid departments protect communities larger than 25,000 people). Of the 1,082,500 firefighters actively

[39] This figure does not account for other costs that result indirectly from fire, such as temporary shelter, medical care, missed work, and psychic harm. NFPA estimates that accounting for these additional costs, the total economic burden of fire is in the range of $92-$139 billion annually.

serving today, 74 percent are volunteers, about 99.4 percent are men, and about 98 percent are white. Almost all firefighters are between 20 and 50 years old, with the highest percentage in their 30's.

In the ten years from 1986-1995, the total firefighting workforce has increased by almost 53,000, or about 5 percent, as shown in Table 3-2. The number of volunteers has fluctuated, dropping dramatically during the late 1980's, and then generally rising to level in 1995 about 3.7 percent above that in 1986. The number of paid personnel, on the other hand, has grown more steadily, rising to a 1995 total almost 10 percent larger than the 1986 paid workforce. Figures 3-2 and 3-3 illustrate these trends, respectively.

3.2.3 Spending

It is often said that "fires aren't put out with water, they're put out with money" (Hoetmer, 1996: 15). Fire suppression is both labor- and capital-intensive and a defense against fire hazards must be maintained continuously, so the fire service is costly. Public fire agency costs represent an important proportion of local government budgets, and private and nonprofit departments are typically supported (directly or indirectly via contract) through a combination of various taxes and fees as well as donations. Thus, the public provision of fire protection raises significant local public finance policy concerns, and increasingly holds political salience as citizens rebel against rising taxes.

From the perspective of fire departments, the fiscal environment appears very constrained. On the basis of a 1990 survey of fire departments that protect municipalities of over 10,000 people, the International City/County Management Association (ICMA) reports that almost 60 percent of their respondents contend that their departmental budgets did not keep up with inflation in the three year period ending in 1990 (Moulder, 1992). Of these respondents, about 75 percent reported that they had experienced budget cuts or cutbacks in other sources of funding. Most commonly, these constraints are reported to have caused departments to leave vacant positions unfilled or to postpone equipment purchases.

Despite the cuts fire departments claim to experience, the National Fire Protection Association (NFPA) estimated that local expenditures for fire protection in 1995 totaled $17 billion, and over the ten years represented in Table 3-1 and Figure 3-1, spending for fire protection has increased steadily, up by more that 27 percent from 1986-1995. Thus, overall, spending increases have been matched with decreased incidence of fires and deaths, but not with clear reductions in aggregate or per fire property losses. While the trend toward fewer fires and deaths is certainly an improvement in the American fire experience, the fact that the fires we have remain highly costly is of concern. It suggests that more fires now are prevented from occurring than were prevented in the past, but that damage from those that occur is not forestalled any more effectively. As the next section will illustrate, several factors may bear on these trends.

3.2.4 New York State

This dissertation relies on data about a sample of fire departments in New York State. The sample frame and data collection efforts are discussed in Chapter 5, but it is worth describing the New York fire service in broad terms here,[40] to establish the basis for generalization from findings about New York fire departments to departments across the nation. New York State has 1,787 local fire departments, 5.7 percent of the national

[40] Figures reported in this section are provided by New York State's Office of Fire Prevention and Control, and can be found in OFPC (1999) and at http://www.dos.state.ny.us/fire/firewww.html.

total. These departments rely on 132,481 firefighters (10.3 percent of the national total), of which almost 16 percent are paid (or paid-on-call), compared to 26 percent of the firefighters nationally. New York State fire departments (excluding New York City[41]) responded to a total of 400,035 incidents in 1998, about two percent of the national total. Total direct dollar loss due to fire is estimated to have been $293 million, about 3.4 percent of the nation's loss. In 1998, 166 civilians died in fires (four percent of national deaths), and 499 were injured as a result of fire (two percent of national injuries).

3.3 Dimensions of the Production of Fire Protection

As explained in Chapter 2, we would like to be able to evaluate the production of fire protection based on the nature of the relationship between production inputs, service outputs, and policy outcomes. This section addresses this concern by considering the question of how to characterize and measure fire service outputs and outcomes. In addition, how fire departments meet service requirements varies widely according to two key sets of factors that will be discussed briefly in this section: organizational configuration and environmental conditions. Differences along these dimensions change the resources, strategies, and tactics fire service leaders and managers use to accomplish firefighting operations.

3.3.1 Service outputs and outcomes

In general, fire departments are presumed to operate predominantly to make communities safer from the threat of fire. That is, as explained above, it is assumed that

[41] New York City alone experienced 60 percent more fires than did the balance of the state in 1998. It also accounted for nearly half of all medical and rescue calls that occurred in the state in 1998. New York City is therefore excluded from figures reported in the text.

the central mission of all fire departments is to protect lives and property from loss or damage due to fire by furnishing fire prevention and fire suppression services. While appealing and logical on its face, this conceptualization presents several theoretical and measurement problems when attempting to translate fire department activities and effects into specific, quantifiable terms. Three problems are salient: multiplicity of goals, conflicting goals, and operationalization of results.

Taking these issues in order, the problem of multiplicity refers to the fact that while traditionally fire departments did little more than put out fires, contemporary fire departments increasingly do more than suppress and prevent fires. For example, NFIRS data for New York State show that only 9.4 percent of emergency calls to which fire departments responded in 1998 were fires of any type. The remaining 90.6 percent included medical and rescue responses (about 48 percent) and responses to a variety of other hazards and service calls. The implication of these proportions is that judging the performance of a fire department on fire-related service outputs and policy outcomes alone is unlikely to capture (or even proxy) the result of all of a department's activities or its entire contribution to a community's overall level of safety.

Not only do fire departments have multiple missions, but fire departments are likely to vary in how they prioritize their missions. It is reasonable to guess that fire departments may be capable of fulfilling several priorities. Calls for help are not continuous, and department resources may be committed productively to other purposes than direct emergency response in between alarms. In fact, Duncombe and Yinger (1993) show that fire departments do experience economies of scope (i.e., they successfully share resources across functions). Nonetheless, if an evaluator's choice of outcome measure does not align with a department's mission prioritization, or at least account for the department's other service responsibilities, empirical results may underestimate a department's productive efficiency.

Finally, even if it is decided that the result of importance is protection from fire and assumed that it is reasonable to assess behavior with respect to this result alone, the question of useful and appropriate measures arises. This question rests on two further dilemmas. First, measuring outputs and outcomes is often difficult to do in the public sector. To choose an appropriate measure of a department's impact, it is necessary to specify what would indicate that one community is safer from fire than another. Moreover, a community's safety is likely to be cumulative, in part. For example, instances in which fires are prevented are not likely to be contemporaneous with a department's prevention-related activities –it may be that an in-school class a child received last year kept him from playing with matches this year.

Second, there is a key distinction and relationship between direct service outputs and policy outcomes (modeled by a two-stage production process depicted in Equations 2-1 and 2-2, above). From the work of Bradford, Malt, and Oates (1969), and the analyses of many that followed them, it has been shown that service outcomes are not independent of the environment in which they are generated, so, in the second stage of the production of fire protection, a community's safety is influenced by the fire department's activities contingent on the harshness of the firefighting environment. Moreover, Duncombe (1992), Duncombe and Yinger (1993), and Duncombe and Brudney (1995) show that for fire technological choices in the first stage of production are also influenced by environmental factors. Environmental contingencies relevant to fire protection are addressed below, but first the types of organizations that produce fire services are described.

3.3.2 Organizations

Fire departments are ubiquitous but not uniform. Essentially all urban and most populated rural areas are protected by some form of fire service, but fire protection is produced via a wide variety of public, private, and nonprofit organizational configurations that vary dramatically in their structure, staffing, funding, equipment, and activities. Such variation provides an opportunity to compare the relative nature of various managerial decision-making environments and to compare the relative impact of organizational factors and management systems on outcomes.

The majority of the country's total population is protected by municipal fire departments staffed exclusively by paid, unionized civil servants. These departments are public agencies normally financed through the government's general fund, which in turn obtains revenues for fire services from various tax structures and bases, as well as fees for licenses and permits, service charges, operating transfers, and intergovernmental agreements (Hoetmer, 1996). City fire departments are most often stand-alone entities within city governments, led by a politically appointed fire chief, who normally reports to the mayor or city manager. Sometimes, a city fire department is paired with the police department and housed within a larger "public safety" department, often headed by a chief-level law enforcement official.

The majority of this country's total land area is protected by volunteer fire departments. Such departments provide essentially the same public services as municipal fire departments, but the relationship between the department and those it protects can vary dramatically. Volunteer fire departments may be independent nonprofit corporations, governed by volunteer boards of directors and typically funded by some combination of donations, fees for service, and taxes through contract with a local government. Other volunteer departments are special purpose governments, run by locally elected fire commissioners who have the power to levy taxes to pay for the provision of fire services within the protected district. Sometimes villages constitute volunteer fire departments whose chief reports to the elected village board or a designated fire committee. Volunteer fire chiefs are frequently elected by and from the department membership.

In a few (mostly southeastern and western) cities, local governments contract with private companies for fire service. Private fire departments are for-profit organizations typically owned by large private corporations in the business of providing emergency services. These departments are funded through the parent company either by government contracts or directly by private property owners who pay an annual subscription fee or are billed for services rendered on an as-requested basis. Under many contract arrangements with private companies, the local government owns the capital assets and volunteer auxiliaries bolster the paid firefighting force. As of 1988, twenty U.S. communities, with populations ranging from 360 to 108,400, contracted with one of six private corporations for fire service. An additional 17 communities used private subscription fire services from these corporations and seven others (Coleman and Granito, 1998).

Finally, in several localities, fire departments facing constrained budgets and personnel shortages have been restructured as "combination" agencies that use mixed staffing of paid (full-time, part-time, or on-call) and volunteer personnel. As of 1998, there were 6441 combination fire departments in the United States, of which about two thirds had more volunteer than paid firefighters (NFPA, 1999). Typically, combination fire departments emerge when previously all-volunteer departments hire a small number of personnel to provide coverage when volunteer members are not readily available, such as during normal business hours. In some cases, however, paid fire departments have created volunteer auxiliaries to supplement the career workforce as an inexpensive means to meet increased service demand or to ensure enough personnel are available in the rare event of multiple calls or a major conflagration that overwhelms normal operating capacity the department's. The role of volunteers in these cases varies dramatically; they can fulfill only support functions or can serve in roles comparable to the regular career staff.

Duncombe and Brudney (1995, and in Brudney and Duncombe, 1992) have examined the economic costs of volunteer firefighters in an effort to determine the optimal (cost-minimizing) mix of paid and volunteer staff in fire departments. They dispel the common assumption that volunteers are nearly costless (implying that demand for them is unlimited) by using a translog cost model to estimate the elasticities of factor demand for volunteers and of factor substitution between volunteer and paid firefighters on the basis of a sample of 474 New York State fire departments.[42] They find elasticities of between -0.32 and -0.35 and between 0.32 and 0.55, respectively (depending on the level of volunteer administration costs). They conclude that fire departments treat paid

[42] The transcendental logarithmic ("translog") function of Christensen, Jorgensen, and Lau (1973) is a specification that imposes relative few restrictions on the form of the cost function.

and volunteer firefighters as substitutes, and that they respond to changes in relative factor prices, but do not make major technological modifications. They also assert that if the administrative costs for each member of an all-volunteer department are less than $600 annually, the department should continue to be staffed by volunteers alone. As this cost increases, departments should add paid staff.

3.3.3 Environment

As discussed above, environmental conditions may affect both how fire departments operate and how successful their operations are in keeping their communities safe from fire. In general terms, major environmental factors can be grouped according to economic, physical, demographic, political, and social characteristics. Several researchers have examined empirically the extent to which some factors of these types affect fire cause, incident rates, and levels of loss. The findings from several relevant studies are consolidated in Table 3-3. A few of these are of particular note.

Schaenman *et. al.* (1977) examined variations in intra-city fire rates in five cities (including one central New York City) with census tracts as their units of analysis. They found three variables that explained 39 percent of the variation in the incidence of fires: parental presence, poverty, and under-education. They also found other significant variables including housing characteristics, income, and race. Gunther (1981) looked at fire cause patterns in Toledo, Ohio and found a strong negative relationship between income and fire rates, particularly with respect to fires caused by human activities (as opposed to mechanical malfunctions). Gunther also found that race did not matter to fire incidence once income was accounted for. Jennings (1996) analyzed census tracts in

Table 3-3. Factors Associated with Fire Cause and Incidence.

STUDY	PHYSICAL	SOCIAL	DEMOGRAPHIC	ECONOMIC
Sternlieb & Burchell (1973)	▪ Vacancy			
Munson (1976)	▪ Pop. Density			▪ Income
Schaenman et.al (1977)	▪ Age of housing ▪ Vacancy	▪ Parental presence ▪ Under-education	▪ Home ownership ▪ Crowded homes ▪ Race	▪ Poverty ▪ Income
Karter & Donner (1978)	▪ Vacancy	▪ Family stability	▪ Home ownership ▪ Crowded homes	▪ Poverty
Gunther (1981)	▪ Climate			▪ Income
Clark (1982)	▪ Code adherence ▪ Cheap constr.			
Munson & Oates (1983)		▪ Unemployment	▪ Home ownership ▪ Race	▪ Income ▪ Poverty
Fahy (1989)		▪ Education		
Fahy & Norton (1989)				▪ Poverty
Hall (1993)	▪ Community size			
Jennings (1996)	▪ Vacancy	▪ Single fem parent	▪ Population age	▪ Income
FEMA (1998)	▪ Climate ▪ Age of housing		▪ Population age	

Memphis, Tennessee and found four factors that explained 63 percent of the variation in fire losses: housing vacancy, family structure, age of the population, and income. He makes the claim that socioeconomic and environmental factors outweigh fire department resources and activities in determining fire losses.

In sum, while some sociodemographic factors are associated with certain causes of fires and not others, there is consensus about several factors that appear ultimately to affect incidence. Important physical characteristics include such attributes as population density, the age of buildings in a given jurisdiction, the occupancy rates, and the local weather. The dominant economic characteristics appears to be the wealth of the community, including income levels and poverty rates. Key demographic factors are the age distribution of a jurisdiction's population and homeownership rates. Finally, important social factors include the nature of family structures within the community and education levels.

Though this has not received empirical attention, the political environment may have bearing on the fire service in both overt and indirect ways. At the most basic level, how "friendly" elected officials are to the fire department has bearing on the department's budget and on the degree of operational and decision-making autonomy allowed the department –and therefore on its capacity to meet its mission. Politics also operate more subtly to affect the role of the fire department as a public service provider. Particularly in smaller communities where the fire department is often at the center of political wrangling and power, the department can be a key nexus of governance demands and public priorities. Finally, social values, such as whether communities value and respect their fire departments, the degree to which people accept responsibility for and participate in their own safety, and even how populations choose to spend their leisure time and money can have significant impacts on the nature and quality of a community's fire protection.

3.4 Forces of Change

Unquestionably, fire departments are considered vital to the safety and security of every American community. In polls conducted by popular magazines, Americans frequently rank firefighters as the most respected of all professionals. At the 1997 National Association of Schools of Public Affairs and Administration meeting, one speaker reported that people trust firefighters more than their own families. Beyond the lights, sirens, and heroic imagery, however, the American fire service is steeped in two and a half centuries of tradition, locked into rigid organizational hierarchies, crippled by powerful labor unions, plagued with volumes of guidelines and regulations, overwhelmed by expanding missions and expectations, and suffering under tight fiscal constraints. As a result, the capacity of the contemporary fire service to meet its public safety mission in today's complex, challenging, and dynamic society appears increasingly tenuous. This section describes some of the emerging conditions both in the fire service and in the communities it serves that pose new challenges to the production of fire protection.

3.4.1 Demographic changes

Changes in population distributions and family structures have an important impact on the size and nature of the labor force available to the fire service, and to volunteer departments in particular. More and more families depend on multiple incomes, and people thus spend more time at work, leaving less time and energy for volunteer commitments. The nature of employment itself has changed from agrarian, craft, shift, and local business work to industrial, service, manufacturing, and management occupations, so that people are less apt to live near where they work, and are less able to leave their workplaces. These effects are exacerbated by the "graying of America" –an older population on average means that fewer people are willing and able to take on the physical demands of firefighting. Thus, volunteer departments are scrambling to recruit and ever-smaller pool of potential members who have increasingly limited leisure time and more options of how to spend it (Perkins, 1990).

3.4.2 Mission requirements and mandates

Over the past fifteen years, the fire service has been driven to change both its mission and operations (Bruegman, 1993). With regard to service requirements, fire departments are now called to do much more than simply putting out fires. They are engaged in activities that range from hazardous materials management to emergency medical response to building inspections to arson counseling to water rescue –and they still march in parades and get cats out of trees. These enhanced responsibilities flow from three main sources: citizen expectations, government regulations, and the physical environment.

Thanks to the activities of regulatory agencies, special interest groups, and the media, the public generally has higher expectations of emergency services agencies than was true even a few years ago. Real-time news events, such as the broadcast of the bombing of the federal building in Oklahoma City, elevate citizen awareness of and concern about existing threats. Real-life television programs like "Rescue 911" and "COPS," and prime time shows about public safety such as "Third Watch" and "ER," raise people's expectations about the quality of service they will receive from fire departments and other emergency service providers. On top of public perceptions, the service has also had to satisfy a plethora of new standards and regulations pertaining to operations and training promulgated by diverse authorities, including legislation such as the Fair Labor Standards Act, agencies such as the Federal Emergency Management Agency (FEMA), the Occupational Safety and Health Administration (OSHA), and state health departments, and private organizations such as the NFPA and the International Association of Fire Chiefs (IAFC).

Finally, the increased volume and changing nature of calls are a result of environmental changes. Some of these are demographic, such as a higher populations of elderly people that require more medical care. New hazards also come with new technologies and building materials, which has altered the nature of the fire threat itself. For example, modern materials produce more dangerous toxins when burned and today's homes tend to have higher fire loads (i.e. they contain more combustible materials). These new dangers demand new approaches and thus new training and new equipment. As a result of these heightened demands, the firefighting occupation –whether fulfilled by paid or by volunteer personnel– is increasingly exacting in terms of time devoted to actually responding to calls, time spent in training, and compliance with government regulations, not to mention physical strength and skill. These are more difficult demands for volunteers to meet in their "spare" time, than for career firefighters to meet while "on the job." Volunteer departments thus find members are hard to recruit because they are daunted by the demanding training schedule required of modern professional firefighters.

3.4.3 Technological developments

While fires continue to be extinguished through largely the same methods that were used in Benjamin Franklin's time, the production technology that facilitates the application of water to fire has evolved dramatically in recent years, with regard to both labor and capital. The firefighting workforce is moving slowly from an almost exclusively young, white, male profile to one populated by women, minorities, and older personnel (Bruegman, 1993). The equipment of firefighting is also becoming more sophisticated and specialized –and expensive. New technology requires a host of ancillary investments, including the necessary training and maintenance to sustain each new capability.

3.4.4 Fiscal changes

Changes in the resource munificence of communities have begun to alter fire department business practices. As funding streams shrink to trickles from the relative torrents of past decades, some fire departments are seeking bolster their financial sufficiency through the use of innovative funding sources and structures (Hoetmer, 1996). For example, departments occasionally participate in efforts to capture economies of scale and diffuse remaining costs across a large population of governmental agencies through cost-sharing arrangements and county- and statewide purchasing agreements. Some departments have begun to assess a wide variety of fees, including user fees for fire or medical services, service cost recovery fees, and fees for specialized services such as hazardous materials site assessments and fire marshal services. Still other departments raise revenues by offering expertise and services to other communities, such as arson investigation, apparatus maintenance, or fire education programs.

3.5 Policy Issues

The consumers of fire protection also face challenges. Many communities are under pressure to revamp their emergency services systems. For example, local governments confront growing demand for services, complex contractual labor demands, insufficient volunteer availability, and pressure to improve the productive use of firefighter downtime. Simultaneously, as implied above, the complexity of modern firefighting demands ever more advanced qualifications, more stringent training, and more sophisticated equipment to support it. In the end, today's fire departments are very expensive to establish and maintain and thus, grappling with increasingly constrained municipal budgets, governments have an incentive to capture economies of scale and scope through innovative emergency services system designs. As communities around the nation revisit the issue of how to fund and configure their fire services, many are asking whether they are receiving the most cost-effective service possible. In addressing this question, some have considered new service arrangements. Two options increasingly entertained are privatization and consolidation of the fire services.

3.5.1 Privatization and contracting out

While a relatively rare phenomenon, privately provided fire protection has become a serious consideration for an increasing number of locales. Proponents of privatization suggest that public producers of fire services have less incentive to hold down their production costs than do private producers who contract with government to provide services. As Fisher (1996) notes, governments respond to political incentives (local officials face competition from potential opponents; communities compete for residents and businesses) more so than economic incentives, in part because "the bottom line" is absent or obscured. Public fire service agencies may also be motivated to maintain job security for their civil service employees, which necessarily depends on having fires to fight, a condition that poses a disincentive to mounting effective fire prevention programs (Stout, 1994). Moreover, public fire departments may be less cost effective because they seek to accomplish other public objectives in addition to fire suppression and prevention. As Ahlbrandt (1973: 14) notes, "A bureaucratic producer, maximizing a complex set of goals and objectives, may not be motivated to utilize the least cost production techniques, whereas a competitive firm can only be inefficient up to the point of potential entry into the market."

Unlike public fire agencies, private fire services are motivated to minimize their costs by market forces. Since fires are expensive to extinguish, the argument goes, these agencies will implement aggressive, and relatively less expensive, fire prevention programs to preclude the demands for fire suppression, thereby minimizing their costs as well as the community's property loss.[43] In addition, private firms may be able to achieve lower production costs through lower labor costs, better management, more emphasis research and development, and faster implementation of innovations (Fisher, 1996).

Some empirical evidence suggests that private providers can afford cost savings to communities. Alhbrandt argues that "efficient political units for demand articulation by the citizen-consumers may differ in size from the unit offering the lowest average production costs" (1973: 1), which suggests that a contractual relationship with a competitive supplier may be more efficient that bureaucratic production for a coterminous political unit. Ahlbrandt (1973) tests this hypothesis by using regression analysis to estimate a cost function for the production of fire protection by public bureaucracies on the basis of a sample of 44 fire departments. He compares estimated costs to actual costs incurred by private providers and finds support for his hypothesis.

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[43] The most renowned example of the seeming success of private fire protection is Scottsdale, Arizona, where Rural/Metro began providing fire protection before the city was incorporated in 1951. Rural/Metro has weathered a vicious series of contract battles and maintained its position as service provider under contract to this day on the basis of evidence that it provides better protection at lower cost. In fact, the Scottsdale case is one of the few that has been the subject of academic study, including the 1973 study of efficiency in the fire service by Ahlbrandt, who concluded that the savings potentially realized through privatization were real, measurable, and significant.

A key counter-argument to privatization and competitive bidding is that they may not cause a service to be produced at the lowest cost if there are few potential suppliers or if the government has limited knowledge about costs (Fisher, 1996). Both of these conditions are characteristic of the fire service. First, there are only about six (Coleman and Granito, 1988) major private companies that produce fire protection across the nation and one, Rural/Metro, far exceeds the others in size, scope, and capacity. Second, measuring fire service costs is a notoriously arduous undertaking with which practitioners and academics alike have struggled (see, for example, work by Ahlbrandt, 1973; Duncombe, 1989 and 1992; Meade, 1991; and Hatry *et. al.*, 1992). In addition, for privatization relationships to be successful, governments must be able to identify the results they desire, a difficult task for the fire service, where, in addition to the tangible goals of fire suppression, less concrete objectives such as community awareness, pride, tradition, and a sense of security are sought. Finally, monitoring contractor performance can be costly to government and reasonable remedies must be available in the event of nonperformance (Fisher, 1996). With regard to fire service, this means that the government must be able to mount alternative protection immediately should the private contractor fail to provide adequate protection.

In addition to these more generic arguments about the viability of privatization arrangements, those who oppose privatization argue that private fire services keep costs low by maintaining only minimum federal standards of personnel coverage and fire apparatus availability. They assert that training and staffing levels are inadequate to meet both community expectations and NFPA guidelines. The low price communities may pay for fire protection, they argue, is more than offset by higher property losses and insurance rates (Stout, 1994). Furthermore, it may be activities such as implementation of fire prevention and education programs, development of residential sprinkler programs, and use of innovative staffing structures that typically accompany privatization that appear reduce costs, and not the production arrangement itself (Bruegman, 1993). If so, it becomes difficult to sort out what the true cost of fire protection is and to identify who bears it.

3.5.2 Consolidation of fire departments

Other communities have undertaken a range of efforts to consolidate or regionalize their fire services. True consolidation is a political event whereby formerly distinct and independent agencies are merged to form a new entity into which the resources of the individual agencies are subsumed. Regionalization is a form of consolidation where only certain functions or resources are shared and available across a geographic area supported by several otherwise independent agencies. These sorts of efforts have become increasingly common in the fire service, particularly among emergency communications centers. The dominant rationale behind consolidation is that the political boundaries that dictate who receives what services are often senseless in terms of efficient fire protection. That is, "jurisdictional boundary lines aren't determined based upon response time or access... annexations in particular develop a crazy political subdivision that looks more like a patchwork quilt than a rational protection-service area. Many times, jurisdictions will leapfrog to desired tax base areas and leave pockets of non-revenue-generating problems for others to protect" (Thompson, 1992). Ever more constrained budgets are also an important impetus for consolidation because of the apparent potential to improve efficiency in service provision.

The proponents of consolidation in the fire service cite numerous benefits and advantages arising from such efforts. Anecdotal and experiential evidence from jurisdictions that have undergone some form of consolidation suggests that the biggest benefit is reduced costs through rational purchase and deployment of capital over a large area. This includes reduced duplication of specialized apparatus, shared reserve apparatus, lower apparatus replacement requirements, lower apparatus maintenance costs, and fewer apparatus and stations through large-scale planning. Under consolidation, labor, too, can be utilized more efficiently, but "consolidation's cost savings come primarily on the capital side, not from the personnel side" (Thompson, 1992). Another important benefit is less duplication of effort in areas such as middle management, administrative support, training provision, provision of prevention, education, and inspection programs, and specialized (but rarely needed) functions such as hazardous materials response or SCUBA rescue and recovery. A third major advantage is that response times are argued to be faster because stations and apparatus are more logically located with respect to the population centers. If these advantages are indeed real, they translate into lower costs, not just directly, but indirectly as a result of better coverage (and thus reduced fire loss), better insurance ratings (therefore lower insurance costs), consistent code requirements (lowering construction and renovation costs to private businesses), and standardized equipment (placing less strain on municipal infrastructure, such as water delivery systems).

Despite the seemingly obvious reasons to consolidate fire services, many locales remain staunchly resistant to the idea. The most powerful obstacles to consolidation revolve around power (Thompson, 1992). Fire departments and fire chiefs are reluctant to relinquish their discretion and authority, and may object to such efforts on the basis of pride, territorialism, or tradition. Furthermore, communities often see consolidation as a threat to local control and autonomy, and fear that fire departments will be less open and responsive to scrutiny by individual communities if they operate in a broader realm. Reticence toward consolidation may be also be bolstered by ignorance of the costs of existing fire services and the potential savings under other arrangements by citizens and local officials, by poor labor-management relations and defensiveness on the part of labor unions, and by the difficulties of resolving disparities in tax rates across the jurisdictions that would be involved in consolidation. Finally, Duncombe and Yinger (1993) provide empirical evidence that returns to population scale in fire protection are constant, indicating that consolidation will not yield savings.

3.6 Puzzles

A central concern of analysis of public production is to understand what value citizens receive for their money with regard to fire protection. Evaluating the relationship between the deployment of assets and the quality of fire protection across the population of fire departments is itself a daunting proposition. Huge disparities exist across the population of fire departments in terms of the numbers and types of firefighting resources they have and the level of protection they provide. As an example, the town of DeWitt, New York (with a population of approximately 25,000 residents) is protected by three independent fire departments possessing, in total, four heavy rescue trucks. New York City, in contrast, many times larger in terms of absolute size and density of population (about 7,080,000 people live in New York City), has only six heavy rescue trucks.

Even across similar jurisdictions, vast differences exist in how assets are deployed. For example, East Genessee street is a major thoroughfare that runs through residential areas of the city of Syracuse (served by a fully paid public fire department) and the town of DeWitt (served by a combination fire department) in central New York. The road is fairly similar along its length in terms of the types of residential structures present, yet the fire protection is dramatically different between the portion covered by the Syracuse Fire Department, where a residential structure fire would initially bring ten trucks, and the portion covered by DeWitt Fire Department, where a residential structure fire would initially bring two or three trucks. As another example, within Onondaga County in central New York, some homes are protected by brand new state-of-the-art apparatus, while others of the same value are covered by 1960's vintage trucks.

The question is, across all of the variations in inputs and environments reviewed in this chapter, which organizational and operational configuration is ideal –which offers the appropriate level of protection with the least expensive commitment of personnel and apparatus? Aggregate trends in spending and outcomes suggests that financial resources alone do not address performance. Spending must be applied to develop a production technology that works to achieve desired outputs and outcomes and does so at minimum cost. That is, if fire departments seek to minimize fire loss, they will be economically inefficient if they spend money on activities and resources that are not systematically related to reductions in fire loss. We must therefore answer the question: In what ways and to what extent does a community's safety from fire vary in response to differences in fire department resources, functions, operations, and structure? Fundamentally, decisions about these attributes are made by fire service managers.

3.7 Conclusion

How important is the issue of management in the fire service, particularly in terms of value added to the citizen? Fire departments are grappling with public demand to do more with less. Fire service missions are expanding even as budgets dwindle (Bruegman, 1993; Hoetmer, 1996). As a result, local fire service managers confront the same dilemma managers charged with providing any public service confront: how to strike a balance between the quality and extent of service they can provide, as dictated both by the professional norms and standards and by citizen demands for service, and the financial burden they are politically willing and legally able to impose upon service consumers. That the resolution of this dilemma hinges on the actions of managers clearly illustrates the reality that managers are a vital link in the public production process. As described above, though, the influence of managers on public productivity has received fairly narrow theoretical and empirical attention.

In the end, the performance and cost of the fire service remain salient issues. As the United States Fire Administration (USFA) notes in a study it commissioned on fire in the United States from 1985-1994, "Fire kills thousands of Americans each year, injures hundreds of thousands, destroys billions of dollars in property, and costs tens of billions of dollars overall, but mayors and city managers, school officials, the media, and the general public are still largely unaware of the magnitude of these numbers" (1997: 1). Most local managers do not have the technical fire expertise to judge the efficiency and appropriateness of their departments' operations. Moreover, the municipal fire service itself has become barricaded into rigid notions of operational standards and administrative structures. Careful analysis of what motivates fire service agencies across the public, private, and nonprofit sectors to operate as they do and the level of quality that results has implications for the success of fire protection efforts generally. A valuable benefit of research in these areas is the opportunity to explore and explain the means and basis of the fire service's strategic behavior and to reveal ways in which the partnership between communities and their fire service might be improved.

CHAPTER FOUR

A THEORETICAL FRAMEWORK FOR EXAMINING THE ROLE OF MANAGERS AND ORGANIZATIONS IN LOCAL PUBLIC PRODUCTION

This chapter introduces the conceptual model that guides this study. The previous two chapters have set the stage for this discussion by attempting to identify and consolidate a range of literature that describes the dimensions of public production, the attributes of public organizations and management, and the nature of the local fire service. While many scholars ratify the intuition that the economics of public production processes, the organizational forms that house production technologies, and the behavior of managers engaged in public production are entangled, these lines of theory and research have evolved separately, and the conceptual and empirical advantages of integrating them have yet to be exploited. The goal of this chapter is to explicate a framework that supports empirical analysis of local public production of fire protection based on merging these disparate bodies of knowledge.

This chapter is organized as follows. First, the theoretical model will be presented graphically and described. Key dimensions of this model will then be explored in detail to yield the set of functions that underpin this study. Finally, the discussion turns to the formulation of testable hypotheses. Chapters 6 and 7 extend this discussion through two distinct empirical examinations of this model: Chapter 6 presents a subjective study that identifies and measures the influences managers perceive, and Chapter 7 specifies the functions implied by the model, and uses them to test the role of managers in the production system with regression analysis. Chapter 5 describes the sampling rationale and data collection effort that supports these analyses.

4.1 The Theoretical Model

Figure 4-1 depicts the model of the local public service production system that this dissertation proposes and will examine empirically. Essentially, this model captures the simultaneous relationship between citizens' desire for a service and the final outcome of that service, and incorporates a staged model of public production. The diagram shows a process in which aggregate citizen demand for a certain amount and quality of services results in a budget that is then used by public producers to purchase the inputs to production. These inputs are then used to produce direct outputs. In turn, those outputs, given the environmental conditions under which they are produced, are associated with the final outcomes citizens care about, and for which they pay.

The general model depicted in Figure 4-1 is applied to the case of fire protection in Figure 4-2. The model for fire represents a system in which the spending on and outcomes of local fire services are jointly determined. Considering the demand side first, the fire production model follows the median voter construct explained in Chapter 2 to include several determinants of the median citizen's demand for fire protection, including the price of the service to the citizen (known as the "tax price"), the citizen's income, and the citizen's preferences. These demand factors drive the level of private spending, in the form of charitable donations, and the level of public spending, captured in the public budget.

On the supply side, the fire department obtains a mix of capital, equipment, and labor that will fulfill its strategic objectives and meet its operational needs, given the prices and availability of factors of production of particular types and quality levels. Department resources are arranged in organizational structures, such as stations and

Figure 4-1. The Local Public Service Production System.

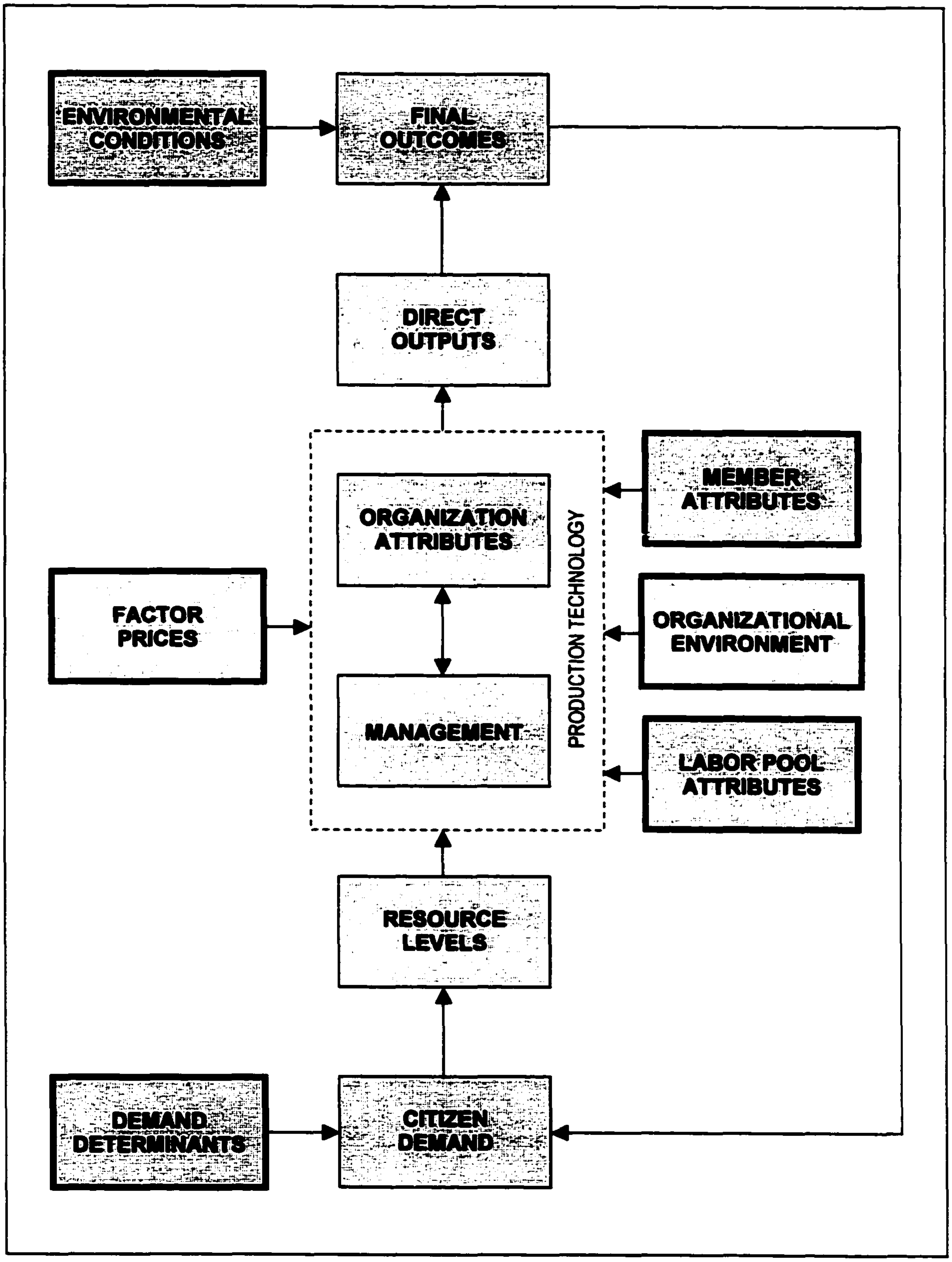
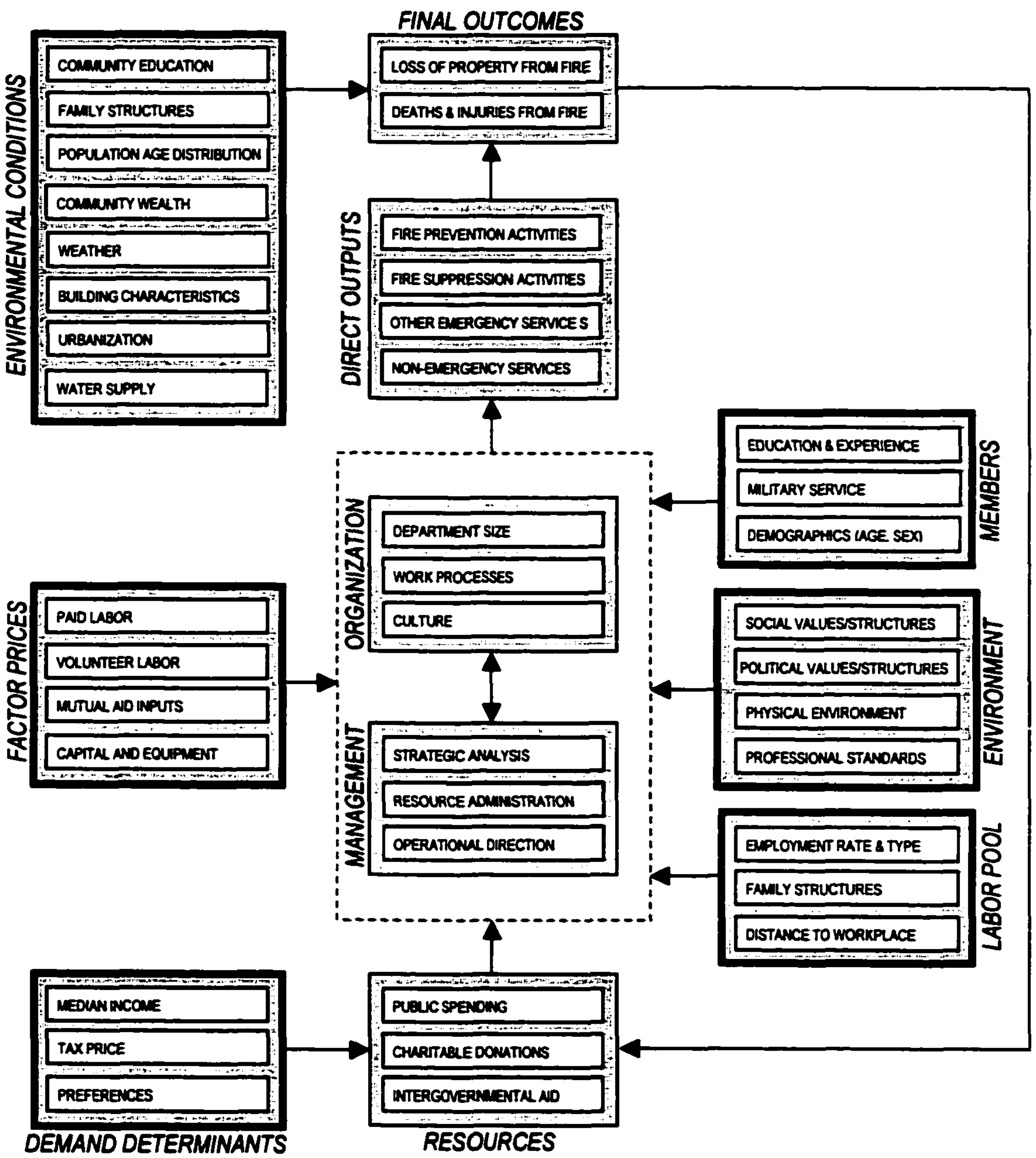


Figure 4-2. The Local Fire Service Production System.



companies, to facilitate the performance of specific tasks using prescribed work processes. Fire department managers then deploy these units to accomplish operational missions. The two activities that fire departments perform that are most directly related to fire protection are fire prevention and fire suppression, but it is important to recall from Chapter 3 that they must also allocate resources to an array of other emergency and non-emergency missions.

Given the harshness of the environment they face, which depends on a host of factors enumerated in Table 3-3, these activities result in some level of safety from fire for the community, as well as other outcomes. As a result of variation in environmental conditions, citizens in different jurisdictions experience different policy outcomes. That is, two different fire companies may achieve different levels of fire loss mitigation, even if they employ the same configuration of trucks and people using the same fire suppression tactics. If, for example, one fire company operates in Jacksonville, Florida, where buildings are new and built to modern codes and the temperature is 70°F, and the other operates in Fairbanks, Alaska, where most homes consist of 1960's vintage double-wide mobile homes with several plywood additions and the temperature is -40°F, the former community is likely to receive a higher service level for its dollar than the latter.

Figure 4-2 also illustrates some complexities about the production system that surface in the fire service. First, fire departments employ some combination of paid and volunteer labor, and these two types of labor have different costs –generally, volunteer labor is considered to be cheaper, though there are hidden costs here that may make it more expensive than many departments realize. Also, fire departments have access to the resources of other departments through mutual aid agreements. These resources are not costless, but there is generally no formal monetary compensation paid for this type of assistance. Finally, the governance structure of the fire department (i.e. whether the department is actually a local government itself, whether it is simply part of a municipality's operating budget, or whether it is an independently incorporated nonprofit organization under contract), describes how closely linked the department is to citizens and has some bearing on how much influence citizens will have over the department's budget and activities.

Four aspects of this model bear further attention: First, the model rests on a two-stage production process, which has implications for the form of the production and cost functions. Second, this system involves a market feedback mechanism –outcomes and resources are simultaneously determined– and a demand function must therefore be specified. Third, the role of organizations and management is central, and thus must be carefully defined and operationalized. Fourth, estimation of this model rests on the ability to identify input, output, and outcome measures. Each of these points will be discussed in turn.

4.2 Staged Production and the Resultant Production and Cost Functions

The model shown in Figures 4-1 and 4-2 distinguishes between direct service outputs and policy outcomes following Bradford, Malt, and Oates (1969), introduced in Chapter 2. As explained above, public production can therefore be viewed as having two stages: the transformation of inputs into outputs, where agencies choose and employ a mix of resources to carry out various activities, and the transformation of outputs into outcomes, where environmental conditions influence the nature of the final result of these activities. Also as explained in Chapter 2, the way in which inputs are combined to produce outputs is known as the production technology, commonly modeled via a production function, and which is, to some extent, the choice of the enterprise.

A production function is a mathematical equation that describes the relationship between the maximum attainable output, D, of a firm's production process and a specific combination of inputs to (or factors of) production, known as the production technology, or the way in which the factors of production are associated. Typically production factors include labor, L, and capital, K, and raw materials, X. Thus, production functions have the general form:[44]

$$D = f\,(L, K, X) \qquad [4\text{-}1]$$

The production function for local public services must account for both stages of production. As Duncombe (1991, 1992), Duncombe and Yinger (1993), and Duncombe and Brudney (1995) explain in their development of production and cost models for fire protection, Bradford, Malt, and Oates' (1969) assumptions imply that, in the first stage, local governments produce an intermediate output, G, with a standard production function, thus:

$$G = f\,(L, K) \qquad [4\text{-}2]$$

[44] Common specifications for production functions that have been applied to the fire service include the Cobb-Douglas production function (employed by Ahlbrandt, 1973) and Leontief function (used by Southwick and Butler, 1985), each of which imposes certain constraints on the nature of the production technology. Duncombe (1992) and Duncombe and Brudney (1995) test the applicability of these functions to the fire service, and finds that neither of these functions, nor a constant elasticity of substitution (CES) function, correctly describes the production of fire protection, in part because costs are not homogenous with respect to outputs. Duncombe (1985), Duncombe and Brudney (1995), and Duncombe and Yinger (1993) have therefore used the more flexible translog cost function to model the fire service.

Since inputs carry prices, each output level has an associated cost. Production functions can therefore be expressed in terms of costs. If it is assumed that governments minimize costs with respect to outputs, then the cost function for the first stage of production is:

$$TC = c\,(G, W, R) \qquad [4\text{-}3]$$

where W and R represent factor prices (wages and rents, respectively).

In the second stage of production, local governments produce the final service outcomes that citizens care about, S, which are depend on the level of service activity, G, as well as environmental conditions, E, and the jurisdiction's population (to account for nonrivalry), N, thus:

$$S = h\,(G, N, E) \qquad [4\text{-}4]$$

Or, solving for G:

$$G = h^{-1}\,(S, N, E) \qquad [4\text{-}5]$$

Which implies the following second-stage cost function:

$$TC = c\,[h^{-1}\,(S, N, E), W, R] \qquad [4\text{-}6]$$

The Duncombe, Yinger, and Brudney studies cited above make an important modification to Bradford, Malt, and Oates' (1969) construct, which assumes that environmental conditions only affect production in the second stage. They note that, for the fire service, environmental conditions are likely to influence the mix of resources a fire department chooses to employ –for example, the size, construction, and use of occupancies in a jurisdiction may affect the tradeoffs made between apparatus, equipment, and firefighters. They therefore incorporate a subset of environmental factors that affect factor substitution in the first stage of production, E', into their overall cost model, thus:

$$TC = c\,[h^{-1}(S, N, E), W, R, E'] \qquad [4\text{-}7]$$

The Duncombe, Yinger, and Brudney studies test this modification and find evidence to reject the Bradford, Malt, and Oates (1969) assumption that environmental factors only operate in the second stage of production.

4.3 Simultaneity and the Demand Function

As mentioned above, in the public production system shown in Figures 4-1 and 4-2, the final outcome levels and spending for a service are determined simultaneously. That is, the size of the budget determines how much of the service can be generated, and a certain level and quality of service requires a budget of a particular size: the outcomes of production contribute to ongoing production decisions, and total cost (total spending) and outcomes are endogenous. To be able to estimate this system, it is therefore important to identify independent determinants of the budget.

As explicated in long lines of literature about voter demand and mobility (discussed in Chapter 2), the types, quantities, and quality of services a government decides to provide is driven by citizens' preferences as expressed through their choice of where to live, how to vote, and what basket of goods and services to consume. Following Equation 2-4 and borrowing from the Duncombe, Yinger, and Brudney work, therefore:

$$S = d\,(Y, P, Z) \qquad [4\text{-}8]$$

Where Y is the median voter's income, P is the tax price the median voter faces, and Z is a set of voter preferences (most typically proxied by socio-economic factors that are thought to be strongly associated with voter preferences). The tax price is the price of an additional unit of a service that an individual voter faces –or how much the median voter must contribute to each additional budget dollar per capita– and is given by the product of the median voter's tax share (the ratio of the median to the per capita residential property value, V_M and V, respectively) and the marginal cost, MC, or the cost to produce one more unit of fire protection:

$$P = (V_M/V)\, MC \qquad [4\text{-}9]$$

4.4 Organizations and Management in Public Production

The public production framework presented in the previous two sections borrows from lines of work by Duncombe, Yinger, and Brudney. The main innovation of this dissertation is to extend this work by finding a way to incorporate the organizational and managerial nature of fire departments, on the basis of a belief that managers fundamentally affect a decision-making unit's productivity because they are the actors that make choices about the acquisition, arrangement, administration, development, and deployment of the resources that generate the unit's direct service outputs. Economic models typically depict only the end-result of these choices, often assuming them to be perfectly efficient solutions, and ignoring the idiosyncratic capacity and behavior of the people that make them. The experience of practitioners and study of public bureaucracies suggests the assumption of efficiency is unrealistic.

In Chapter 2 it was argued that productivity, a measure of the relative amounts of output and input involved in a given production process, is a useful means for evaluating performance comparatively across production units. Productivity varies as a result of differences in technology, the production environment, and the efficiency of the process (Lovell, 1993). The question of particular interest when analyzing the generation of public services is, therefore, whether and how the individual decision-making units can improve their levels of productivity by altering these components. For example, if the level of productivity is sensitive to the choice of technology, the government may be able to realize gains in outcomes by altering the way in which services are produced.[45] Hence, the organizational arrangements that define work processes and the activities of managers who direct them are central to the proposed model of public production.

The model presented in this chapter thus accepts an economic production framework but emphasizes the role of organizations and managers, incorporating factors about which there is good consensus in the organization theory and public management literatures. Organizational factors are more readily identified, as outlined in Chapter 2, and those included in Figure 4-2 are: size, work processes (tasks and technology), and culture, as the predominant drivers of organizational structure. These factors describe the nature of how work gets done by organizations, and thus forms the core of the first stage of production.

Two of these factors have been incorporated to a limited extent in previous work on the production of fire protection. Duncombe and Brudney (1995) address tasks by including service responsibilities in the second stage of production to show the level of activity necessary to produce a given outcome taking into account differences in service responsibilities. Similarly, they address technology by including the paid/volunteer staff mix in the second stage of production to account for the interaction between the labor

[45] It bears mentioning that some theorists, most notably Baumol (1967), assert that governments can do little to change their production technology. That is, public services tend to be inherently labor-intensive. For example, it is difficult to replace medics, teachers, or park rangers with machines, and thus public production technologies are generally static. Baumol's hypothesis does not, however,

force configuration and the environmental cost factors. They provide the example that "the impact old, multistory buildings may have on the cost of providing a given level of fire service quality may depend critically on the response time of the fire department" (1995: 362) which, they argue, may vary with the staff mix. The logic of this argument seems to indicate, however, that staff mix ought instead to be included in the first stage of production, whereby the intermediate output, response time, is seen to depend on staff mix, and to determine final outcomes in the second stage, given the environmental cost factors.

The organizational factors included in Figure 4-2 both influence and are influenced by managerial decisions, a more complex set of factors to operationalize. Some aspects of management were explored broadly in Chapter 2; the objective of this section is to offer a more operational definition of the managerial factors in the model. To this end, this model treats management as the process of directing, controlling, and coordinating the human, capital, and information resources of an enterprise to achieve specific, established collective objectives. It has three fundamental dimensions: strategic, structural, and operational, each of which will be described briefly.

4.4.1 Strategic

The strategic dimension of management centers around the formulation of organizational purpose and the development of an informed plan for realizing that purpose. In this arena, fire service managers must decide what their department can and should do immediately and over time. These decisions are based on an understanding of

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preclude the possibility of improvement in the quality of public services, nor does it necessarily imply that improvements do not involve technical advances.

what a community needs and wants with regard to fire protection services, as well as knowledge of the fire department's resources, abilities, and performance. Key functions associated with strategic management include defining the organization's mission, articulating a vision for the organization, establishing goals, objectives, and standards, setting priorities, devising operational and resource plans, developing evaluation criteria, monitoring and evaluating performance, and designing remedial or corrective strategies to improve performance.

4.4.2 Structural

The structural dimension of management involves the classic administrative functions of arranging, sustaining, and controlling organizational resources. Key administrative decisions in this realm include how to obtain adequate productive resources and how to preserve these resources in optimal operational condition. Structural management thus requires the manager to serve as an intermediary between the environment and the organization, exploiting the resource munificence of the environment. It also requires the manager to establish internal protocols by which resources will be systematized, inventoried, maintained, and controlled, including defining norms that will govern interpersonal relationships. Structural/administrative functions are often accomplished within a framework of management systems, such as financial management systems, human resources management systems, or information technology systems, that institutionalize procedures for tracking the performance and prescribing the behavior of the organization.

4.4.3 Operational

The operational dimension of management focuses on deploying organizational resources and securing essential services from them to fulfill the organization's goals and strategy. Here, managers decide what tasks the organization will undertake to meet its mission, determine what configuration of resources will be applied to perform each requisite task, prescribe appropriate behavior with regard to these tasks, and direct training programs that support optimal performance of these activities. Often managerial directives with regard to operations are codified in standard operating procedures, which reduce the day-to-day operational decision-making burden.

Figures 4-1 and 4-2 suggests that management and organizational factors may be both interrelated and interdependent. Fundamentally, managers direct and control work processes by defining tasks and technologies to improve productivity, implying that the interaction between managers and organizational work processes has more influence on productivity than would either alone or would their summed impacts: In short, good management makes resources more productive. Moreover, the influence of management on productivity is likely to vary across different organizational contexts. In addition, some organizational and managerial factors may be simultaneously determined. Organizational arrangements are the result of managerial choices, but also influence the decisions managers make.

Further complexity arises because the interaction between organizational and managerial factors and their influence on productivity also varies across external environments. Thus, not only does a given set of management factors enhance organizational productivity more in some fire departments than in others, but a given combination of fire department characteristics is more productive in some jurisdictions than in others. Figures 4-1 and 4-2 specify three key sets of factors that influence production technology: the organizational environment, the attributes of department members, and the characteristics of the available labor pool. Here, the organizational environment refers to cost factors that bear on the first stage of production in particular, specified as E', above. The attributes of department members include prior education and experience, age, sex, and military service. Arguably the composition of the labor force with regard to these attributes could be influenced by organizations and managers though biases in selection of members with certain characteristics, but the characteristics themselves are intrinsic and personal, and generally considered beyond the control of the fire department in this model.

These specifications imply that Equation 4-7 should be modified to incorporate sets of organization factors, O, and managerial factors, M, in the first stage, and also to account for the cost factors that affect the first stage as just discussed, thus:

$$TC = c\,[h^{-1}\,(S, N, E), O, M, W, R, E'_1, E'_2, E'_3] \qquad [4\text{-}10]$$

where E'_1 represents cost factors in the organizational environment, E'_2 is a set of member attributes, and E'_3 is a set of labor pool characteristics. This model demonstrates that managers make choices about the level, use, and mix of production inputs in response to influences from within and outside of their organizations. This model thereby highlights the key influence that managers have in public production and on performance, and also specifies the influences on managerial decisions and activities. The nature of these internal and external influences, and an approach to measuring managers' perceptions and valuation of them, are the focuses of the analysis presented in Chapter 6. The specification and estimation of equations that characterize the influence of various dimensions of organizations and management on the levels of spending and fire protection chosen by a community are the focuses of the analysis presented in Chapter 7.

4.5 Measuring Inputs, Outputs, and Outcomes

This chapter rests on the pretense that the systematic study of production functions will yield useful insights into the relationship between inputs and outcomes. In other words, if the production function can be specified, then it is possible to calculate the least cost configuration of inputs, and to prescribe actions that managers can take to optimize organizational performance. This reasoning implicitly assumes that it is possible to distinguish inputs, intermediate outputs, and final outcomes empirically. Many researchers recognize that it is often difficult to measure inputs, outputs, and outcomes, particularly in the government sector.

As Hanushek (1986) points out, production functions involve many inputs whose quantity, quality, and price are not precisely known, which makes the stream of inputs hard to characterize and its impacts hard to measure. The fire service case readily raises examples of this dilemma. As explained above, many fire departments rely on volunteer labor, the cost of which is difficult to quantify, though Duncombe and Brudney (1995) have made some progress here by developing a model of the economic costs of volunteer services in terms of recruitment, training, and supervision costs. Fire departments also frequently employ mutual aid resources, the costs of which are difficult to identify and have not been explored in the literature.

Furthermore, from the perspective of a community's overall level of protection from fire, many relevant inputs are beyond the control of fire departments, such as the private inputs property owners provide in the form of smoke detectors, fire extinguishers, sprinkler systems, or fire drills. Finally, some aspects of the fire protection process are cumulative, in that inputs applied in the past influence the level of protection a community enjoys in the present. For example, enforcement of building codes during construction offers protection throughout the life of an occupancy. The implication of these complications to precisely quantifying production inputs is the danger of generating biased estimates of their effects. As Hanushek (1986) points out, if the choice of inputs in the model omits important ones, or if they have inconsistent effects on performance as a result of unspecified interactions, estimates are difficult to interpret: The use of production functions is strained by the host of inaccessible tacit production decisions that constitute the formulation of inputs and their configuration (Murnane and Nelson, 1984).

Output measurement poses dilemmas as well. Key problems are that the direct outputs of public services are not always easily quantifiable, that public agencies often do not report their outputs and thus output data are not readily available, and that agencies typically have multiple outputs of which only some may be measured. Duncombe and Yinger (1993) note that many researchers turn to proxies for intermediate outputs that are either bundles of inputs, which ignore variation in the input mix, or are in reality outcome measures, which are not independent of the production environment. Likewise, measures of final results have similar limitations. In particular, chosen measures may not be closely related to the long-run missions and objectives of public agencies, may not reflect tradeoffs between conflicting goals, and may not capture the full impact of an agency across multiple outcomes.

Characterization of the fire protection production system suffers from several of these limitations, but some key measures of outcomes do exist for which consensus has developed in the literature. Most evaluators (see especially ICMA, 1998 and Hatry *et. al.*, 1992) and researchers (including the various studies by Duncombe, Yinger, and Brudney cited above) use three measures of the effectiveness of fire protection: civilian casualties (number of deaths and injuries due to fire relative to the jurisdiction's population), property loss (direct dollar loss per fire or relative to the aggregate property value in the jurisdiction), and number of fires (relative to population or property value). Another measure of the quality of fire protection that is commonly used in studies of the fire service is the fire insurance rating from the Insurance Services Office (ISO), which is based on extensive periodic evaluation of several dimensions of fire department capability, including personnel, equipment, training, and water supply.

These measures have both advantages and drawbacks. On one hand, they allow measurement of both major component of fire protection, using property and life losses as measures of fire suppression effectiveness and number of fires and casualties as measures of fire prevention effectiveness. In addition, these measures are commonly tracked and reported by fire departments, so data are often available. These measures are somewhat crude, however. For example, fire loss is not as precise a description of fire department capability as would be a measure of the extent to which fires are confined to the room of origin. Some evaluators have proposed and used such measures for big city departments (ICMA, 1998), but these data are very difficult to obtain for smaller, volunteer departments whose data management and reporting capabilities are often not as extensive. The ISO ratings do constitute a sophisticated quality measure, but they are updated infrequently and inconsistently, and are disproportionately driven by the availability of water in a jurisdiction.[46] Finally, these measures do not capture the results of other fire department missions or objectives –implicitly, these other activities are simply controlled for in the structure of the estimating functions as constraints on accomplishment of the selected fire protection results.

4.6 Hypotheses

On the foundation of the conceptual model presented in this chapter and extant perspectives in the literature, it is possible to specify a set of hypotheses about the influence of organizations and managers on public production that may be explored empirically. The central hypothesis this dissertation posits is that fire service managers perceive external environmental and internal organizational pressures on their departments and respond to them. As these pressures increase, fire department managers take actions and develop systems for using department resources more productively, and the average cost of fire protection falls. That is, the more protection from loss due to fire that stakeholders desire from a fire department for its jurisdiction, the stronger that desire is, and the more clearly it is communicated to the department, the more efficiently the department will employ resources in fire prevention and fire suppression activities,

[46] The ISO public protection classification system uses a ten-point scale, with one being the best rating. Any area that is more than five road miles to a responding fire station automatically receives a rating of ten, regardless of the quality of the fire department. Any area that is more than five road miles to a responding fire station and has hydrants more than 1,000 feet away automatically receives a rating of nine. Thus, the quality of the protection afforded by rural fire departments is possibly understated.

thereby providing more protection with the same levels of resources or providing the same level of protection with fewer resources.

This core perspective can be examined by defining nine testable hypotheses in three categories: external environmental pressures on fire departments and their managers, internal organizational pressures on fire departments and their managers, and managerial influence on fire department performance. While the data limitations of this dissertation prevent comprehensive tests of each of these hypotheses, the following discussions serve to frame specific questions about which empirical examination of the role of management in fire department performance may be focused, as will be demonstrated in Chapters 6 and 7.

4.6.1 Hypotheses regarding external influences on management

H_1 (Social environment): The more contact citizens in a fire department's jurisdiction have with the fire service, the more efficient the fire department will be, and the lower the jurisdiction's loss due to fire will be. There are two important and distinct ways in which the amount of interaction people have with the fire service may affect the production of fire protection. First, as citizens become more aware of the nature of firefighting and the results of firefighting activities, they are likely to scrutinize the behavior and activities of their fire department more closely. The public choice literature suggests that such scrutiny prompts public officials to choose a more efficient mix of resources and to use their resources more efficiently. Second, as citizens become more educated about the threat of fire and ways to reduce this threat, they may be induced to take actions that effectively make the firefighting environment less harsh and thus allow the same level of firefighting resource inputs to be more productive.

H_2 (Political environment): The more autonomy from external, local, general purpose governing bodies a fire department has, the less efficient the fire department will be, and the higher the jurisdiction's loss due to fire will be. As explained in Chapter 3, fire departments assume several configurations with respect to local governmental units: Some are embedded in municipal governments as subordinate departments, some are special governmental units themselves separate from the local municipal government, and some are independent corporations under contractual relationships with governmental units. The degree of distance from municipal government influences the extent to which fire departments are directly and regularly accountable to local political authorities, and ultimately to the public these authorities represent. If these ties are attenuated, fire departments may be more likely to pursue objectives that are inconsistent with the fire protection service instructions and expectations of the local government.

H_3 (Professional environment): The more autonomy from the regulations, standards, and norms of fire service associations and governing bodies a fire department exercises, the more efficient the fire department will be, and the lower the jurisdiction's loss due to fire will be. The larger fire service field in which a fire department is embedded is characterized by statutory and regulatory requirements, accreditation criteria, recognized performance standards, and accepted behavioral norms. Compliance with these rules may be costly to a fire department for two main reasons. First, compliance may involve purchase of additional or modification of existing labor, capital, or equipment resources, or a significant commitment of time. Second, compliance with a universal standard or norm may mean compromising a higher effectiveness level by abandoning behavior more suited to particular local conditions.

4.6.2 Hypotheses regarding internal influences on management

H_4 (Organizational tasks): The more diverse, numerous, and elevated a fire department's service responsibilities are, the less efficient the fire department will be, and the lower the jurisdiction's loss due to fire will be. In recent years, the missions of fire departments have expanded dramatically. As discussed in Chapter 2, fire departments no longer simply put out fires –increasingly, they are being called to respond to an ever-wider range of emergency and non-emergency situations, as well as to perform non-suppression functions. Moreover, publicity about the potential ability of emergency services to mitigate previously insurmountable threats has raised citizen expectations about the level and quality of service they receive. As fire departments are asked to do more, they can respond efficiently only to the extent that they can capture economies of scale and scope in their employment of department resources. If tasks are numerous and diverse, potential economies are reduced, and it is less likely that required tasks can be accomplished to the desired level of quality with existing resource levels and capabilities.

H_5 (Democratic culture): The more rigid, centralized, and hierarchical a fire department's management is, the less efficient the fire department will be, and the higher the jurisdiction's loss due to fire will be. Conversely, the more flexible, participative, and team-focused its management is, the more efficient it will be, and the lower the jurisdiction's loss due to fire will be. While fire suppression itself is a fairly predictable and analyzable task for which military-like organizational forms traditionally have been appropriate, the diversity of the modern firefighting workforce and the more dynamic role today's fire departments play in community protection call for moderation of the paramilitary culture. Fire departments that attempt to retain a top-down, authoritarian

management structure will be unable to accommodate the needs of the contemporary volunteer workforce –a workforce that must be gratified by its contribution to the community, else it will allocate its scare leisure time to other activities– and to cultivate the system of shared values central to cohesive interaction and coherent behavior.

H_6 (Professional culture): Fire departments with older, better educated, better trained, and more experienced firefighters will be more efficient than fire departments with less knowledgeable and skilled firefighters, and their jurisdictions will experience lower losses due to fire. Moreover, fire departments with paid personnel will tend to have more knowledgeable and skilled firefighters than all-volunteer fire departments. Firefighting is a labor-intensive endeavor. While some factor substitution may be possible, as Duncombe (1992) demonstrates, Baumol's hypothesis[47] probably holds for the fire service, in that firefighting is not easily automated –ultimately, people put out fires. Firefighting also requires a workforce with specialized knowledge, a high level of technical and tactical skill, and an innate ability to confront work that is dangerous and physically demanding, and that is available at all times. Thus, the quality of a fire department's workforce directly affects its performance. Since it is easier to control the quality of a paid workforce, and to ensure its availability, fire departments with at least some paid personnel can be expected to be more efficient. On the other hand, personnel costs for paid firefighters are significantly higher than for volunteers. Thus, optimal efficiency may be obtained at some staff mix between fully-paid and fully-volunteer, and

[47] Baumol's (1967) hypothesis states that if some sectors of the economy were to increase productivity, wages throughout the economy would increase, and production costs would increase in sectors where productivity does not improve. The nature of many government services precludes productivity gains because labor is the essence of these services, and wage increases cannot therefore be offset by factor

Baumol's claim may be overturned in part by the substitution of volunteer for paid labor.[48]

4.6.3 Hypotheses regarding management

H_7 (Strategic capacity): The more formalized and well-developed a fire department's strategic and resource planning ability is, the more efficient the fire department will be, and the lower the jurisdiction's loss due to fire will be. Formal planning systems permit fire service managers to have ready access to information about a fire department's resources, costs, and results. Fire departments with well established, well-developed systems for monitoring and measuring the relationship between inputs, outputs, results, and costs –i.e. departments that can gain knowledge about the efficiency of their operations– are likely to care enough about the level of fire protection in their jurisdictions to collect performance information and thus can be expected to have a propensity to use it to improve their performance. Managers armed with information about performance trends can make more fruitful adjustments to their chosen production technology, deploying their resources to optimize productive capacity. Managers can also think strategically about fire department activities and service priorities, thereby making decisions that support long-term performance improvements, rather than making "seat-of-the-pants" decisions about resource use.

H_8 (Administrative capacity): The better developed a fire department's formal human resources, financial, and capital management systems are, the more efficient the

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substitution. As a result, citizens must either reduce consumption of these services, or pay more for the current service quality and level.

[48] Duncombe and Brudney (1995) provide some evidence that this is the case, and estimate the cost-minimizing staff mix at different levels of volunteer administrative costs.

fire department will be, and the lower the jurisdiction's loss due to fire will be. Formal management systems permit fire service managers to track, marshal, develop, direct, and control its human, physical, and information capital, to discharge fire protection policies and programs. These activities support, but are distinct from, all of the other managerial work of government more directly related to fire prevention and suppression. Their role is to provide managers with information about and help managers account for the working condition and capability of organizational resources to ensure that the resources necessary to meet operational requirements are available and ready. Without sophisticated management systems, fire departments will have only fortuitously the resource capability they need to prevent fires effectively and suppress fires expeditiously. As one fire service adage claims, "Fires always burn down to the capability of the fire department."

H_9 (Operational capacity): Fire departments that employ modern firefighting techniques and technology will be more efficient than fire departments that do not use modern approaches, and their jurisdictions will experience lower losses of life and property due to fire. Another fire service saying predicts that "All fires eventually go out." The extent to which the fire department is able to speed this inevitable outcome depends on the fire suppression tactics and equipment it applies. While bucket brigades delivered water to fires in the 18th Century and could still do so today, almost 300 years of innovation have produced an array of sophisticated techniques and equipment that can greatly enhance the ability of fire departments to effect rescues and put out fires quickly. Some of these technologies are prohibitively expensive to smaller departments, but many are relatively low-cost. Nonetheless, fire departments have a reputation for allowing

tradition to impede progress and can be slow to adopt even proven approaches.[49] Those that are open to change and make the effort to educate themselves about modern technology are expected to see better fire protection results.

4.7 Conclusion

The model and hypotheses proposed in this chapter attempt to establish a framework within which conceptual and methodological approaches from public economics and public management can be brought to bear on the question of how organizations and managers influence the performance of local public production systems. This framework has important ramifications for analysis because it is substantially more complex, and therefore more demanding to estimate, than earlier models. The next chapter addresses the data demands implied by a research agenda that seeks to examine this model and test the hypotheses enumerated above.

[49] Anecdotal examples of this are easy to find in the field. For example, the benefits of using positive pressure ventilation to remove heat and hazardous gases from structure fires have been well documented for almost 20 years. This technique and the equipment that supports it is comparable in cost to the traditional and much less effective approach of using smoke ejectors, yet many departments refuse to adopt contemporary technology.

CHAPTER FIVE

SAMPLE SELECTION AND DATA COLLECTION

The previous chapter described a conceptual model that frames examination of the role of managerial functions and organizational attributes in local production of fire protection. Models that account for managerial and organizational factors in governmental activity provide a more realistic representation of the complexity of public production systems than earlier generation public demand and cost models. They can also serve to improve upon more rigid theoretical perspectives, such as classic implementation and agency theory, reviewed in Chapter 2. Such enhanced models extend the data demands of quantitative analysis, however. Beyond data about exogenous environmental forces, data collection efforts must now penetrate public agencies to capture variation in organizational and managerial attributes and behavior. Moreover, since this study seeks to gain purchase on the operation of the "black box" of public management from both objective and subjective perspectives, it relies on two distinct methodological approaches, regression analysis and factor analysis, each of which has different data requirements.

This chapter will explain the multi-method data collection effort that supports this dissertation. It begins by addressing the sample frame, explaining the rationale behind sample selection, the selection criteria, and the character of the resulting sample structure. Next, the relevant independent data sources are identified, and the nature of the data collected is described. The discussion then turns to the centerpiece of the data collection effort: the three survey mechanisms by which internal organizational and managerial attributes were examined. The survey instruments, survey administration, and interview approach are described. Following explanation of the survey process, the important role of census data in this study is addressed, and the method by which census data were mapped onto fire jurisdictions is explained. Finally, descriptive statistics for the final sample are presented and discussed. The chapter concludes by considering the limitations of the data that were obtained.

5.1 Sample Frame

This dissertation aims at a better understanding of local public service production through examination of the case of fire protection in New York State. This choice begs two questions: Why is fire protection a worthwhile object of study, and why does New York State provide an appropriate empirical opportunity? The objectives of this section are to explicate the justifications for these choices and to delineate the sample that emerged as a result of them.

5.1.1 Rationale

Fire departments present a uniquely useful vehicle for studying the questions of public service provision for several reasons. First, fire protection is unequivocally a core public service. General agreement on the appropriateness of fire protection as a publicly provided service shifts debate off the policy question of whether or not government should be involved in this type of service to the key issues of interest here: whether it is cost efficient and why or why not. Second, fire departments are ubiquitous but not uniform. Essentially all urban and most populated rural areas are protected by some form of fire service agency. As was described in Chapter 3, however, fire protection is produced via a wide variety of public, private, and nonprofit organizational configurations that vary dramatically in their legal status, governance structure, staffing, funding, equipment, and activities. Such variation provides an opportunity to compare the relative performance of various service production options.

The third reason fire departments are useful for studying public production is that public fire protection costs represent an important component of local government budgets. Thus, the public provision of fire protection raises significant local public finance concerns. Fourth, the fire service has come under scrutiny as conditions of fiscal stress have prompted local officials to consider alternative service delivery priorities, mechanisms, and arrangements. The organizational and managerial dimensions of the production of fire protection have received relatively little academic attention, however, and thus decision-makers have little theoretical or empirical evidence on which to base choices among alternatives. Fifth, fire protection involves a relatively simple set of inputs and outcomes that can be more clearly specified than those of other public services, suggesting that measuring the results of managerial activities may be more possible for this service than for others. Finally, the configuration of fire departments resembles that of other special-purpose agencies, such as school districts, indicating that any empirical traction gained through study of fire protection may contribute to scholarship about other local public services.

The next important choice made in establishing the sample frame for this study was to limit it to New York State. This decision represents a trade-off between the control of unobservable heterogeneity and the generalizability that would be obtained through a broader sample more representative of the fire protection experience across the nation, and the cost of data collection in terms of time and access. Because variation in organizational form is particularly germane to the research focus of this study, it is important to capture organizations of all types, from large city departments to very small, rural, all-volunteer departments. A broader geographic scope therefore offers more opportunity to incorporate variation, but also presents more extreme data collection challenges because volunteer departments may have personnel in station only intermittently and their limited personnel grapple with the multiple routine demands of fire protection in their spare time, so they are likely to have little residual energy to commit to survey responses. With these constraints, it is more reasonable to conceive of obtaining data expeditiously from a proximal source directly accessible to the researcher, and therefore this study was confined to New York State.[50]

New York State affords several advantages that help cope with the challenges of data collection. First, there is a diverse variety of organizational types represented in good proportion throughout New York State. These organizational types fall into four broad categories: city departments (3.4% of the total population of fire departments in the state), village departments (21.6%), fire districts (45.3%), and independently incorporated companies (29.7%). City and village departments are agencies within the general purpose municipal government. Fire districts are autonomous special purpose governments governed by publicly elected commissioners, with the authority to levy taxes (collected for them by towns) and issue debt instruments. Finally, since cities and villages are the only general purpose governments allowed to organization fire

[50] Some studies have attempted to use national samples, but these are typically confined to major metropolitan departments (see, for example, the annual Phoenix Fire Department Survey of Fire Department Operations, which looks at about 350 of North America's largest departments and includes no volunteer agencies), or suffer from low response rates (For example, the National Fire Protection

departments under New York State law, many towns are covered in part or whole by fire protection districts, where fire departments in one of the above categories affords protection under contract with the town. Over 23 percent of the state's fire departments protect town fire protection districts. Each of these categories of fire departments relies to varying extents on both paid and volunteer firefighters. Table 5-1 shows the proportions of fire departments by category and staffing in New York State.

Table 5 1. Distribution of Fire Departments by Legal Structure and Staffing in New York State, the Sample, and Among the Respondents.

Type	Staff Mix	State*	Sample	Respondents
City	Paid	33	12	6
	Volunteer	9	1	0
	Combination	19	4	1
	Total	61	17	7
Village	Paid	7	1	0
	Volunteer	359	105	36
	Combination	19	2	1
	Total	385	108	37
District	Paid	0	0	0
	Volunteer	783	158	67
	Combination	27	14	9
	Total	810	172	76
Independent	Paid	11	0	0
	Volunteer	514	138	53
	Combination	6	0	0
	Total	531	138	53
OVERALL		1787	435	173

* State figures are estimated from 1989 data

Association, a major professional association with national recognition and acceptance in the fire service, reports that only about 30% of the departments it surveys each year respond).

The second advantage to data collection that New York State offers is its network of county fire coordinators. These are appointed county-level public officials (mostly full-time paid personnel, but some part-time and some volunteers) whose job is to orchestrate the fire protection resources of their counties and to establish policies governing regional resources, such as 911 communications, training programs, disaster plans, emergency equipment stockpiles, and specialized response capabilities. These officials have regular contact with all fire departments in their counties, often convening or attending monthly meetings of their counties' fire chiefs. They also maintain basic data about the fire departments in their counties, including the departments' mailing addresses, their current equipment and manning, and the location of fire district boundaries.

The third benefit of selecting New York State is that it mounts a more comprehensive effort to monitor the performance of its fire services than do many other states. New York State's Office of Fire Prevention and Control (OFPC) collects important data about the state's fire departments to support the state's participation in the National Fire Incident Reporting System (NFIRS). Fire departments in New York State are required by law to report extensive data about every emergency response they make. On this basis, the OFPC produces an annual report entitled "Fire in New York" that compiles selected statistics about response type and volume across the state. It is important to note, however, that, while vital, the data available from the OFPC have important limitations. Many departments do not comply with reporting regulations. Those departments that do report frequently submit data that is incomplete or inaccurate. Furthermore, most of this data is not available in automated form, and obtaining hard copies is arduous. Nonetheless, some key performance data are centrally collected by New York's state government.

In addition to the response statistics available from the OFPC, the New York State Comptroller's Bureau of Municipal Research and Statistics collects some financial data related to fire protection. Total expenditures for fire are reported annually for cities, villages, towns, and counties. In addition, more detailed departmental financial data are available for fire districts. These data are not collected from city and village departments, since they are incorporated into municipal budgets, nor from independent fire companies, since they are not instrumentalities of government and are not bound by governmental reporting systems.

Given these advantages to confining the study to New York State, the issue remains whether generalizability is significantly compromised by limiting the study in this way. There is some evidence that the nature of fire departments varies somewhat across regions of the United States. For example, the NFPA reports that the number of career firefighters per capita is somewhat higher for the Northeast that for other regions of the country. The number of volunteer firefighters per capita is also higher for the Northeast than for other regions of the country, except for in communities under 2,500, where the Northeast is average (NFPA, 1998). Similarly, the National Fire Data Center (NFDC) reports that fire death rates vary regionally, with the highest rates in the Southeast. New York is about average (NFDC, 1998). The NFDC also notes that causes of fires are similar around the nation.

Overall, despite the variations noted above, the nature of the fire protection experience in New York State appears generally similar to the national experience in several ways. First, fire protection is universally a local function, and typically is tax supported. Also, fire departments exhibit similar structures around the country –the majority of fire departments in all states are volunteer, and most states include municipal departments, special districts, and nonprofit corporations, as New York does. In addition, the annual number of fires is dropping across the nation, and other emergency missions – particularly emergency medical response– are gaining emphasis in fire departments everywhere. Finally, fire departments in most areas report constrained budgets that do not keep pace with inflation (Moulder, 1992), and the topics featured in trade journals and at professional conferences this year reflect an array of alternative service delivery arrangements under consideration throughout the country.

5.1.2 Sample selection

On the basis of the rationale outlines in the previous section, a sample of fire departments in New York State was chosen. The structure of the sample rested on three key criteria. First, the relevant population was considered to include all fire departments in New York State *excluding* New York City and Long Island. New York City was excluded because its fire problem is disproportionately large compared to the remainder of the state: There were 60,158 fires in New York City in 1998 compared to only 37,612 in the remainder of the state. New York City's fire department currently employs 10,997 uniformed personnel, over 92 percent more than the state's next largest city, Buffalo, which employs 862. Long Island fire departments were excluded because fire service professionals in New York State generally consider the behavior of these departments to be idiosyncratic. While much of the evidence to support this claim is anecdotal, it is pervasive. These wealthy all- or mostly-volunteer departments are notorious for activities such as having paid bartenders on staff, sending their members on cruises, maintaining fire engines that are competition dragsters, and hosting upwards of twenty gala parties per year. Some stories about "the island" are no doubt exaggerated, but enough credible stories circulate to warrant omitting Long Island from the study as an outlier relative to typical volunteer departments.

The second decision that guided sample selection was to structure the sample by county, in order to capitalize on the county fire coordinators as a data collection resource. While it would be preferable to structure a random sample of the entire state, possibly stratified by department type, in order to bolster representativeness and control for unobserved heterogeneity, such a strategy would require the researcher to enlist the assistance of 55 county fire coordinators,[51] which would be excessively time consuming. Instead, a more feasible sample structure was chosen that included all fire departments in 20 counties, making administrative demands more manageable and greatly reducing the cost of data collection.

The third criterion for sample selection was the county-level reporting record with respect to fire incident reports. As noted above, New York State law requires fire departments to report incident data to the OFPC, but many departments fail to do so. Some counties have better reporting records than do others, mostly because the fire coordinators in these counties take an active role in ensuring that their departments submit reports. The OFPC data includes the only available comparable outcome measures; only departments for which these data are available can be included in the

[51] There are 62 counties on New York. Omitting the five boroughs of New York City and the two counties on Long Island, the 55 remaining counties constitute the population relevant to this study.

study because independent collection of these data would be cost prohibitive. It is therefore sensible to sample counties in which outcome data is available for a high proportion of fire departments.

This third selection decision is obviously more problematic in terms of the danger of introducing bias, particularly since this study is about management, and output activity reporting might be presumed to be correlated with management capacity. To help mitigate this concern, before identifying the sample counties, a series of county-level criteria were identified against which to evaluate the characteristics of a sample of counties relative to characteristics of the remainder of the counties in the state. The criteria, listed in Table 5-3, relate to environmental conditions that other research, reviewed in Chapter 3, has shown can be relevant to firefighting operations. The top 20 counties in terms of fire incident reporting percentages were then identified and evaluated according to these criteria using county-level U.S. Bureau of the Census data from the 1994 Counties File of the *City and County Data Books*, and county-level fire protection data from the OFPC's 1997 annual report. The results of this analysis are described in the following section.

5.1.3 Sample characteristics

The sample chosen for this study is a single-stage cluster sample of fire departments, where the clusters are 20 counties in New York State. The chosen counties are distributed geographically throughout the state, and all economic development regions are represented. Figure 5-1 shows a map of the sample. In addition, at the fire department level, the county sample captures 9.6 percent of the population of fire departments. Table 5-2 shows that the sample of fire departments closely parallels the population with respect to the distribution of departments by legal structure and staff mix.

Table 5-2. Proportions of Fire Departments Represented in New York State, the Sample, and Among the Respondents by Legal Structure and Staffing.

	State*		Sample		Respondents	
Characteristic	**Total**	**Percent**	**Total**	**Percent**	**Total**	**Percent**
City	61	3.4%	17	3.9%	7	4.0%
Village	385	21.6%	108	24.8%	37	21.4%
District	810	45.3%	172	39.6%	75	43.4%
Independent	531	29.7%	138	31.7%	53	30.6%
Paid	51	2.9%	13	3.0%	6	3.5%
Volunteer	1665	93.2%	402	92.4%	156	90.2%
Combination	71	4.0%	20	4.6%	11	6.4%

* State figures are estimated from 1989 data

The county sample was not selected using probability procedures, but the counties included appear fairly representative of the counties in the state along the criteria described above and other census information. A t-test for sample independence shows that differences in the mean values between the sample counties and the remainder of the population with respect to the criteria in Table 5-3 are not statistically significant.[52] The results of the difference in means test for the criteria are shown in Table 5-4. Difference in means test were also performed for 254 values from the 1990 Census of Population and Housing, with similar results.[53] (These results are available from the author.)

[52] There is one exception to this result: For direct general government expenditure per capita the null hypothesis that the means of the samples are equal can be rejected. This criterion is crudely constructed, however, representing all city expenditures divided by county population, and probably does not indicate spending for fire protection county-wide very clearly.

[53] The null hypothesis that the means of the samples are equal could be rejected for only 3 values out of 254. These were: the number of vacant housing units, the number of mobile homes, and the number of

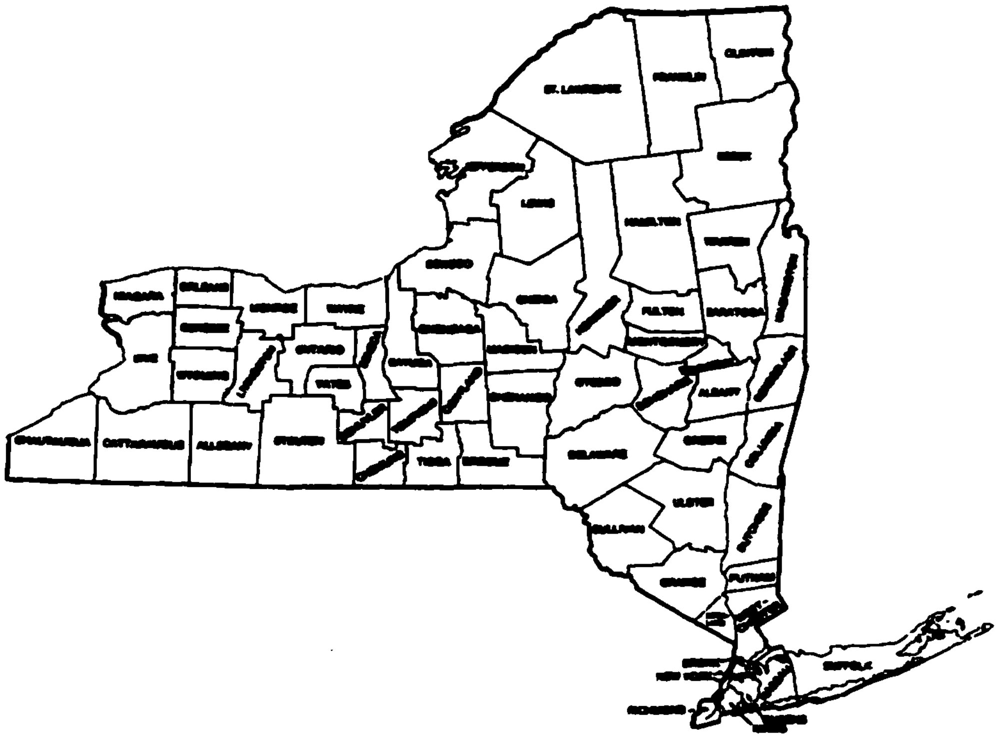
Table 5-3. County Sample Selection Evaluation Criteria.

URBANIZATION	
1.	Economic development region*
2.	Number of cities with populations over 10,000
3.	Percentage of land area that is farmland
4.	Population density
WEALTH	
5.	Per capita income
6.	Percentage of households with annual incomes below $15,000
7.	Percentage of households with annual incomes over $75,000
8.	Direct general government expenditure per capita
BUILDING CONDITION	
9.	Percentage of housing that is owner-occupied
10.	Median owner-occupied house value
11.	Percentage of housing units that were built before 1940
12.	Percentage of housing units with public water
FIRE PROTECTION	
13.	Number of fire departments per 100 square miles
14.	Number of fire departments per 100,000 people
15.	Number of civilian deaths and injuries per 100,000 people
16.	Number of fires per 100,000 people

* As defined by the New York State Department of Economic Development

housing units heated with propane. While these variables can be expected to bear on the nature of the firefighting environment, these differences are probably overwhelmed by the similarities on all other dimensions. Moreover, one county ultimately elected not to participate in the study. When this county is excluded from the sample, the difference in means between the sample and the remainder of the population on these three values becomes insignificant.

Figure 5-1. Map of Sample.



COUNTIES INCLUDED IN SAMPLE:

Allegany	Essex	Monroe	Schuyler
Chemung	Fulton	Montgomery	Tompkins
Clinton	Genesee*	Niagara	Warren
Cortland	Jefferson	Orleans	Wyoming
Dutchess	Livingston		Yates

*Chose not to participate

Table 5-4. Results of Independent Samples Test.

Criterion	Sample =1	N	Mean	SD	Difference	t*	p
2	1	20	0.75	0.79	-0.22	-0.6937	0.4909
	0	35	0.97	1.29			
3	1	20	35.57	19.61	6.99	1.4488	0.1533
	0	35	28.58	15.73			
4	1	20	189.41	237.56	-85.50	-0.8124	0.4202
	0	35	274.91	433.82			
5	1	20	16319.95	3545.89	-898.36	-0.8331	0.4085
	0	35	17218.31	4005.34			
6	1	20	24.08	5.55	-0.06	-0.0422	0.9665
	0	35	24.14	5.17			
7	1	20	6.89	5.82	-0.60	-0.3630	0.7180
	0	35	7.49	5.96			
8*	1	20	1.81	0.18	-0.17	-2.2120	0.0313
	0	35	1.98	0.32			
9	1	20	69.85	6.33	-0.57	-0.3699	0.7129
	0	35	70.42	5.02			
10	1	20	74855.00	36950.39	-9996.43	-0.8079	0.4228
	0	35	84851.43	47691.08			
11	1	20	40.32	9.48	1.00	0.4177	0.6779
	0	35	39.32	7.94			
12	1	20	58.25	17.42	0.11	0.0194	0.9846
	0	35	58.14	20.90			
13	1	20	3.64	1.29	-0.97	-1.5872	0.1189
	0	35	4.61	3.19			
14	1	20	32.12	15.56	-5.59	-0.7035	0.4848
	0	35	37.71	33.45			
15	1	20	10.42	8.00	1.52	0.6859	0.4957
	0	35	8.89	7.87			
16	1	20	595.95	99.29	-44.23	-1.1054	0.2740
	0	35	640.17	162.01			

* The t-test is two-tailed. Equal variances are assumed, except in the case of the number of fire departments per 100 square miles, based on Levene's test.

5.2 Data Sources

This dissertation relies on an array of data sources and collection methods to obtain data that can triangulate on the role and actions of organizations and managers in public production. This section reviews the data sources that were used, and explains how primary source instruments were designed and administered, with a view toward establishing the validity of the data obtained.

5.2.1 Secondary sources

The focus of this dissertation is fire department management, and thus this study depended on fire departments themselves to provide a great deal of information. To reduce the reporting burden on individual departments, as much information as possible about each department in the sample was obtained from secondary sources. The most important of these were the OFPC and the New York State Comptroller's Division of Municipal Affairs, both of which were very supportive of the project.

The data obtained from the OFPC pertains to the outputs and outcomes of individual fire department activities. The OFPC provided a master list of all of the fire departments in New York State, the number of civilian deaths and injuries and fire losses experienced by each fire department in the state in 1997, and department, county, and state-level data on the number of calls to which each fire department in the state responded in 1997, by call type. The county- and state-level data were in automated form, but the department-level data were only available in hard copy, and were entered manually and audited by a second person.

The data obtained from the State Comptroller pertains to each fire jurisdiction's public expenditures for fire protection. The Division of Municipal Affairs provided city, town, and village expenditure totals for fire protection, as well as total expenditures by fire districts, for 1997. City and village expenditures could generally be attributed to a single fire department. Sometimes towns were entirely protected by a single department, in which cases the allocation of expenditure data was straightforward. More often, however, towns were carved up into fire protection districts, each protected a different fire department. These town's fire protection expenditures therefore had to be allocated among multiple departments. In these cases, an attempt was made to obtain total tax revenue figures from the fire departments directly. Failing this, expenditure levels per department were approximated by allocating total town expenditures among the departments in proportion to the approximate percentage of the town's total land area each protected, estimated through visual inspection of maps of fire jurisdiction boundaries.

Other secondary data sources were drawn upon to a lesser extent to help provide values missing after the primary data collection effort discussed below. These included the following:

1. A current comprehensive list of fire protection classifications for New York State localities purchased from the Insurance Services Office.
2. Data about the leadership, legal structures, staff mixes, equipment inventories, budgets, missions, and call volumes of some fire departments posted at individual fire department web sites.
3. Data about the mailing addresses, legal structures, staff mixes, equipment inventories, budgets, and call volumes of some fire departments recorded in a 1995 national directory of fire departments published by the PennWell Publishing Company for *Fire Engineering* magazine.
4. Data about the legal structures, staff mixes, equipment inventories, budgets, and call volumes of some fire departments included in *Firehouse Magazine*'s annual "Volunteer Run Survey" for 1996.

5.2.2 County fire coordinator survey

In this study, primary data collection began with the County Fire Coordinators. As explained above, the county coordinators are responsible for supporting the provision of mutual aid among emergency services providers by maintaining inventories of the resources of the response agencies in their counties.[54] In January of 1999, the fire coordinators of the 20 counties sampled in the study were contacted by mail and telephone for several purposes. First, the project was explained to each coordinator to solicit support of the effort. Each coordinator was also asked to complete a short written survey that requested a simple inventory of the legal organization, vehicles, personnel, and protection responsibilities of each fire department in his county. The survey form is included at Appendix 1. In addition, each coordinator was asked to provide a current mailing address and telephone contact list for the fire chiefs in his county, as well as a map that showed the boundaries of each department's jurisdiction.[55] Finally, arrangements were made with each coordinator to attend an upcoming monthly fire chiefs' meeting to explain the project to the chiefs directly, and ask for their participation.

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[54] Mutual aid is a system by which emergency response agencies assist one another by providing resources in instances where the capacity of a primary response agency is overwhelmed, either because a single incident is unusually demanding of resources, because specialized resources are required that the agency does not own, or because multiple incidents occur at once. New York State has a statewide mutual aid policy, in which most departments participate, that stipulates that communities will assist each other in significant emergencies. OFPC personnel specially trained in the national incident command system manage the provision of statewide mutual aid for large-scale fire incidents and natural disasters through the New York State Fire Mobilization and Mutual Aid Plan. Many counties also have more specific county-wide policies managed by the County Fire Coordinators. Further, departments may have formal or informal agreements amongst themselves. Under these agreements, mutual aid may be dispatched automatically, under conditions specified in a pre-planned response, or may be provided upon request.

[55] The cooperation of the fire coordinators with respect to this information was of particular importance because it is not maintained at the state level. The OFPC's list of fire chiefs is several years out of date, which makes it highly inaccurate, since most departments hold annual elections of officers. Moreover, extensive inquiries revealed that no state office possesses maps that show fire jurisdiction boundaries.

After a ten-month series of follow-up letters, telephone calls, and personal visits to the county fire coordinators, complete responses were received from 16 of the 20 coordinators. Partial responses were received from another three coordinators. Missing data from these responses were obtained through follow-up work with other sources. One coordinator replied to the initial written survey, but refused to support the study further, and actively discouraged the fire departments in his county from participating. Ultimately, only one fire department of the 18 in that county participated in the study.

5.2.3 Fire department written survey

The centerpiece of this study and the data collection effort was an extensive written survey administered to fire departments. The survey instrument was designed to obtain data about a fire department's missions and service responsibilities, organizational structure, resources, and financial, human resources, and capital management practices and systems. The draft instrument was examined by five reviewers experienced in social science survey design and administration. The draft was revised and then pilot-tested with ten fire chiefs in Onondaga and Madison Counties, who completed the survey and provided comments in response to a series of questions about its content and clarity. The instrument was again revised to finally include approximately 100 multi-part closed-ended questions. The final instrument is included at Appendix 2.

The survey, an introductory letter, and a postage-paid business reply envelope were mailed to the fire chiefs of the 435 fire departments in the 20-county sample in late April, 1999. Reminder postcards were mailed ten days later, and again one month later. Beginning one month after the survey was originally sent and continuing through July, all fire departments that had not yet responded were contacted by telephone or email and asked to respond. Surveys were resent to departments that had not received or had misplaced them. In addition, half-hour presentations to fire chiefs were made at 17 county-wide fire chiefs meetings during May and June, and additional copies of the survey were distributed to chiefs in person at these meetings. Finally, in August, departments who had agreed to participate but had not yet responded were sent an appeal letter with another copy of the survey and were contacted again by telephone.

Surveys were received at a slow, fairly steady rate from early May through September. A few more trickled in until the last response was received on November 1, 1999. In total, 173 surveys were received, for a response rate of 40 percent. Table 5-2 shows the types of respondents by department legal structure and staff mix, compared to the sample and the population, and indicates that the distribution of departments among the respondents closely parallels that in the population. Table 5-5 shows the number of respondents by county. All survey responses were coded using a straightforward numerical system, entered into a database, and audited by the author. During data entry, missing values that could readily and reliably be extrapolated from answers to other questions or from the secondary data sources listed above were supplied.

5.2.4 Fire chief survey and interviews

As a supplement to the written survey and to address more directly the research question of how fire chiefs perceive pressures in their decision-making environments, a group of New York State fire chiefs was interviewed and administered a separate survey from that described above. This fire chief survey was based on Q methodology, a technique designed to facilitate systematic subjective study of perceptions that also provides an efficient and methodic framework for conducting interviews. The fire chief

Table 5-5. Response Statistics.

County	Departments	Respondents	Percent
Allegany	29	14	48.3
Chemung	20	12	60.0
Clinton	22	15	68.2
Cortland	12	9	75.0
Dutchess	37	15	40.5
Essex	24	10	41.7
Fulton	17	6	35.3
Genesee	18	1	5.6
Jefferson	46	14	30.4
Livingston	20	8	40.0
Monroe	36	13	36.1
Montgomery	19	8	42.1
Niagara	32	9	28.1
Orleans	12	4	33.3
Putnam	14	7	50.0
Schuyler	9	3	33.3
Tompkins	16	6	37.5
Warren	23	10	43.5
Wyoming	19	4	21.1
Yates	10	5	50.0
TOTAL	435	173	39.8

survey thus satisfies two key objectives of this study: It reveals and typologizes fire chiefs viewpoints, and it adds contextual richness to support interpretation of the written survey data. Q methodology and the administration of the fire chief survey are explained in Chapter 6; this section describes who was included in this portion of the project. The fire chief survey instrument is at Appendix 3.

The Q approach is designed to identify perspectives or points of view that exist among members of a population. Since this study seeks, among other things, to identify and describe the perceptions fire chiefs in New York State have of their decision-making environments, the fire chief survey was administered to a group of chiefs from different types of departments and with a broad range of experience. An important feature of Q methodology is that it does not depend on large or probabilistic samples. Therefore, the sample frame for the fire chief survey included some chiefs who had participated in the pilot or actual fire department survey process described above, as well as some who were members of the New York State Career Fire Chiefs' Association, to whom the survey was administered during a monthly meeting of that group.

The fire chief survey was administered to 32 chiefs from 32 different fire departments in 21 counties in central New York State between August and November, 1999. Of these chiefs' departments, 13 had fully-paid staffs, 12 had all-volunteer staffs, and seven were staffed by a combination of paid and volunteer personnel. Of the chiefs themselves, 18 were paid and 14 were volunteers. Fifteen of the chiefs were from departments that also responded to the written survey. In two additional cases fire chiefs that participated in the fire chief survey were from departments that were included in the main fire department sample, but did not respond to the written survey.

5.2.5 Census data

One important requirement of the analysis of the production of public services is the ability to control for exogenous influences on the production process and on the nature of outcomes, as explained in Chapter 4. Previous studies have demonstrated that several environmental factors that bear on the incidence and cost of fires are captured by census data (as shown in Table 3-3 and by the work of Duncombe, Yinger, and Brudney cited in Chapter 4). Moreover, the model presented in Figure 4-2 suggests that environmental factors are relevant to managerial decision-making, and thus measures of them are vital to estimation of the influence of management with respect to policy outcomes. This dissertation therefore draws heavily on data from Summary Tape File 3 of the 1990 Census of Population and Housing.

The important role of census data in this study posed a difficult data gathering dilemma for three reasons. First, fire jurisdiction boundaries are not coterminous with any other political boundaries, nor with census tracts or block groups, except fortuitously. Second, in most cases there are no records of New York fire jurisdiction boundaries maintained in automated Geographic Information Systems (GIS). Third, current and precise hard-copy maps of fire jurisdiction boundaries generally do not exist at aggregate levels and are not maintained by any central government office. Government taxation offices do maintain information that identifies in which fire jurisdiction a given parcel of land is located so that property taxes may be assessed and distributed correctly, but this information is not aggregated onto usable maps that show fire jurisdiction boundaries. Individual fire departments often have maps that show their own jurisdictions, but obtaining copies of them would be more even trying than obtaining survey responses.

Finally, county fire coordinators sometimes have maps of the fire jurisdictions in their counties. Ultimately, copies of these maps were obtained. In cases where they were not available, fire coordinators were asked to sketch the fire jurisdiction boundaries on standard road maps.

Once county-level maps of fire jurisdiction boundaries were obtained, the locations of these boundaries were manually transferred to census maps, so that the relationship between fire jurisdictions and census tracts and blocks could be ascertained. Based on these consolidated maps, it was possible to visually estimate what proportion of a given census tract was protected by a given fire department, and, conversely, what proportion of any given fire jurisdiction was represented by a given census tract. On the basis of these estimates coupled with data provided by the country fire coordinators about the area and population protected by each of their fire departments, census values were imputed for each individual fire jurisdiction in the sample. The imputation rules are explained in Appendix 4.[56]

5.3 Descriptive Statistics of Sample Departments

To give a sense of the organizations that were ultimately included in this study, the minimum, maximum, and mean values along some basic descriptors among the fire departments that responded to the written survey are provided in Table 5-6. These descriptors capture the human, capital, and financial resource levels, key environmental factors, and some outputs and outcomes. These simple descriptive characteristics

56 The imputation process was arduous, time consuming, and admittedly little better than a rough estimate. Consultation with researchers familiar with census data and concerned with its application to other special districts revealed that no standard imputation scheme exists, however.

Table 5-6. Descriptive Statistics.

	Minimum	Maximum	Mean
Population protected	250	61,840	5,873
Area protected (square miles)	1	280	42
Age of department (years)	5	191	78
ISO rating	2	10	6
Number of fire engines	1	8	2.5
Number of aerial ladder trucks	0	3	0.3
Number of ambulances	0	3	0.6
Number of stations	1	5	1.4
Total number of personnel	12	238	57
Number of volunteers	0	238	54
Number of paid personnel	0	144	3
Percent of personnel that are female	0	79	9
Percent of personnel that are minorities	0	8	0
Percent of personnel that are EMT's/paramedics	0	99	27
Average age of firefighters	19	52	36
Percent of personnel that are college graduates	0	69	22
Percent of personnel with military experience	0	66	17
Annual hours of fire department training	24	3840	255
Local expenditures on fire (1997)	5,215	9,430,347	409,974
Total number of emergency responses	1	4152	321
Number of fire calls	0	587	33
Number of medical calls	0	2331	147
Civilian deaths and injuries (1997)	0	36	0.7
Total fire loss (1997)	0	6,589,900	230,061

indicate that there is a great deal of variation in the nature of the departments that participated in the survey, giving hope that the data collected may have some explanatory power. One exception to this is the demographic composition of the departments in the study –most are comprised almost exclusively of white males. Some have a small number of female firefighters, and only a few have minorities represented in their labor force.

5.4 Conclusion

The data amassed in support of this dissertation represent one of the most comprehensive fire service data sets available today. Other much larger data sets exist, but they do not include comparable detail about the internal management practices of fire departments; other more detailed data sets also exist, but they do not represent the population of paid, volunteer, urban, and rural fire departments as broadly. One contribution this dissertation therefore makes is the availability of rich, multi-dimensional data as the foundation for new kinds of analyses and a clearer perspective on the fire protection production system. It must, however, be acknowledged that the data collected have some important limitations in terms of validity, reliability, and freedom from bias that constrain their ability to support fulfillment of the analytical goals outlined in Chapter 4. These issues are the subject of this section.

One important concern is that many of these data are self-reported. In the case of the subjective fire chief survey, this is desirable –as will be explained in Chapter 6, a benefit of Q methodology is that the subjects themselves model their own perceptions, which helps to prevent the researcher from imposing her own bias. In the fire department written survey, on the other hand, self-reported data are susceptible to bias that is difficult to characterize, particularly in the case of subjective questions that ask the departments to rate their performance in various areas. A department might, for instance, strive to be as honest and accurate as possible, or it may be motivated to paint an overly favorable picture of its activities out of worry that the results of this analysis might threaten it in the future, or it might believe that a strongly negative portrayal of performance might somehow prompt needed change. Interviews and conversations with hundreds of fire chiefs over the past year indicate that each of these attitudes is likely across the sample of departments.

To help improve the validity of the subjective questions, careful attention was paid to making the questions as reliable as possible, including standardizing presentation and scales and using language likely to mean the same thing to all fire service professionals. In addition, the survey asks multiple questions that measure the same subjective state. Ultimately, these questions were combined into single scales when high Cronbach's alpha values (over 0.7) supported the belief that the questions reliably measured the same notion. The variables constructed in this way are identified and discussed more fully in Chapter 7.

Responses to factual questions on the written fire department survey may also be unreliable or biased because the respondent did not understand some or all of relevant questions, did not know some or all of the answers, or did not wish to report some or all of the answers accurately. The first contingency, clarity of the questions, was mitigated in the survey design process through careful review and pilot testing of the instrument, as explained above. Nonetheless, the nature of the responses to some questions written survey, on the other hand, self-reported data are susceptible to bias that is difficult to characterize, particularly in the case of subjective questions that ask the departments to rate their performance in various areas. A department might, for instance, strive to be as honest and accurate as possible, or it may be motivated to paint an overly favorable picture of its activities out of worry that the results of this analysis might threaten it in the future, or it might believe that a strongly negative portrayal of performance might somehow prompt needed change. Interviews and conversations with hundreds of fire chiefs over the past year indicate that each of these attitudes is likely across the sample of departments.

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The extent to which those departments that did not respond to the written survey are systematically different from the population as a whole is also difficult to ascertain. The prevailing wisdom about mail surveys is that those who respond –and particularly those who respond early– tend to have a strong interest in the subject matter under study, suggest that bias is related to the purpose of the research (Fowler, 1993). In this project, this view could imply that nonrespondents care less about the quality of management and its impact on performance than do respondents. Such a perspective is difficult to sustain, however, given that most of the fire departments in the population and in the study are volunteer agencies that must trade off time devoted to managerial and service-related activities for time devoted to completing a survey –sacrificing the completion of one of many surveys a fire department typically receives might be seen as a sound and legitimate management choice with respect to service to the community.[57] Moreover, it

[57] Fire departments regularly receive surveys from consulting firms, vendors, professional associations, and other researchers. While a fire chief might support the objectives of this study, he might not readily distinguish between this survey and the many others he receives, and thus may ignore it inadvertently.

is difficult to distinguish early respondents from later respondents in this study because the responses came in at a very steady rate, not in waves that correlate to follow-up efforts, and because volunteer fire officers tend to receive their mail irregularly, and some may in fact have responded immediately upon receiving the survey, even if they appeared to be returned late.

Another characteristic of the data that should be noted is that they are not precisely contemporaneous. That is, the survey data were reported in 1999, while the most recent outcome and expenditure data available from independent sources were for 1997. In a few cases, data about department capital resources were as much as ten years old. Great effort was made to minimize these time differences, but some were unavoidable, and it should be recognized that they do inhibit the validity of any causal inferences to some extent. A related concern is that the data in this project are generally cross-sectional. As implied in Chapters 2 and 4, a sophisticated conceptualization of management processes and systems suggests that managerial and organizational activities have cumulative impacts over time –that is, the decision a manager makes today may not influence public service outcomes until some time in the future. Cross-sectional data cannot capture these relationships directly.

These constraints bear on the validity of the data and subsequent analysis because they may reduce the level of confidence the researcher can have that the reported characteristics of the sample accurately represent the true nature of the population as a whole. Much of validity concerns the extent to which the written survey optimally captures answers directly related to the theory and research questions. There is no concrete way to assess this –it rests on the academic and professional experience of the researcher with the subject matter. In addition, as described above, efforts were made to maximize reliability and minimize bias through careful design and administration of the written survey. Some statistical corrections are also available to manage bias. For example, non-response bias can be addressed by weighting the answers of certain sets of those that responded. This does not seem appropriate for this study, however, since the sample seems similar to the population along key dimensions of fire department structure, as shown in Table 5-2. Overall, a careful research process and detailed knowledge of the field under study lend confidence in the value of this dissertation's data set, but this confidence is tempered by acknowledgement of the data's limitations.

CHAPTER SIX

EMPIRICAL METHODS AND FINDINGS PART I: ANALYSIS OF MANAGERS' PERCEPTIONS OF THEIR ENVIRONMENTS

The overarching phenomenon this dissertation seeks to illuminate is how and why public managers affect the quality, level, and cost of public services. Chapter 2 revealed that despite a compelling impetus to carefully specify the determinants of public performance levels, little theoretical and empirical attention has been focused on a key intervening operator in the translation of resources into results: the public manager. Managers continually make subjective judgements about the level and mix of resources public organizations obtain and maintain, and about how to deploy these resources – important decisions in terms of public performance. Nonetheless, the role of public management in public production has yet to be satisfactorily specified or measured. If we seek to measure the performance of public organizations, and to understand the causes of variation in performance, a key question demands: What things influence managers' actions and to what extent?

This chapter takes an important step toward answering this question by pursuing two empirical issues: identifying the influences on public managers in the context of running their organizations, and determining how important these influences are in the eyes of the managers themselves. On the assumption that how managers perceive their environments and the various pressures exerted on them –and the extent to which they view these things as important– will affect the decisions they make about obtaining and deploying resources in their organizations, this chapter presents an exploratory empirical analysis of the portion of the model developed in Chapter 4 that specifies the influences on managerial actions. Specifically, a novel form of factor analysis is used to typologize managers according to the ways they perceive their internal and external organizational environments.

The chapter is organized as follows. First, a typology of environmental pressures is developed based on the review of organizational culture and environments presented in Chapter 2 and the dimensions of the fire service environment described in Chapter 3, to serve as a framework within which to consider the perceptions of managers. The need for a subjectively-focused empirical methodology is then explained, and the Q factor analytical technique is introduced. Next, an application of Q methodology to the question of how managers perceive their decision-making environments is presented. The chapter concludes with a discussion that demonstrates that fire chiefs have strong and diverse opinions about the environments in which they work, but that they can be grouped according to similar perceptions, an exercise that is revelatory about commonly occurring objective conditions and their subjective acquisition by key decision-makers. The empirical vehicle for this chapter is subjective study of 32 fire chiefs in New York State.

6.1 A Typology of Pressures in the Managerial Environment

As indicated in the model shown in Figures 4-1 and 4-2, this dissertation posits that management is influenced by an organization's attributes and its environment. In other words, pressures are exerted on fire chiefs that may influence the decisions they make about how to configure and deploy the fire protection technologies employed by their departments. Some of these pressures are generated within the department itself (termed "internal" pressures), while others are generated by the socio-political community and institutional field within which the department exists ("external" pressures). Since internal and external organizational environments are notoriously complex, as noted throughout the relevant literature,[58] coherent analysis must rest on a framework that specifies the key aspects of environments that may exert important and independent influence on decision-makers.

Rainey's (1997) synthesis of the literature of organizational culture and environments points to five core dimensions particularly relevant to the perceptions and actions of managers: social, political, fiscal, technological, and professional. Arguably, important classes of influences are omitted from this list, such as ecological conditions (characteristics of the physical environment) and legal constraints. These influences are accounted for in the general model (Figures 4-1 and 4-2) as exogenous conditions because they tend to be fairly fixed and stable over long periods of time and generally can be understood in a similar way by all actors in the public production system. The dimensions listed here, on the other hand, are more malleable, subtle, and unpredictable, and each actor in the system –most importantly, each managerial decision-maker– is likely to understand and respond to them in unique ways. In other words, the pressures managers face along these dimensions can have a particular impact on public production depending on how a public manager perceives them.

Environmental pressures can thus be characterized generally along five dimensions, defined as follows:

[58] This is discussed in Chapter 2, but see especially Thompson (1967) who synthesized several early studies of organizational environments into an analytical framework, Powell and Dimaggio (1991) who

External

- **Social:** Pressures generated as a result of the demographic or socio-economic characteristics, values, perceptions, and expectations of the population protected by the fire department.

- **Political:** Pressures generated as a result of the desire for power of, the distribution of power among, and the exercise of power by the public agents within the community the fire department protects, including officials elected by citizens to govern the fire department.

- **Fiscal:** Pressures generated by the resource munificence of the community the fire department protects, including elements such as the tax base, philanthropic funds, and factor markets.

- **Technological:** Pressures generated by knowledge accumulated within the fields of public management and fire science about the effectiveness and productivity of existing and new firefighting techniques and resources.

- **Professional:** Pressures generated by shared values, norms, and expectations within the public sector and the fire service field as communicated by institutions, organizations, and regulatory or governing bodies outside the fire department.

Internal

- **Social:** Pressures generated as a result of the demographic or socio-economic characteristics, and the shared values, perceptions, and expectations of the fire department members.

- **Political:** Pressures generated as a result of the desire for power of, the distribution of power among, and the exercise of power by the people within the fire department.

- **Fiscal:** Pressures generated as a result of constraints on the fire department's ability to project, invest, control, and spend its monetary resources efficiently, effectively, and productively.

- **Technological:** Pressures generated by constraints on the ability of the fire department to acquire, develop, deploy, and maintain its resources effectively and efficiently.

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develop New Institutionalism and explain the concept of institutional fields as an influential context for organizational behavior, and Schein (1992) who describes the dimensions of organizational culture.

- **Professional:** Pressures generated by experience, training, and occupational norms about the fire department's service responsibilities held in common or individually by the people within the fire department.

The extent to which these pressures actually influence the actions of fire chiefs depends on whether chiefs perceive them and how strongly they feel about them. Thus, a method of analysis that provides systematic access to the subjective perceptions of fire chiefs is required, as will be explicated in the remainder of the chapter.

6.2 A Method for Measuring the Influences on Management

This section elaborates briefly on the discussion in Chapter 5, and introduces Q methodology, an analytical technique that facilitates systematic study of human subjectivity,[59] defined as "a person's communication of his or her point of view" (McKeown and Thomas, 1988: 12). Q methodology is used to identify patterns of perceptions about a topic across individuals, and to construct typologies of values or perspectives. This approach may therefore help close gaps in the existing management literature through rational subjective analysis. The next section describes how Q methodology was applied to the fire service case in an attempt to begin to understand the linkage between how fire chiefs perceive their environments, the management decisions they make, and how this might ultimately affect their departments' performance.

The application of Q methodology rests fundamentally on the concourse of communication about a subject, from which is drawn a sample of statements selected to represent the range of opinion. Participants in a study that uses Q methodology model

[59] Stephenson is credited with developing Q methodology in 1935. For a more detailed description and technical explanation, and comprehensive reviews of applications of the technique, see in particular Brown (1980) and Brown, Durning, and Selden (1998).

their points of view by sorting these opinion statements into a forced quasi-normal distribution according to the extent to which they agree or disagree with them. This sorting process produces what is called a "Q-sort," or an individual's set of relative rankings for all statements included in the sample. Thus, in Q methodology, the participants are treated as variables, the statements they sort comprise the sample, and the ranks assigned to the sample statements by a participant through the sorting process comprise observations on that participant.

The ways the participants sort the statements (captured in the individual Q sorts) are compared using common factor analytic techniques to arrive at factors that represent groups of people who sorted the statements the same way. Thus, the people whose sorts load significantly on a given factor share similar views on the subject under study. Interpretation of the factors is based on the construction of a factor array, or "model Q-sort," for each factor. This is accomplished by merging the sorts that loaded significantly on that factor, weighted according to their loadings, to achieve average scores for each statement, by factor. These model Q-sorts permit the statements that uniquely define each factor –and thus each type of person– to be identified. Types can then be compared to discover areas of consensus and dissensus about the subject in question.

It is important to recognize that Q methodology effectively reveals different perspectives that exist and are shared by groups of people. Since the participants are not randomly sampled in large numbers –in fact, Q studies typically involve small numbers of respondents– Q method does not provide insight into how these known "subjectivities" are distributed across a population. Other worldviews may exist that might be revealed if different people were chosen (Selden *et. al.*, 1999). It is possible, however, to look for patterns of other attributes across groups, such as variations in demographic characteristics, to lend insight into what might contribute to a person's proclivity to adhere to a certain perspective.

6.3 Empirical Application to New York Fire Chiefs

The objective of the work presented in this chapter was to explore how fire chiefs perceive the various internal and external pressures on them in their role as managers of a local public service production process and to categorize these perceptions. The Q-sample was therefore designed to represent these pressures evenly, and included a deductive, structured selection of 40 statements that characterize them, four for each of the 10 types of pressure defined above.[60] These statements were selected from and are paraphrases of comments made by fire chiefs in New York State during the course of informal interviews and conversations with them, during 17 recent county fire chiefs meetings, and as reported by local newspapers throughout New York State in articles during the past year. The statements, organized according to the type of pressure they describe, appear in Table 6-2.

Thirty-two fire chiefs[61] were asked to sort the statements into a quasi-normal distribution ranging from –3 (most strongly disagree with the statement) to +3 (most strongly agree with the statement). For the statements with which they agreed and

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60 As Brown points out, "The selection of statements… for inclusion in a Q sample is of utmost importance but remains more an art than a science…" (1980: 186).

61 For the purposes of this study, a fire chief is any chief-level officer in a fire department, including the ranks of deputy, assistant, district, or battalion chief. Fire departments configure their senior managers in various ways, and thus have varying numbers of chiefs with an array of titles and roles. In general, though, a chief-level officer is a senior manager with significant responsibility for personnel and equipment, and broad operational and administrative decision-making authority.

Table 6-1. Factor Loadings.

Chief	Factor 1	Factor 2	Factor 3	Factor 4
1	.62*	.11	.03	.10
2	.03	.13	.77*	.21
3	.55*	.00	.51*	-.03
4	.37	.20	-.05	.22
5	.74*	-.12	-.10	-.25
6	.63*	-.12	.09	.15
7	.58*	.05	.02	-.03
8	.76*	-.06	.24	.03
9	.31	-.02	.38	.66*
10	.67*	.07	.03	-.15
11	-.06	.49*	.09	.61*
12	.25	.08	.69*	.34
13	.15	.26	.11	.07
14	.27	-.21	.01	.82*
15	.80*	.07	.07	.11
16	.11	.80*	.16	-.16
17	.75*	-.09	.01	.25
18	.62*	.26	-.14	.15
19	.48*	.12	.17	-.14
20	-.02	.87*	.07	.04
21	.15	.15	.08	.77*
22	-.09	.37	.10	.41*
23	-.07	-.06	.77*	-.02
24	-.11	.66*	-.19	-.09
25	-.06	.68*	-.12	.22
26	.50*	.52*	.02	-.08
27	.06	.05	.04	.23
28	.10	.37	.24	.13
29	.24	.03	.38	-.12
30	-.19	.07	.20	.64*
31	.06	.79*	.17	.08
32	-.22	.56*	-.08	.40

* Significant at the .01 level

disagreed most strongly, chiefs were asked to explain why they felt as they did. In addition, chiefs were asked to provide some basic information about their age, professional experience, and education. The directions the respondents were provided and the form on which they recorded their responses are included in Appendix 1.

All Q-sorts were completed during the period of August through November, 1999. To reduce the chance that the study would omit common perspectives present in the fire service population, fire chiefs with a broad range of experience and from different types of fire departments were included. Overall, 32 chiefs from 32 different fire departments in 21 counties in central New York State were included. Of these departments, 13 had fully-paid staffs, 12 had all-volunteer staffs, and seven were staffed by a combination of paid and volunteer personnel. Of the chiefs themselves, 18 were paid and 14 were volunteers. All fire chiefs who participated in the study were white males (as are almost all fire chiefs in New York State). The age of the respondents ranged from 31 to 62 years. They had between seven and 40 years of experience in the fire service, and between three months and 22 years of service as a fire chief. Nineteen chiefs reported attending at least two years of college. Two chiefs held Associate's degrees, five had earned Bachelor's degrees, and three Master's degrees.

The Q-sorts of the respondents were correlated to create a 32 by 32 matrix of correlations between the sorters. This matrix was factor analyzed using the principal components method. Eight factors with eigenvalues greater than unity were rotated using varimax. Four factors emerged for which the loadings of at least four chiefs' sorts were significant at the 0.01 level, and for which the correlations between the factors were 0.36

or less, making them clearly distinct.[62] These factors therefore each represent a particular perspective on internal and external pressures held by a group of chiefs. The factor loading for each chief represents the correlation of his sort with that factor. Thus, all chiefs who load significantly on a factor have a similar view of these pressures. The loadings of each chief on each factor are shown in Table 6-1. Further, as explained above, factors are interpreted according to a factor array. The response by statement for each group of chiefs is shown in Table 6-2, which shows how those chiefs that loaded on each factor sorted each statement as a weighted average (i.e. in which column in the forced distribution shown in Figure 4 the group of chiefs would have placed each statement).

6.4 Findings and Discussion

This section classifies and describes the views that different groups of fire chiefs have of the pressures they face in the context of managing their departments. Overall, the findings show that chiefs in all of the groups perceive various pressures from each of the categories defined above to be powerful. That is, chiefs ranked statements that describe social, political, fiscal, technological, and professional pressures both within and outside of their departments at the extreme ends of the distribution from most strongly disagree to most strongly agree. The four groups of chiefs that emerged from the Q factor analysis do, however, vary in terms of which pressures were most important (i.e. in terms of the strength of their agreement or disagreement with each statement).

[62] The standard for considering two factors distinct from one another is that the correlation between them be less than 0.05.

Table 6-2. Q-Sort Values by Statement and Factor (Organized by Dimension).

	EXTERNAL	Group 1	Group 2	Group 3	Group 4
Social					
1.	Citizens have a good understanding of what my department does.	-2*	-1*	1**	-3**
10.	Our community is loyal to its fire department –that is, our citizens like and support the fire department.	1	0*	2	-1*
20.	Local television stations and newspapers tend to report too negative a view of my department.	-2	-2	-1	-1
40.	Citizens expect too much of my fire department.	-1	-2	-3**	0**
Political					
8.	Local public officials and/or the fire commissioners impede my ability to run my department efficiently and effectively.	-3**	2**	-1*	0*
14.	Local public officials and/or the fire commissioners trust me to make good managerial decisions and they give me adequate discretion.	1	-1**	0	0
28.	As fire chief, I feel directly accountable for my department's performance.	3	3	2*	3
31.	Public officials in the community like and support my fire department.	2**	-2	-1	-2
Fiscal					
2.	My department is more vulnerable to budget cuts than other local public agencies and service providers.	-3	3**	-2	-1
9.	My department gets good financial support from the community through charitable donations and support of fund raising efforts.	0	-3	1	-2
17.	Elected public officials in my jurisdiction are very reluctant to raise taxes to pay for fire protection equipment and services.	-1**	3	0**	2
22.	The local public officials in my community understand and support my department's resource needs.	0*	-3	-1*	-2
Technological					
7.	I devote a lot of effort to keeping up with new ideas and trends in the fire service by reading journals and attending meetings, conferences, and shows.	1	0	3**	1
13.	There is a shortage of capable people interested in becoming firefighters in the local community.	3	-2**	0**	3
16.	It is important for my department to adopt state-of-the-art "cutting edge" firefighting technologies.	-1	-1	-1	1**
19.	My department depends a lot on mutual aid from other fire departments to ensure there are adequate resources available to handle the calls we get.	-1**	-3**	2	2
Professional					
12.	It is important for my department to foster and maintain good working relationships with other public agencies in my community.	1	1	0	2*
25.	State and county fire chiefs meetings are important and I make it a priority to attend them.	-1**	1	2	0
29.	It is important for my department to foster and maintain good working relationships with surrounding fire departments.	2	0**	1	2
30.	I think it is important and useful to complete New York Fire Reporting System reports for the incidents we respond to.	0	1	3**	0

* Statement is distinguishing at the p < .05 significance level. ** Statement is distinguishing at the p < .01 significance level.

Table 6-2. Continued.

	INTERNAL	Group 1	Group 2	Group 3	Group 4
Social					
23.	Our fire department would benefit from having more women and minorities.	-1	0	0	0
24.	There is a lot of conflict among the members of my fire department.	-2	-1	-2	1**
35.	Tradition gets in the way of progress in my fire department.	-3**	-1**	1*	0*
37.	The members of my fire department are loyal to their officers and chiefs.	0*	1*	-1	-3
Political					
6.	The members of my fire department have an important influence over administrative decisions.	0	0	2**	0
11.	The members of my fire department have an important influence over operational decisions.	0	0	1	1
26.	The members of my fire department are resistant to changes in how we operate.	-2	-2	0**	1**
33.	The members of my fire department are open to new ideas.	1	0	-2*	-1*
Fiscal					
15.	As chief, I have a lot of discretion over how money in my department is spent.	3**	1	-1**	0
18.	Concrete data about how my fire department performs is important to how I make budgetary decisions.	0	0	0	1
32.	I have a good idea how much it costs for my department to perform each of the services it is called to provide.	0	0	0	0
38.	Planning to acquire and maintain the resources necessary to meet future service delivery needs in one of my most important responsibilities as chief.	2	2	1	1
Technological					
4.	I know what I need to know about management to run my department effectively.	-1	0	-3	-2
27.	My fire department has the right type and amount of apparatus and equipment to fulfill its missions.	2**	-1	-3	-2
36.	As fire chief, I am too busy solving immediate, day-to-day problems to be able to devote sufficient time to strategic planning.	-2	-1**	-2	2**
39.	My fire department makes good use of the knowledge, skills, and abilities its members have to offer.	0	1	1	-1**
Professional					
3.	High quality service to our community is a priority for everyone in my fire department.	1	1	0	-1
5.	The company officers in my department are experienced and competent leaders.	1**	2**	-2	-3
21.	A strong, clear chain of command –both on and off the fire ground– is essential to having a well-run fire department.	2	2	3	3
34.	The firefighters in my department are well trained and educated to perform their emergency response duties.	0	2**	0	-1

* Statement is distinguishing at the p < .05 significance level. ** Statement is distinguishing at the p < .01 significance level.

When the strength of the perceptions of the chiefs in each group and the statements that significantly distinguish each group from the others are examined,[63] it becomes apparent that the chiefs viewed the conditions within their organization to be either mild (very congenial and supportive) or harsh (very conflicted and full of obstacles) in general. Similarly, they saw the environment external to their department to be either mild or harsh. In addition, the chiefs described their perceptions of their priorities and propensities as managers, which allows them to be characterized according to general managerial style. Furthermore, the combination of environmental conditions and managerial approaches is likely to generate an overall level of pressure to which managers are presumed to respond when they make decisions. Based on variation along these dimensions, the perceptions of the four groups of chiefs are classified as follows:

1. Low pressure: A mild environment both within and outside of the department, and very centralized management.
2. Moderate pressure: A mild internal organizational environment, harsh external conditions, and centralized management.
3. High pressure: A harsh internal organizational environment, mild external conditions, and very participatory management.
4. Very high pressure: A harsh environment both within and outside of the department, and participatory management.

The descriptions of each group below will illustrate these classifications. Table 6-3 shows the classification scheme for the four groups. Throughout the discussion that follows, the numbers of the relevant statements are included in brackets. Refer to Table

[63] Table 6-2 shows how each group ranked all forty statements, as a weighted average. In addition, the table 6-identifies which statements were ranked by each group significantly differently from the other groups, and thus distinguish each group in terms of the substance and strength of their perceptions.

6-2 to see the extent to which the chiefs in a given group agreed or disagreed with the cited statements on average, and relative to chiefs in other groups.

Table 6-3. Group Characteristics.

GROUP	EXTERNAL ENVIRONMENT	INTERNAL ENVIRONMENT	MANAGERIAL STYLE		INTENSITY OF PRESSURE
1	Mild	Mild	Very Centralized	→	*Low*
2	Harsh	Mild	Centralized	→	*Moderate*
3	Mild	Harsh	Very Participatory	→	*High*
4	Harsh	Harsh	Participatory	→	*Very High*

6.4.1 Group 1 – Low Pressure

The chiefs in the Factor 1 group perceive their management environment to be supportive. Outside their departments, the public officials and citizens in the community appear to these chiefs to like and support their fire departments [10, 31], and seem willing to pay for them [2, 17]. The departments have adequate financial and capital resources to accomplish their missions [16, 19, 27], and local public officials trust these chiefs to deploy these resources appropriately, granting them administrative and budgetary discretion [8, 14, 15]. The exception to the supportive atmosphere enjoyed by these chiefs is the sense that there are few capable people available to staff the fire service [13]. Some of the comments made by chiefs in this group are illustrative of the positive external conditions they perceive. Many noted that they felt fortunate to have positive ties with the public officials in their municipalities, recognizing that their colleagues in other communities did not enjoy such supportive relationships. A few pointed out that having volunteer members of the fire department serve on town boards certainly helped this relationship. Another chief mentioned that having a well-run town facilitated having a well-run fire department, because priorities were clear and were supported by financial policies.

Likewise, the chiefs in this group also feel that the conditions inside their departments are benign. They report that the members of their departments make high-quality service a priority [3]. Their members also get along [24] and are progressive and open to new ideas and operational changes [26, 33, 35]. High morale in these departments seems to depend on a commonly held and intrinsic sense of purpose. One chief remarked that his firefighters are "fanatics at looking after the community. It's just there, you don't have to instill it." Along these lines, another chief implied that responsiveness to change revolves around the interaction between why the chief makes the decisions he does and the extent to which the chief's rationale appeals to the firefighters' pragmatism. As he said, "Common sense dictates need, and firefighters understand that and respond to it. They accept change that is necessary, reasonable, or not far off from current practice." This positive environment appears to permit chiefs the freedom to concentrate on setting organizational goals and planning for future resource needs, rather than worrying about day-to-day crises [36, 38].

Chiefs in Group 1 also seem to place strong emphasis on effective leadership and management, and to take these responsibilities seriously [21]. One chief explained that fire chiefs must be responsive to the ideas and concerns of their members (especially in the case of volunteers), but must also set clear guidelines, describing the volunteer fire service as "a democracy run by a Gestapo." One chief articulates the comments of many others when he says, "The department looks to me for leadership. The Fire Commission looks to me for the smooth operation of the department. The town looks to me as the emergency management coordinator... Let's face it, when the department does well, we all do well. When the department fails, it's '*Where is the chief?!*'"

This group also makes planning a priority [36, 38], works to foster good relationships with other fire departments and public service agencies [12, 29], and devotes considerable effort to educating themselves about new trends and technologies in the fire service [7]. Even though these departments face a severe shortage of trained and experienced firefighters and officers, these chiefs work to capitalize on the skills and talents of their members, and do not need to call on mutual aid from other departments to accomplish their mission [13, 19, 39]. In these departments, the chiefs are vested with a great deal of discretion over how money is spent [15] and department members do not have an important influence on administrative or operational decisions [6, 11]. For these chiefs, the positive environment in which they work coupled with the authority and latitude they are afforded suggests that the pressures on them in decision-making are relatively tame.

6.4.2 Group 2 – Moderate Pressure

Chiefs that loaded on Factor 2 perceive a supportive internal environment. They describe a professional atmosphere in their departments, with experienced and competent leadership [5], well-trained and educated firefighters that are cohesive and loyal to their officers [24, 34, 37], and a prevailing emphasis on high-quality service [3]. One chief asserted that "many of the officers in this department could be chief." Another described his department as "a cohesive unit with much greater strength and ability than the sum of the individuals." These chiefs also have no shortage of capable personnel [19, 13] and can be selective about whom they hire –one chief reported that "there are hundreds of capable people taking entrance exams." Another noted that many candidates already have fire and advanced emergency medical training and certifications in hand when they join the department. Finally, these chiefs enjoy a workforce that is open to progress and operational changes [26, 35].

On the other hand, Group 2 chiefs face harsh political and fiscal pressures from outside their departments. Chiefs in this group feel that local public officials and citizens do not understand what their departments do [1, 22], and do not support them financially [9, 17, 22]. In fact, they are adamant that public officials do not like their departments or trust the chiefs to run them effectively [8, 14, 31]. Many chiefs expressed extreme frustration at their departments' treatment by local officials. At best, these chiefs feel their departments are "taken for granted." At worst, they view themselves as "budgetary sacrificial lambs," asserting that their departments are more vulnerable to budget cuts than are other agencies [2]. As one chief exclaimed, "The fire department in the 1990's is the budgetary bastard child in most cities. We are the insurance policy no one wants to pay for, so they up the deductible by downsizing the department." Other chiefs expressed similar frustrations, often reporting that local mayors view the fire department as over-staffed and over-paid, and therefore "constantly looking for ways to reduce manpower."

As an additional frustration, the lack of financial support from the local officials seems to impede acquisition of appropriate levels and types of equipment [27]. For example, one chief explained, "Due to a lack of on-going investments, my department operates with apparatus which uses the technology of the 1940's and 1950's. It is difficult to obtain basic budget money to purchase newer types of tools and equipment which have developed in the last 10 years." This is exacerbated by the complex technology required to provide effective fire protection. As one chief explained, "Elected officials generally have very little knowledge of the complexity of operations (both emergency and staff) performed by this department...Very few officials will devote the necessary time to acquire the knowledge needed to make informed decisions regarding this department."

Despite the fact that local public officials do not seem to trust these chiefs to make good managerial decisions –and even impede these chiefs as they work to run their departments (several chiefs complained about micro-management)– these chiefs exhibit a propensity for strong management. They feel directly accountable for their departments' performance [28], and report that they work hard to run their departments effectively and efficiently. In this they rely on a strong chain of command [21] because, as one chief said, "a break in the chain creates animosity and distrust." In fact, firefighters in these departments do not have an important influence on administrative or operational decisions [6, 11], though chiefs report that they do make good use of the skills and abilities of their departments' members [39]. In addition, these chiefs work to maintain good relationships with other agencies [12], they engage in data collection and reporting about their operations [30], and they emphasize strategic planning [36, 38]. The contentiousness of the political environment in which Group 2 chiefs operate may heighten the demands they face over those confronted by Group 1. At the same time, these pressures appear to be tempered by the competence and commitment of their operational staffs and workforces, governed by a clear chain of command.

6.4.3 Group 3 – High Pressure

The chiefs in Group 3 face relatively benign external conditions. Citizens in their communities are loyal to their fire departments and support them with donations [9, 10]. Public officials do not seem to these chiefs to like their departments, but neither do they impede the chiefs' ability to run them effectively [8, 31]. Local officials also do not seem to understand the resource needs of these departments [22], but are not really reluctant to pay for them –these chiefs report that their departments are no more vulnerable to budget cuts than are other public agencies [2, 17].

Group 3 chiefs are, on the other hand, constrained by their internal environments. The officers in these departments are reported to be inexperienced and incompetent [5], and the firefighters are not loyal to them [37]. The department members are a cohesive group [24], but tradition impedes progress and they resist new ideas [33, 35]. One chief explained, "Old timers get *so* stagnant –they don't want to train because they've 'been there done that' a million times. It's also hard to convince the old-timers that it's an important investment to purchase new equipment –they don't see the need to improve operations and safety." This is problematic because, though these chiefs value a strong chain of command, the department members have an important influence on both administrative and operational decisions [6, 11, 21]. In fact, these chiefs report that they have very little say over how department money is spent [15]. For Group 3, it appears that the strain of overcoming the constraints on change and progress within their organizations is heightened by the democratic nature of their departments.

These chiefs also claim that they do not know what they need to know about management to run their departments effectively [4], and they rely on the knowledge and abilities of their departments' members [39]. As one volunteer chief said, "There's no chiefs' school you go to when you get elected –you just have to learn it as you go." He also pointed out that "Set rules are nice, but impractical. You have to be flexible… we're a little disorganized, but *everyone* participates. Other departments are almost too organized, too rule-bound –and have lost sight of their purpose: to solve problems however you can." This may explain why this group of chiefs feels less directly accountable for department performance than do the other three groups [28]. Many of these chiefs also turn elsewhere for guidance, placing a great deal of emphasis on reading journals, fostering good relationships with other departments, and attending state and county chiefs meetings and professional conferences [7, 12, 29] –as one said, "hey, maybe someone's got an idea."

6.4.4 Group 4 – Very High Pressure

Group 4 chiefs experience nearly the opposite conditions that Group 1 feels it faces. In the case of Group 4 chiefs, both the external and internal management environments are harsh and hostile. These chiefs believe that the citizens they protect do not like their fire departments [10], and this is borne out by the lack of charitable donations [9]. Likewise, local elected officials do not like or support these departments [31], do not understand these departments' resource needs [22], and will not raise taxes to pay for them [17]. One chief asserted that "Citizens and public officials have no idea what it takes to run a fire department. They only think we're important when an incident happens." Possibly as a result, these departments lack the equipment they need to do their jobs [27], and often depend on mutual aid to handle emergency calls [19].

Internally, chiefs in Group 4 contend with a workforce of firefighters and line officers they perceive to be untrained, inexperienced, and incompetent [5, 34], and that do not make high-quality service a priority [3]. In fact, one chief said, "Only a few members really want to provide high quality service to their community –most just do it to get out of the house or when it is convenient to them." Morale in these departments is low –firefighters are not loyal to their officers and there is a great deal of conflict among department members [24, 37]. The members of these departments stick to tradition and resist operational changes [26, 33].

Management is troublesome for the chiefs in Group 4, who perceive themselves to be very ill-equipped to correct the problems that plague them. One said he knew "barely enough to keep the boat on course." They believe a strong chain of command is essential to having a well-run fire department [21], but they and their officers lack the management skills necessary to uphold this philosophy [4, 5]. One chief lamented, "I know the answers, but I can't make them happen." As another explained, "we …ignore that many need training in being a leader/manager." Chiefs also feel that they are much too busy solving day-to-day problems to devote time to strategic planning [36], despite the fact that they believe this to be one of their most important responsibilities [38]. Furthermore, they admit that their departments do not make good use of the knowledge and abilities of its members [39], but department members do have an important influence over operational decisions [11] and the chief does not have much control over how department funds are spent [15]. In short, the harsh, negative management environment and the influence of incompetent, antipathetic members on department decisions conspire to exert very high pressure on the chiefs in Group 4.

6.4.5 Areas of consensus

Among the four groups of chiefs there are some statements about which there is general agreement. Most significantly, almost all chiefs reported feeling directly accountable for their department's performance –in fact, none of the 32 chiefs who participated disagreed with statement 28, and three of the four factor arrays rank this statement +3 (see Table 6-2). Despite these strong feelings, though, chiefs demonstrate ambivalence about the importance of concrete data about department performance to budgetary decision-making. This is demonstrated by the ranking of statement 18 as neutral or disagree by 23 of the chiefs, and as neutral in three of the four factor arrays. Similarly, statement 32's rank of 0 by all four groups indicates that most chiefs lack confidence that they know how much it costs their departments to provide services. Chiefs also universally agree that one of their most important responsibilities is planning to acquire and maintain the resources necessary to meet future service delivery needs. As one chief said, "I can't be too busy to plan." In this case, only one of the 32 chiefs disagreed with this statement. So, chiefs not only feel responsible for how their department performs, but also think that resource management is one of their key duties.

Consensus on these statements, coupled with the level of agreement, suggests that chiefs are likely to be very responsive to pressures exerted on them by their environments. That is, if chiefs did not feel accountable for their department's performance, they would be less likely to pay attention to or care about the demands of their organization and community. Moreover, chiefs do not appear to rely much on performance data, implying that they use other sources of feedback performance, such as pressure exerted by citizens, public officials, and department members. The broad agreement with statements 38 and 28, despite the type of environment (constrained or supportive) faced by the chiefs, lends credence to the model specification proposed in Figure 2. In other words, there is support for the notion that chiefs view themselves as responsible for resource management in their departments, and that in making decisions about resources they are conscious of and are thus likely to respond to influences in their environments.

Data from the 173 responses to the fire department written survey conducted in parallel with the Q analysis (described in Chapter 5 and included at Appendix 2) corroborates these findings. Almost all of the written surveys were complete by fire chiefs. In response to a survey question that asks how important various sources of information are to the department's ability to assess its performance, most respondents said that department members' opinions, community attitudes, professional standards, and comparisons with other fire departments were very important, as shown in Table 6-4. At the same time, almost half do not use numerical data to evaluate their performance, and over three quarters do not use formal means of assessing citizen opinions.

An interesting counterpoint to these responses arises from another set of questions that asked respondents to rank their departments' competence in a variety of management functions (at Table 6-5). Here, respondents report that they are doing an excellent job at financial management, though many do not have audited financial statements, and a fair to good job at capital and strategic management, though many did not have written

Table 6-4. Self-assessed Importance of Feedback by Source.

	Community attitudes about the FD	Information from citizen surveys	Feedback from elected officials	Department members' opinions	Feedback from state government	Feedback from the board	Comparison with other FDs	Professional standards	Numerical data	Trade journals	Vendors' opinions	Consultants' opinions
Very important	55.4	10.1	30.0	74.5	37.6	44.6	54.1	64.4	27.4	29.3	16.5	4.4
Somewhat important	22.9	6.4	25.5	16.5	24.2	19.1	23.6	18.5	12.1	17.9	8.9	3.2
Not very important	10.8	5.7	12.1	4.4	13.3	7.1	6.4	2.5	10.8	17.2	15.3	2.5
Unimportant	0.0	0.0	1.3	0.0	0.7	0.0	0.0	0.7	1.9	4.4	8.3	2.5
Not used	10.8	77.7	31.2	4.4	24.2	29.3	16.0	14.0	47.8	31.2	50.9	87.3
Total	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8
Missing	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Total	100	100	100	100	100	100	100	100	100	100	100	100

(Values reported are percentages of respondents who ranked each category at a given level of importance.)

Table 6-5. Self-assessed Competence in Management Functions.

	Computer automation	Capital planning	Cost accounting	Use data in decisions	Financial management	Measuring performance	Strategic planning
No activity	8.7	6.9	6.4	8.1	1.2	3.5	0.6
Very poor	3.5	2.9	6.4	2.3	0	1.7	1.2
Poor	8.7	3.5	8.7	16.8	2.3	7.5	9.8
Fair	26.6	16.8	24.3	23.7	6.9	24.9	18.5
Good	26	27.2	26.6	28.9	32.9	42.8	40.5
Excellent	19.7	25.4	17.9	14.5	39.9	12.7	22
Outstanding	4	12.1	5.8	2.3	13.3	2.3	3.5
Total	97.1	94.8	96	96.5	96.5	95.4	96
Did not report	2.9	5.2	4	3.5	3.5	4.6	4
Total	100%	100%	100%	100%	100%	100%	100%

(Values reported are percentages of respondents who ranked each category at a given level of importance.)

capital or strategic plans. Finally, respondents admit they do only a fair job at cost analysis, automation, performance measurement, and using data in decision-making. Thus, as in the Q analysis, these data show that chiefs are likely to be very responsive to pressures exerted on them by various actors in their environments, but that they do not appear to value formal means of assessing performance.

6.4.6 Descriptive characteristics of the groups

While Q methodology does not permit conclusions about the distribution of these four perspectives across the population of fire chiefs, some characteristics of these groups are worth noting because they may lend some insight into why chiefs perceive their circumstances as they do. Some characteristics that may be related to the views held by chiefs are shown in Table 6-6. The most striking of these is the distribution of the paid and volunteer chiefs in the set of respondents across the groups that emerged. Chiefs in Group 1 (which is the group that faced generally mild conditions) are almost all volunteers, while those in Group 2 (that faced a mild internal but harsh external environment) are exclusively paid. In addition, the chiefs in Group 2 are the oldest and have more years of service, both in their fire departments and as fire chiefs. On the other hand, chiefs in Group 1 have the most formal education and those in Group 4 (that reported a harsh environment both internally and externally) the least. Interpretation of these relationships can only be tentative because the size of the p-sample (the number of participants) is small, but information gained from the interviews with the chiefs are suggestive of some possible explanations.

Paid chiefs are likely to be required to have high experience and qualification levels in order to be appointed or hired, whereas volunteer chiefs in New York State are

Table 6-6. Group Demography.

Characteristic	All Chiefs	Group 1	Group 2	Group 3	Group 4
Number of paid chiefs	18	2	8	2	4
Number of volunteer chiefs	14	11	0	2	2
Number of fully paid departments	13	2	7	1	2
Number of all-volunteer departments	12	9	0	2	2
Number of combination departments	7	2	1	1	2
Mean age	47	45	52	52	45
Mean years of fire service experience	23.9	20.6	26.9	23.3	22.7
Mean number of years as a chief	8.3	7.8	9.7	8.1	8
Mean years of college attended	2.8	3.3	2.7	1.6	1.3

usually elected by and from their departments' general membership. We would thus expect paid chiefs to have more confidence in their own qualifications as managers, while volunteer chiefs, who may not hold management jobs outside of the fire service, may feel inadequately prepared for the demands of executive fire service management. Consistent with these expectations, only chiefs in Group 2 did not report disagreeing with statement 4: that they knew what they needed to know to run their departments effectively.

In addition, paid chiefs have workforces that are partly or entirely comprised of paid firefighters, who are hired into careers generally characterized by clear job descriptions, work expectations, and professional standards. Paid departments also rarely suffer from a shortage of high-quality potential employees in the labor pool. It is not uncommon for paid departments to receive hundreds of applications for a single opening, so they can be very selective about who they hire. Conversely, all-volunteer workforces tend to be more uneven in terms of both quality and availability, with widely varying professional standards and expectations, other career and non-career priorities and obligations, and fire service training and education levels.

Moreover, the firefighting occupation –whether fulfilled by paid or by volunteer personnel– is very demanding in terms of time devoted to actually responding to calls, time spent in training, physical strength and skill, and compliance with government regulations. These are more difficult demands for volunteers to meet in their "spare" time, than for career firefighters to meet while "on the job." Knowing these aspects of paid versus volunteer departments, we would expect that paid departments might tend to have very supportive internal environments compared to departments with volunteers, where there is more apt to be turmoil, conflict, or ambiguity. The findings of this study are consistent with this supposition; 75% of the chiefs from all-paid departments report facing very positive conditions inside their departments, while 63% of the departments with volunteers report similar conditions.

While paid chiefs may tend to have the advantages of more professional personal management capacity and a generally more professional workforce, they also tend to manage departments that are agencies within a larger municipal governments. That is, their agencies often must compete with other departments and public service providers in the budget process to garner some portion of the local government's revenue pie. Volunteer fire departments may serve one or more localities under contract, in which case they, too, face competition for funds, though only as frequently as these contracts are renewed, which may be as seldom as every twenty years. In other cases, however, volunteer departments are governed by a board of fire commissioners that has the power to levy property taxes, and so may not face as competitive a funding environment. In addition, one chief's comment offers an explanation for the mild external conditions experienced by many volunteer departments: "Citizens don't pay attention to us because we work so well… The fire service is like a scratch on the furniture to most people –after a while you don't know it's there." As we might expect from these circumstances, most of the paid chiefs in this study (75%) fell into groups that perceived the external environment to be fiscally unfriendly toward the fire service, whereas all but two of the chiefs from all-volunteer departments (over 85%) were in groups that reported a relatively unthreatening external context.

6.5 Conclusion

This chapter has presented the theoretical underpinnings, method, and findings of the portion of this project that sought to explore and typologize the various ways in which fire chiefs perceive the context in which they make operational and administrative decisions. The study finds four distinct views that exist among chiefs, across which the managerial environments seem to range from benign to harsh, both within and external to fire departments. Chiefs also appear to adopt distinct managerial styles. The reigning circumstances surrounding management and the chiefs approach to management coalesce to generate a particular atmosphere of pressure that can influence the decisions chief make. This study additionally reveals that there exist areas of consensus among fire chiefs, regardless of their circumstances, which may serve as baseline determinants of their activities.

This aspect of this dissertation has been primarily exploratory, seeking to specify a theoretical foundation for examination of government performance that explicitly accounts for the attributes of the people that make crucial production decisions, to demonstrate a method for empirical evaluation of managers' attitudes, and to reveal some of the perceptions that operate in the fire service. The results for fire chiefs show that these public managers have strong and diverse opinions about the environments in which they work. There is evidence that these public managers are not purely self-interested, but are deeply concerned about their departments' ability to fulfill its missions, and are acutely aware of the multiple and conflicting interests around them that may obstruct or enable these goals.

This work strives to "unpack" managerial behavior, and is predicated on the notion that the process of managerial decision-making has an objective component, comprised of actual environmental characteristics, and a subjective component, driven by each manager's personal perceptions of these forces. The work assumes a theoretical framework in which managers' perceptions, coupled with their values and motivations and subject to budget constraints, drive their decisions and actions. Furthermore, the presumption is that chiefs who hold similar perceptions of their environments will be pushed toward similar decisions or actions. This study demonstrates that managers can, in fact, be grouped according to similar perceptions, an exercise that is revelatory about commonly occurring objective conditions and the subjective acquisition of their effect.

Thus, this study has served as a pilot test that suggests that I may find some significant relationships between the character of fire chiefs and the structure of their departments and the types of decision-making pressures they face if I were to re-run this study with a larger and more carefully constructed p-sample. From the investigation presented here also arises a core question that serves as a primary target for future research: In what ways does how a manager perceives the environment within and outside of his agency affect the decisions he actually makes about his agency's resources? Further, does the type of environment a fire chief faces therefore change the level and quality of protection a community receives from its fire department? To answer these questions requires, in part, empirical tests of the general model presented in Figures 4-1 and 4-2, which is the subject of the next chapter.

CHAPTER SEVEN

EMPIRICAL METHODS AND FINDINGS PART II: SIMULTANEOUS COST ANALYSIS OF LOCAL PUBLIC PRODUCTION

As explained in earlier chapters, the econometric dimension of this dissertation follows a production/cost framework founded conceptually on Bradford, Malt and Oates' (1969) two-stage public production process as adapted for the fire service by Brudney, Duncombe, and Yinger over several studies. The innovation in this dissertation is the inclusion of factors that account for the influence of managerial choices and organizational conditions on public production. This chapter therefore specifies empirical functions implied by the conceptual framework presented in Chapter 4, and uses them to test the role of managers in the production system using regression analysis.

The chapter is organized as follows. First, a simplified cost model based on the conceptualization represented in Figure 4-2 is discussed and its main variables are described in detail. Then a set of descriptive statistics suggestive of the nature and influence of fire department management and of the relationships among key variables are presented and discussed. Next, the econometric methodology employed to estimate the cost model is addressed, with particular attention to the simultaneous nature of the model. The data used to estimate the model are drawn from the sources and surveys described in Chapter 5. Finally, the empirical findings of the estimation process are presented and the implications for the role of management in the production of public fire protection are considered.

7.1 Empirical Model Specification

As explained in Chapter 4, economic production analysis typically rests on cost models that relate spending for a good or service to three main sets of variables: the outcomes of production, the inputs to production, and the production environment. On this basis, the conceptual discussion in Chapter 4 arrives at an empirical model, represented in Equation 4-10, in which the cost of fire protection is a function of several sets of factors. Moreover, certain of these factors are jointly determined with the cost of fire protection, including the outcomes of fire protection, and managerial decisions. This section draws from the discussion in Chapter 4 to present a simplified cost model that is susceptible to empirical estimation using the data available.

7.1.1 Structural model

For this empirical analysis, the model implied by Figure 4-2 is simplified to the following set of structural functions:

$$C = f_1(S, M, I, N, E) \qquad [7\text{-}1]$$

$$S = f_2(M, C, T, Y, Z) \qquad [7\text{-}2]$$

$$M = f_3(C, S, E') \qquad [7\text{-}3]$$

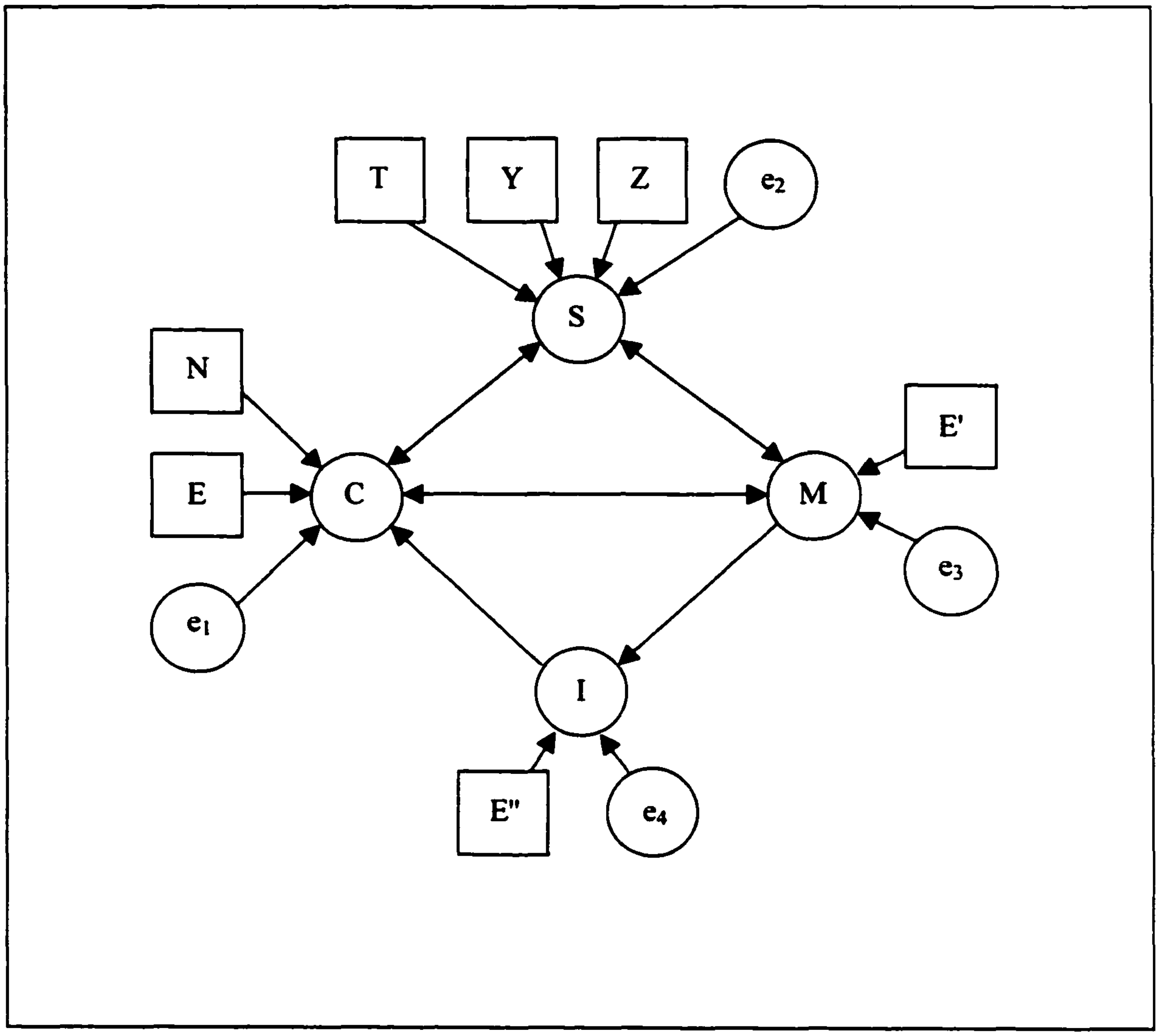
$$I = f_4(M, E'') \qquad [7\text{-}4]$$

where C is the cost of fire protection, S is fire protection outcomes, M is a set of managerial activities, I is the mix of factor inputs, N is the population of the fire jurisdiction, T is the median voter's tax share, Y is the median voter's income, Z is a set of voter preferences, and the E's are sets of cost factors in the production/organizational environment.

Before discussing these variables in detail, two characteristics of the structural model bear mention. First, the variables in the model can be distinguished according to whether or not they are within the control of the fire department. Some variables are considered to be at the discretion of fire departments, such as the input mix the department chooses to produce fire protection. Similarly, managerial activities are by definition the choice of the decision-making unit, as managers are considered the key decision-makers. Other variables are influenced by factors fire departments cannot control, but also depend on department discretion. In particular, fire departments are thought to seek to maximize fire protection outcomes and to minimize costs, but these variables are also affected by environmental factors. Environmental variables, the jurisdiction's population, and voter characteristics are viewed as wholly beyond the influence of fire departments.

The second important aspect of the structural model is that several variables are determined within the system of functions, including service cost, service outcomes, department management, and factor inputs. Moreover, the relationships between costs and outcomes, between costs and management, and between management and outcomes are bidirectional –these variables have a reciprocal effect on each other, as shown in the influence diagram in Figure 7-1. The presence of multiple endogenous variables jointly determined in a series of interrelated functions means that ordinary least squares (OLS) regression analysis of this model will not provide optimal estimates of the relationships among the variables. As a result, an alternative estimation technique is required, as will be explained in a later section.

Figure 7-1. Influence Diagram for the Structural Model



The variable definitions are given in the text. The e_n's are error terms. The arrows show the direction of influence. The boxes indicate exogenous variables (determined outside the system). The circles indicate endogenous variables (determined within the system).

7.1.2 Measures and data sources

This section describes in detail the main variables used in the analysis. The factors that influence the demand for a public service (Equation 7-2) were explained in Chapter 2; the components of the cost function are the focus of this discussion. The key sets of variables are cost, outcomes, management, inputs, and the environment. Variable names are indicated in capital letters. Table 7-1 defines the variables in the cost model and identifies the data source for each.

Cost. This analysis uses as its dependent variable the natural logarithm of the total annual expenditures on fire protection per capita (LNCOSTPC).[64] Expenditure per capita is an appealing dependent variable because it allows the results of the analysis to be interpreted in terms of how much various influences (of particular interest, managerial activities) affect what fire protection costs each resident of the department's jurisdiction. The total expenditure figure includes current operations, equipment and capital outlays, and debt service. For fire districts, city fire departments, and village fire departments, the total expenditure figure reported in the New York State Comptroller's Special Report on Municipal Affairs for 1997 was used. For independent departments and fire protection districts, these data were estimated from the Comptroller's figures for town expenditures. In addition, fire departments were asked to provide a total budget figure for fiscal year 1998 in the written survey. Eighty-eight percent of survey

[64] The specification of the dependent and some independent variables as natural logarithms arises from empirical precedent in the estimation of cost functions, which typically are derived from the general Cobb-Douglas functional form $Q=AK^{\alpha}L^{\beta}$, and can be estimated as $\ln Q=\ln A+\alpha \ln K+\beta \ln L$. Loglinear models are advantageous because they lend themselves to multiple regression analysis, and because they help to mitigate the effects of heteroskedasticity. It must be acknowledged, however, that Duncombe, Brudney, and Yinger's work has demonstrated that the Cobb-Douglas specification does not appear to describe the production of fire protection well, so it must be considered a rough approximation.

Table 7-1. Variable Definitions and Sources.

Name	Definition	Source[a]
Dependent:		
COSTPC	Total spending on fire protection per capita; LNCOSTPC=ln(COSTPC)	FDS; SRMA
Outcomes:		
STRFIRHU	Total structure fires per housing unit; LNSTRFIR=ln(STRFIRHU)	FIRS/COP
FIRELOSS	Total property loss due to fire/total residential property value	FIRS/COP
OUTPUT	1/FIRELOSS; LNOUTPUT=ln(OUTPUT)	
Management:		
STYLE[b]	Extent to which leadership is participatory	FDS
CMPFM[b]	Self-assessed competence at financial management	FDS
PLANNING[b]	Extent to which FD has formal strategic, capital, operations plans	FDS
PERFORM[b]	Self-assessed ability to do performance monitoring/assessment	FDS
RECORDS[b]	Extent to which FD has formal written or automated records	FDS
FSTRAIN	Fire suppression training hours per year	FDS
Inputs:		
PERVOL	Proportion of the departments labor force that is volunteer	CFCS
SPECEQ[b]	Extent to which FD uses specialized equipment	FDS
Service tasks:		
OTHCALLS	Total own-area calls excl. structure fires; LNOTHER=ln(OTHCALLS)	FIRS
TOTMA	Total mutual aid calls of all types; LNTOTMA=ln(TOTMA)	FIRS
Environment:		
APART	Proportion of housing units in structures with more than 20 units	COP
CHEAP	Proportion of housing units with value less than $30,000	COP
CITYFD	Legal structure of FD is as a city department	CFCS
DENSITY	Population density	COP
EDUCAT	Proportion of population with an associates degree or higher	COP
FARMER	Proportion of population employed as farmers or fishermen	COP
HYDRAN	Proportion of jurisdiction that has fire hydrants	FDS
LANFRM	Proportion of land area that is farmland	FDS
LANSCH	Proportion of land area that is school grounds or campuses	FDS
INCMED	Median household income; LNINCMED=ln(INCMED)	COP
POP	Jurisdiction population; LNPOP=ln(POP)	COP
NOKIDS	Proportion of households without children	COP
NONURB	Proportion of housing units that are non-urban	COP
OCCCOM	Proportion of occupancies that are retail, business, or commercial	FDS
OCCIND	Proportion of occupancies that are industrial or manufacturing	FDS
OCCWAR	Number of warehouses protected	FDS
OWNER	Proportion of housing units that are owner-occupied	COP
POOR	Proportion of population that is below the poverty level	COP
TAXSHARE	Median house value/house value per capita	COP
TRAILR	Proportion of housing structures that are mobile homes	COP
UNEMPL	Proportion of population that is unemployed	COP
VACANT	Proportion of housing structures that are vacant	COP
WATER	Proportion of housing units with public water	COP
WOOD	Proportion of housing units with wood heat	COP

[a] These are indices where a higher value indicates a greater extent

[b] Variable source abbreviations are: FIRS (New York Fire Incident Reports for 1997), SRMA (New York State Comptroller's Special Report on Municipal Affairs for 1997), CFCS (County Fire Coordinator written survey), FDS (Fire Department written survey), COP (Imputed for fire jurisdictions from the 1990 Census of Population and Housing –see Appendix 4 for the imputation methodology).

respondents answered this question. These responses were viewed as unreliable, however, because of dramatic variation in the structure of the departments' budgets. Nonetheless, the Comptroller's figures were audited against these responses, and cases of dramatic disparities were researched to ascertain an appropriate figure.

Outcomes. As observed in Chapters 3 and 4, specifying satisfactory measures of the outcomes of fire protection is troublesome. Good outcome measures are important because they permit evaluation of the influences on costs controlling for the level and quality of service. In addition, outcome measures that capture the results of the range of an organization's activities are preferred. Given that the aggregate level of fire protection a community enjoys results from efforts in two main mission areas, fire prevention and fire suppression, it is thus desirable to have outcome measures that capture the results of each of these sets of activities. Two outcome measures are therefore used in this analysis: number of fires and property loss due to fire.

The log of structure fires per housing unit (LNSTRFIR) attempts to capture the results of fire prevention activities, under the assumption that fire departments with more effective fire prevention programs will experience fewer fires, all else equal. Structure fires, rather than total fires, are used because fires in buildings are generally more dangerous and damaging than other types of fires (such as grass fires or dumpster fires). Most fire education programs focus on mitigating the threat of fires in buildings, particularly fires in homes. The number of structure fires relative to housing units was used because the total number of buildings in each jurisdiction was unknown. This is a meaningful ratio because most structure fires are house fires. The LNSTRFIR measure is somewhat counterintuitive as an outcome measure because fires occur when a set of environmental conditions beyond the fire department's control coincide –that is LNSTRFIR is a function of environmental causes and fire prevention activities, and measures fires caused by the environment that the department does not prevent, therefore one cannot isolate the outcome dimension of LNSTRFIR without controlling for environmental factors.

The figures for number of structure fires were obtained from the New York State Office of Fire Prevention and Control's database of Fire Incident Reports. One problem that arises with the figures in these reports is inconsistency across fire departments in what is considered a structure fire. Normally, a structure fire is judged by the fire chief to occur when parts of the structure and its contents are substantially involved in flame. In some departments, such as the City of Syracuse, *any* fire the occurs in a building is reported as a structure fire, even a minor fire, such as a stove fire that does no damage to the surrounding room or its contents. Unfortunately, there is no way to assess the extent of this inconsistency.

The second outcome measure used in this analysis is the log of the inverse of direct fire loss (in dollars) relative to aggregate residential property value (LNOUTPUT). This measure captures both fire prevention and fire suppression.[65] Obviously, fires that are prevented do not cause property losses. Fires that are suppressed quickly and with minimal collateral damage (from ventilation tactics or the application of water) result in lower losses than fires that are put out slowly (as a result of, for example, long response

[65] Use of loss per fire, rather than loss relative to residential property value was considered. Such a measure would focus more directly on fire suppression efforts, though good fire prevention can minimize loss in fires that do occur. Based on preliminary analysis, it was determined that the chosen variable produced more robust and stable results.

times or inadequate or unskilled manpower or equipment limitations) or with poor firefighting techniques, all else equal.

Fire loss figures were also obtained from the OFPC's database of Fire Incident Reports. The most serious problem with these figures is that fire losses are estimated, in the best case, by the commander on the fire scene or, in the worst case, by whomever may complete the report long after the incident, whether or not they were present at the fire to inspect the damage. Generally, according to many fire chiefs interviewed during this study, the fire losses reported to the OFPC are "ballpark" guesses made by personnel who are not formally trained in property or damage assessment. In fact, when departments were asked on the written survey to assess their ability to estimate fire losses, 43.5 percent reported their ability as "fair" or worse. Assuming these self-assessments represent an optimistic view of true behavior, the credibility of the reported fire loss data is suspect. Moreover, the loss assessment is frequently left blank on incident reports, and so the available figures may underestimate true total losses. Again, there is no way to assess the extent of this inconsistency –these data must be considered cautiously, though they can serve as indicators even if conclusions based on them are necessarily tentative.

Management. The conceptual discussion in Chapter 4 proposes that ultimate choices about the configuration and deployment of production resources result from complex interdependencies between managers and the internal environments of their organizations. The analysis and findings presented in Chapter 6 demonstrate that fire chiefs perceive and react to pressures that arise from within their departments. At the same time, intuition, experience, and empirical research indicate that organizational structures evolve in response to the decisions managers make about the acquisition and administration of personnel and capital. This chapter sets aside the question of how management and organizations relate to one another for future work, and focuses on the question of how the management-organization "package" influences costs. For simplicity, the variables included in the model will be termed "management variables," though they can be viewed more realistically as representing managerial decisions that result, in part, from organizational influences.

The approach of ignoring variables that are expressly organizational is justifiable in the present study for three reasons. First, this study focuses on organizations of the same general type: fire departments. While fire departments do vary somewhat in terms of the hallmark dimensions of organizational structure (as reviewed in Chapter 2), they share some very strong similarities as hierarchical, paramilitary organizations –a firefighter walking in the door of an unknown department would likely find the command structure, arrangement of organizational sub-units, tasks, technology, and operational procedures to be very familiar. Variation can thus be expected to be constrained within this population, which would limit the explanatory power of standard organizational variables, such as tasks, technology, and complexity. Second, one key organizational variable that much public management research has found to be important is size. In the case of fire departments, organizational size is strongly related to the size of the population the department protects. (Table 7-2 shows strong and significant bivariate correlations between the number of personnel, vehicles, and stations fire departments in this study have and the population of the jurisdictions they protect.) In this study, size is therefore taken into account through the inclusion of population in the model, which also allows the presence of economies of scale to be evaluated.

Table 7-2. Correlation Between Fire Department Size and Jurisdiction Population.

	Population	# of personnel	# of vehicles	# of stations
Population	1.0000	.5186	.5531	.6406
# of personnel	.5186	1.0000	.6614	.5194
# of vehicles	.5531	.6614	1.0000	.5990
# of stations	.6406	.5194	.5990	1.0000

All values are significant at the 1% level (two-tailed t test)

A final –and pragmatic– reason for excluding explicit measures of organizational structure, even forgiving the constraints noted above, is that the number of cases available in the dataset constructed for this study is too small to support the elaborate empirical models that would be required to represent the simultaneous determination of managerial and organizational factors within the public production framework, which is itself simultaneous. In truth, omitting the joint determination of management and organizational factors is a mis-specification of the conceptual model presented in Chapter 4. This may cause the coefficients in the estimated model to be biased because variables are omitted and the underlying relationship among included variables is misrepresented. Given the above discussion, however, I expect such bias to be small.

With these caveats, the empirical model that is estimated in this study includes variables that seek to capture the three main dimensions to the function of management that were defined in Chapter 4: strategic, administrative, and operational. The full set of variables considered includes the following:

1. PLANNING, an ordinal index indicates the extent to which a department has written plans and procedures, including strategic, capital, and pre-fire plans, a statement of goals, and standard operating procedures. This index, constructed from dummy variables based on survey questions, captures both the presence of a strategic perspective (a managerial function) and the degree of formalization (an organizational characteristic) in the department.

2. PERFORM, an ordinal index, constructed from survey responses, that indicates the extent to which the fire department views itself as competent at measuring its performance and costs and at using these data in decision-making.

3. CMPFM, an ordinal scale based on a survey question that indicates the extent to which the fire department views itself as competent at financial management.

4. RECORDS, an ordinal index derived from survey responses that indicates the extent to which the fire department maintains written or automated records in a variety of areas, including service activity, training, personnel, finance, inventories, and maintenance.

5. STYLE, an ordinal scale that indicates the extent to which the department views its management as participatory, based on the degree of member input in administrative decision-making.

6. FSTRAIN, the number of hours of fire suppression training conducted by a department annually, as reported on the survey.

Three of these were included in the model: STYLE, PERFORM, and RECORDS. Factor analysis of all six variables shows that the planning, performance measurement, and financial management variables appear to represent a common managerial function, as they load powerfully together (at 0.720, 0.761, and 0.704, respectively). This is further substantiated by a Cronbach's coefficient alpha for these variables of 0.6, which suggests that they are reliable measures of a common construct. In the interest of parsimony, only PERFORM is included in the final estimation. Similarly, STYLE and FSTRAIN are negatively related, but load strongly together (loadings of -0.780 and 0.662, respectively; $\alpha = -0.5$). STYLE was chosen to be included in the estimated model, as it has many fewer missing values.

Inputs. The operational function of management involves decisions that concern the production technology the department will employ. These decisions are included in this model as measures of the mix of inputs, but they must also be considered management variables as they are management choices. Two variables designed to represent the influence of the mix of production inputs on the short-run cost of producing fire protection are included in the model. These are PERVOL, the percentage of the workforce that is volunteer, and SPECEQ, an index that indicates the extent to which the department has access to an array of specialized equipment, either in-house or through mutual aid. PERVOL is based on figures reported by the County Fire Coordinators and SPECEQ is derived from fire department survey responses. These input measures are used in place of factor prices because equipment prices are generally similar across departments and because, while volunteers are not costless, their price is very difficult to identify and measure. Major capital purchases (for example, trucks and stations) are long-term decisions not included in the model.[66]

[66] Fire departments use very similar capital. All fire departments have fire engines, for example. While these engines vary in their capabilities (and capital in general may vary in its productivity), data about this variation are not readily available. The pilot survey attempted to ascertain information about fire department apparatus, but it was determined that the reporting burden for a worthwhile level of detail would deter response to the survey, and these questions were dropped from the final instrument. The numbers of vehicles and stations are strongly correlated with the population protected, and thus are not included in the model.

Environment. As discussed in Chapters 2 and 4, a properly specified cost model must account for the influence of the environment on the production of outcomes. Based on the findings about environmental factors related to fire incidence identified in the fire service literature (Chapter 3 and Table 3-3), a set of 22 variables related to building construction (APART, TRAILR), building condition (CHEAP, VACANT, WOOD, WATER), building use (OCCCOM, OCCIND, OCCWAR, NONURB, OWNER), the distribution of family structures (NOKIDS), demographic characteristics (EDUCAT, INCMED, POOR, TAXSHARE, UNEMPL) and land use (DENSITY, HYDRAN, LANFRM, LANSCH) in the jurisdiction are included. These variables are defined in Table 7-1. In addition, LNPOP (the log of the jurisdiction's population) is included to control for the influence of the size of the jurisdiction and also for the possibility of congestion. Finally, CITYFD (a dummy variable that defines whether or not the fire department is legally structured as an agency within a city government) is included to control for the direct influence of the local government on the fire department.

Service Responsibilities. This final set of variables is included to control for the fact that a fire department's attention is divided among several missions, many of which do not directly relate to a jurisdiction's fire protection, which is what the outcome variables in the model measure. These other missions do, however, contribute to the overall cost of the fire department, the dependent variable in the model. The variables are LNOTHER, or the log of the total number of calls to which the department responded that were not building fires (such as medical, rescue, hazardous materials, or non-emergency citizen assistance), and LNTOTMA, the log of the number of mutual aid calls. These data were obtained from the OFPC. It is important to note that these variables can also be considered organizational variables because they define the tasks of the department. Moreover, the service responsibilities a department chooses to accept are, to some extent, managerial decisions. In this model, however, these variables are not considered endogenous because they are largely driven by long-term community expectations and are beyond the control of the fire chief in the short term.

7.2 Descriptive Findings

Descriptive statistics for the variables in the model are presented in Table 7-3 for all respondents, and in Table 7-4 by workforce configuration, perhaps the most obvious and important structural distinction among fire departments. Table 7-4 permits all-paid, all-volunteer, and mixed-staffing departments to be compared. In terms of costs and outcomes, these figures show that annual spending for fire protection per capita in 1997 ranged from a low of $1.30 to a high of $575.99. This cost was highest for jurisdictions with paid departments ($118.99 per capita on average) and lowest for jurisdictions with volunteer departments ($61.14 per capita on average), probably due to the impact of salaries and benefits on the budgets of departments with paid personnel. Volunteer departments respond to the fewest structure fires, but experience the highest aggregate fire losses. Combination departments see the most fire and report the lowest losses. With respect to management, the most significant distinction among the three categories of departments is in hours of fire suppression training, where paid departments conduct the most by far –an average of almost 200 percent more hours than volunteer departments, which conduct the least training. On the other hand, volunteer departments report a relatively more participatory management approach on average than either paid also be considered organizational variables because they define the tasks of the department. Moreover, the service responsibilities a department chooses to accept are, to some extent, managerial decisions. In this model, however, these variables are not considered endogenous because they are largely driven by long-term community expectations and are beyond the control of the fire chief in the short term.

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Table 7-3. Descriptive Statistics.

Variable	n	Minimum	Maximum	Mean	Stand Dev
COSTPC	169	1.30	575.99	64.81	61.93
STRFIRHU[a]	171	.00	3.00	4.54	4.51
FIRELOSS[b]	171	.00	15.00	5.42	1.45
STYLE	168	.00	13.00	6.96	2.86
PERFORM	164	.00	18.00	1.23	3.40
RECORDS	170	4.00	16.00	11.29	2.79
PLANNING	163	.00	5.00	2.54	1.37
FSTRAIN	165	.00	60.00	69.51	75.33
CMPFM	167	.00	6.00	4.52	1.03
PERVOL	173	.00	1.00	.95	.20
SPECEQ	169	.00	16.00	9.85	2.28
OCCWAR	171	.00	87.00	2.73	7.59
OCCCOM	169	.00	.30	.11	.08
OCCIND	169	.00	.30	.04	.05
OWNER	173	.25	.87	.64	.14
WOOD	173	.00	.29	.10	.07
TRAILR	173	.00	.31	.13	.09
UNEMPL	173	.01	.09	.03	.01
NONURB	173	.00	1.00	.06	.17
EDUCAT	173	.08	.47	.18	.07
WATER	173	.01	1.00	.46	.30
LANFRM	168	.00	.90	.29	.27
LANSCH	168	.00	.51	.03	.07
HYDRAN	172	.00	1.00	.35	.37
NOKIDS	173	.29	.47	.38	.03
CITYFD	173	.00	1.00	.04	.20
POOR	173	.01	.20	.09	.04
DENSITY	173	3.25	5731.50	44.32	945.42
INCMED	173	18567.81	68423.11	31448.67	9084.31
TAXSHARE	173	2.32	9.55	5.14	1.31
FARMER	173	.00	.06	.02	.01
APART	173	.00	.14	.01	.02
POP	173	25.00	6184.00	5872.61	8424.21
CHEAP	173	.00	.16	.04	.04
VACANT	173	.02	.71	.16	.15
OTHCALLS	171	1.00	3869.00	283.45	531.32
TOTMA	172	.00	219.00	27.08	3.01

[a] Per thousand housing units
[b] Per thousand dollars of residential property value

Table 7-4. Comparison of Means for Variables in the Model by Department Type.

Variable	Paid	Volunteer	Combination	Overall
COSTPC	118.99	61.14	83.88	64.81
STRFIRHU[a]	6.25	4.30	6.97	4.54
FIRELOSS[b]	3.55	5.78	1.36	5.42
STYLE	3.17	7.40	3.09	6.96
PERFORM	12.17	1.08	11.08	1.23
RECORDS	11.50	11.07	13.92	11.29
PLANNING	4.00	2.46	3.00	2.54
FSTRAIN	186.50	62.41	98.00	69.51
CMPFM	4.67	4.52	4.42	4.52
PERVOL	.00	1.00	.75	.95
SPECEQ	8.60	9.92	9.50	9.85
OCCWAR	25.00	1.88	4.33	2.73
OCCCOM	15.00	1.06	16.09	1.60
OCCIND	8.60	3.14	9.36	3.70
OWNER	.50	.64	.73	.64
WOOD	.01	.11	.02	.10
TRAILR	.02	.14	.02	.13
UNEMPL	.04	.03	.02	.03
NONURB	.43	.04	.10	.06
EDUCAT	.15	.18	.23	.18
WATER	.95	.41	.81	.46
LANFRM	.00	32.20	6.00	29.33
LANSCH	6.67	2.83	6.82	3.23
HYDRAN	10.00	29.08	84.25	35.40
NOKIDS	.33	.38	.40	.38
CITYFD	1.00	.00	.08	.04
POOR	.16	.09	.04	.09
DENSITY	3534.28	217.34	1773.46	44.32
INCMED	22935.86	31143.69	39644.39	31448.67
TAXSHARE	5.23	5.20	4.40	5.14
FARMER	.00	.02	.00	.02
APART	.04	.01	.02	.01
POP	2968.50	4036.04	17691.00	5872.61
CHEAP	.05	.04	.01	.04
VACANT	.09	.17	.04	.16
OTHCALLS	1797.17	161.89	1159.64	283.45
TOTMA	1.50	26.82	38.75	27.08

[a] Per thousand housing units
[b] Per thousand dollars of residential property value

Table 7-5. Comparison of Means for Other Variables by Department Type.

Variable	Paid	Volunteer	Combination
Age of the department (in years)	120	76	75
Number of firefighters	67	55	84
Number of stations	3	1	2
Number of engines	5	2	4
Average age of firefighters	33	36	37
Percentage of personnel that are chiefs or officers	30	18	18
Percentage of personnel that are college graduates	38	20	31
Percentage of personnel that have military experience	43	17	13
Percentage of personnel that are minorities	<1%	<1%	1
Percentage of personnel that are women	2	12	9
Percentage of personnel that are EMT's or paramedics	75	20	39
Department morale (lower is better)	3	4	5
Department Insurance Services Office rating	3	6	4
Number of building inspections conducted annually	554	5	146
Number of classes for school kids conducted annually	71	3	29
Total calls in 1997	1890	195	1134
Percentage of all calls that were fires	9	24	9
Percentage of responses that were mutual aid	1	21	5
Percentage of own-jurisdiction calls that were false	13	10	12
Percentage of own-jurisdiction calls that were HAZMAT	8	12	7
Percentage of own-jurisdiction calls that were EMS	49	35	50
Percentage of own-jurisdiction calls that were rescue	5	6	5
Percentage of own calls that were non-emergency	17	19	19
Percentage of own calls that were structure fires	4	6	3

or combination departments, which are similar. Interestingly, volunteer departments also rank highest on use of specialized equipment. Paid departments do more formal planning and rank themselves better at financial and performance management than do other types of departments, but combination departments report that they do more comprehensive record-keeping. The variation along these dimensions is not, however, as stark as it is for training and management style.

Comparison of the different types of departments with respect to the environmental variables show that, as expected, volunteers protect more rural areas, with higher mean values for land area devoted to farming, numbers of homes heated with wood, and numbers of mobile homes, but lower numbers of warehouses, commercial buildings, and industrial sites, fewer housing units served by public water systems, lower overall populations, and lower population densities. On the other hand, combination departments appear to protect the most affluent areas. On average, their jurisdictions are populated by more educated people with higher incomes and more valuable homes. They have lower unemployment, fewer renters, and fewer vacant houses. Finally, paid departments tend to protect the highest populations and the smallest land areas, the poorest and least educated populations, the cheapest housing structures, and the most warehouses. They meet this mission with the benefit of a public water supply, however.

Table 7-5 compares the paid, volunteer, and combination departments that responded to the fire department survey across a set of additional descriptors that do not appear in the regression analysis. Comparison of means for these characteristics reveals some striking differences among the categories. In particular, in paid departments, a much higher percentage of the workforce is college educated, holds a professional medical certification, and has a military background. Paid departments also have fewer women and their workforces are younger, on average. In addition, paid departments operate with more managerial overhead –thirty percent of these departments' personnel are chiefs, captains, or lieutenants, as compared to only 18 percent in both volunteer and combination departments. Interestingly, morale is reportedly highest in paid departments and lowest in combination departments, on average.

Paid departments appear to provide the most fire prevention services and volunteer departments the least, measured by the number of building inspections and classes for children conducted. Also, paid departments tend to run many more calls annually than do either combination or volunteer departments (averages of 1890, 1134, and 195, respectively for 1997), and almost none of these calls are mutual aid to other departments. In contrast, over 20 percent of the calls to which volunteer departments respond are mutual aid. Moreover, over half of the calls to which paid and combination departments respond are medical (EMS or rescue), and only 9 percent are fires, as opposed to volunteer departments, for which only 35 percent of calls are medical and 24 percent are fires.

In sum, the descriptive characteristics captured in Tables 7-3, 7-4, and 7-5 suggest a general picture of the fire service in which paid departments protect densely populated areas that generate a high volume of calls for service. They rely on professionally trained and educated workforces to provide substantial fire prevention and suppression services. They also use a proportionally larger managerial staff, and firefighters tend to have less discretion in managerial decisions. In contrast, more rural areas with a lower demand for fire department response tend to be protected by volunteer departments. In these areas, many of the emergency calls are for fires, and the losses from these fires are high. Volunteer departments have the least trained and educated workforces and provide the fewest fire prevention services, but they also cost the least. Combination departments are generally mid-range between paid and volunteer departments in terms of departmental characteristics. Their firefighting environments seem the mildest, however: affluent communities supported by a public water supply.

7.3 Model Estimation

This study hinges on a set of data about a sample of fire departments, the cost function represented in Equation 7-1, and the desire to test the independent influence of each of various managerial actions on the cost of fire protection. The econometric workhorse for using data to estimate the parameters of a function is linear least-squares regression analysis. A version of this approach is used in this study. This section describes the regression technique applied and presents the diagnostic procedures used to examine difficulties in the data that could compromise the analysis. The next section presents and discusses the results of the analysis.

7.3.1 Econometric method

The ordinary least squares (OLS) regression model assumes that the disturbance term is stochastic –independent of the right-hand-side variables in the model. Under conditions of implicit simultaneous causality, such as exist in the multiple-equation model to be estimated in this study, this assumption is violated. This is because in simultaneous systems, a dependent variable in one equation feeds back into a dependent variable in another equation as a regressor, and vice versa. As a result, the endogenous variables are correlated with the error term of the equation in which they appear as explanatory variables, and OLS regression leads to biased and inconsistent parameter estimators.[67]

One approach to the estimation of simultaneous systems that overcomes the problem of the possible correlation of endogenous variables with error terms is two-stage least squares regression analysis (2SLS), a method that intuitively involves two successive applications of OLS.[68] In the first stage, the reduced form models are estimated: Each of the stochastic endogenous variables in the system is regressed on the full set of predetermined variables in the system[69] to determine the fitted value of each endogenous variable. In the second stage, the structural equation of interest is estimated by replacing the endogenous variables with their fitted values as proxies that are independent of the error terms in the system. This procedure yields biased but consistent parameter estimators for the structural equation.[70]

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[67] Bias and inconsistency mean that, as the sample size increases infinitely, the estimators do not converge on their true population values. For a straightforward discussion and proof of the occurrence of this phenomenon under circumstances where explanatory variables are correlated with the error term, see Gujarati, 1995.

[68] Estimation actually proceeds in one stage by Generalized Least Squares.

[69] Some of these predetermined variables appear in the structural equation of interest. (In this study, this is the cost function.) For this discussion, these variables are termed "exogenous." Some of the predetermined variables do not appear in the cost function, but are used to predict the endogenous variables. These are termed "instruments." In fact, the predicted values of the endogenous variables serve as instruments for the endogenous variables themselves in the second stage of 2SLS. For clarity in this discussion, the term "instrument" will refer to those predetermined variables that predict the endogenous variables.

In this study, 2SLS is used to estimate the cost function from the structural model represented in Equations 7-1 through 7-4. The estimating equation is:

$$\begin{aligned} \text{LNCOSTPC} = {} & \text{LNSTRFIR} + \text{LNOUTPUT} + \text{PERFORM} + \text{STYLE} + \\ & \text{RECORDS} + \text{PERVOL} + \text{SPECEQ} + \text{LNPOP} + \\ & \text{CHEAP} + \text{VACANT} + \text{LNOTHER} + \text{LNTOTMA} \end{aligned} \qquad [7\text{-}5]$$

where LNCOSTPC, LNSTRFIR, LNOUTPUT, PERFORM, STYLE, RECORDS, PERVOL, and SPECEQ are considered endogenous, and LNPOP, CHEAP, VACANT, LNOTHER, and LNTOTMA are exogenous. The remaining environmental variables listed in Table 7-1 are instruments for the endogenous explanatory variables. The results of the first stage and full estimations will be presented shortly. First, the management of conceivable difficulties with data and estimation is discussed.

7.3.2 Regression diagnostics

During the course of this analysis, several potential problems with the data and available estimation procedures were explored and mitigated to the extent possible. Four issues will be discussed here in turn: simultaneity (the bi-directional influence of variables on each other), identification (the ability to obtain unique numerical estimates of the structural coefficients), heteroskedasticity (the presence of a non-random pattern in the residual error terms), and multicollinearity (the presence of interrelationships among the independent variables).

Simultaneity. The 2SLS method yields inefficient estimators if there is no simultaneity, and thus it is preferable to use OLS under this condition. While the model proposed in this study turns on the joint determination of the supply of and demand for fire protection, it is desirable to enhance our confidence that simultaneity exists in the

[70] The estimated coefficients under 2SLS exhibit a negative bias –the predicted β's are likely to be less

model through an empirical test. The Hausman specification error test can be used to check for the presence of simultaneity by assessing whether the endogenous regressors in the cost equation are correlated with the error term. Hausman's test is a weak test for simultaneity because the null hypothesis is that no simultaneity exists. In this study, the test is further weakened by the small sample size. Nonetheless, an application of Hausman's test was conducted in which the predicted residuals from all of the reduced form equations were included as regressors in an OLS regression estimation of the cost equation.

The results of a partial F-test indicate that the null hypothesis of no simultaneity can be rejected for this model at the 10 percent significance level, but not at the 5 percent significance level. The test procedure and full results are presented in Appendix 5. Bolstered by these results, this study proceeds under the assumption that simultaneity is present for three reasons. First, the theoretical model under consideration was carefully developed from the principles of economic production function theory, as described in Chapter 4. This model is inherently simultaneous. Second, lines of empirical research into local government production of fire protection and of education support simultaneous modeling (Duncombe,1991 and 1992; Duncombe and Yinger, 1993 and 1997; Duncombe and Brudney, 1995). Third, as noted above, the Hausman test is a weak test, and the 10 percent significance level for the partial F-test can be considered adequate.

Identification. Simultaneous systems may give rise to what is known as the "identification problem," a condition in which is it impossible to obtain unique estimates

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than the true β's. In addition, this effect is more pronounced for small samples (Studenmund, 1997).

of any or all of the coefficients in the model's structural equations because the available data are compatible with more than one set of structural coefficients, and the system is therefore either un-, under-, or overidentified. One way to check whether a system is identified is to apply the order condition, a necessary (though not sufficient) condition for identification.[71] The order condition requires that in a model of M simultaneous equations, an equation must exclude at least M-1 of all of the variables in the entire model in order to be identified. The equation is overidentified if the variables in the equation minus one are less than the total number of exogenous variables in the system. The cost equation estimated in this study meets the order condition to be overidentified because it includes only 13 of the 34 variables in the system, which includes 26 exogenous variables.

Heteroskedasticity. Heteroskedasticity is a condition where the variability in the residual error terms is not constant for all values of the explanatory variables. It is detected through examination of the residuals, and may be diagnosed informally by inspecting scatterplots of the residuals against the variables in the model. In this study, such diagnoses were performed on both the first stage models, by looking at partial plots of residuals of each independent variable and the residuals of the dependent variable for each model, and the second stage models, by looking at the plot of the squared residuals against the predicted value of the dependent variable, as recommended by Gujarati (1995).

[71] While the order condition is only necessary, the rank condition is both necessary and sufficient, but more complicated to apply. The order condition is considered generally adequate to ensure identifiability (Gujarati, 1995; Pindyck and Rubinfeld, 1998).

The partial plots for the first stage models do not turn up any remarkable results; neither patterns nor non-random outlying cases are obvious in these plots. In the second stage model, no pattern is apparent,[72] but two cases appear as outliers in a plot of squared residuals against predicted value of LNCOSTPC: One case is over 7.5 standard deviations from the mean, the other is over 5. All other cases were within 2 standard deviations of the mean. When these are two cases are dropped, the results of the model estimation are stable in terms of the signs and magnitude of the coefficients, and the significance levels improve, as will be seen when these results are presented and discussed in the next section.

While tempting to present better results, it is unappealing to omit cases because they appear to be outliers without clear justification for doing so, such as an unresolvable measurement or coding error in the data, or some characteristic about the case that makes similar occurrences unlikely to be replicated in the population. Moreover, it is unappealing to drop cases when the total number of observations is small, as in this study, because a single case may look like an outlier in the sample, but may in fact capture an important source of real variation in the population. In other words, it is difficult to exclude an observation without some assurance that it is truly idiosyncratic. A regression surface fitted to include an outlier is nonetheless a poorer fit to the preponderance of the available data, and omitting the cases may give a truer impression of the relationships under consideration.

[72] It could be that the use of natural logarithms of key variables in this analysis masks or mitigates heteroskedasticity as the use of weights in a generalized least squares approach would. However, there is no obvious pattern to the residuals in the first or second stage even when the non-logged versions of the variables are used.

Neither of the outlying cases in this analysis are strikingly peculiar with respect to departmental characteristics. In one of the cases at hand, the description of the fire department and its jurisdiction provided by the County Fire Coordinator does not correspond very well with the information provided by the department itself, suggesting that the imputation scheme applied in this study may have failed to assign reasonable values of the predetermined census variables to the jurisdiction. In the other case, the survey response gives a hurried and careless impression (many questions are left blank), and almost all of the questions that require self-assessments are answered at the extreme positive end of the scale (i.e. "outstanding"). The data for these two cases therefore may not be reliable, and thus it may be justifiable to drop them. In favor of a conservative approach to analysis, the results in this study are presented both with and without the outlying cases, to permit alternative interpretations.

Multicollinearity. Multicollinearity occurs when the independent variables in a regression analysis are correlated.[73] Under this condition, the estimation procedure is incapable of identifying the independent effects of these interrelated variables on the dependent variable. The estimated coefficients of collinear variables remain unbiased, but they are less precise –their standard errors tend to be larger than if the variables were independent of one another, making confidence intervals broader, statistical significance harder to achieve, and estimates sensitive to changes in model specification.[74] In 2SLS, the consequence of multicollinearity among the exogenous variables from different structural equations is that the predicted values of the endogenous variables (which, in the

[73] The "perfect" case of multicollinearity occurs when one independent variable is a perfect linear combination of one or more of the other independent variables.

[74] Note that imprecision also arises when the sample size is small, as it is in this study.

reduced form models, depend on all of the exogenous variables in the system) will be collinear, and the second stage estimates are likely to be imprecise. Unfortunately, there is usually no adequate recourse for multicollinearity except obtaining more data.[75]

Multicollinearity is detected and its severity diagnosed with three main tools. First, estimation results are examined for the presence of high R^2 values coupled with many insignificant t-scores. Second, bivariate correlation coefficients among the independent variables are reviewed for high values. Third, the variance-inflation factor (VIF)[76] is examined. Generally, a VIF greater than 10 is considered to indicate severe multicollinearity, though some authors use lower values (Studenmund, 1997). Alternatively, the reciprocal of the VIF, known as the tolerance, represents the proportion of a variable's variance that is not accounted for by other the independent variables in the equation, so that a variable with low tolerance contributes little information to the model.

Under these criteria, some multicollinearity is apparent in this study in the first stage models. The R^2 for the first stage models is 0.41 on average, with the highest being 0.79. In the case with the highest R^2, 7 of the 24 independent variables are significant, and the t-scores are greater than 1 for an additional 4. In addition, the bivariate correlations among the predetermined variables are shown in Appendix 6. Many are significantly correlated with r values greater than 0.3. The variables OWNER (the proportion of housing units that are owner-occupied) and VACANT (the proportion of housing units that are vacant) exhibit severe multicollinearity, with VIF values over 10

[75] Common strategies for addressing multicollinearity include model respecification, which is undersirable if the problem truly lies in the data rather than the model, and alternative variable specification, a form of model respecification undesirable if it centers on an atheoretical optimization of the fit of the model to the sample.

[76] The VIF is an index of the impact of collinearity on the precision of estimation. $VIF = 1 / (1 - R^2)$

and tolerances below 0.08. The variable LNINCMED (the log of the median income) also appears collinear, with average VIF values in the first stage models of 8 and average tolerances of 0.12. Finally, WATER (the proportion of housing units with public water) shows less severe multicollinearity (VIF = 5.5 and tolerance = 0.18 on average across the first stage models). Three of these variables (OWNER, LNINCMED, and WATER) are instruments, and are significant in at least one of the first stage models, as discussed below and shown in Table 7-6. VACANT is an exogenous variable in the second stage, where it is significant.

That multicollinearity is present in the models does not alter the strategy of the analysis for several reasons. First, the multicollinearity does not appear to be severe in most cases –only for the 4 variables identified above out of the 26 predetermined variables in the model. Second, the results of the two-stage model are significant, so there is little motivation to try to remedy the collinear variables in the first stage. Third, sensitivity analysis shows that alternative choices for the collinear variables in the first stage do not radically alter the second stage estimation results, though some coefficients seem to be less robust than others.

7.4 Empirical Findings and Discussion

This section presents the results of the 2SLS regression estimation of Equation 7-5. For completeness, both the first and second stage models are discussed. The objectives of this section is to make the results clear, to address interpretation of the regression coefficients, and to offer alternative explanations for the results. The next chapter will discuss these results with respect to the hypotheses posed in Chapter 4.

7.4.1 First stage models

The results of the OLS estimation of the reduced form equations for each of the 7 endogenous variables in the model are presented in Table 7-6. Of the sample of 173 observations, from a minimum of 145 to a maximum of 161 observations were included in the first stage regressions. The models explain from a low of 20 percent to a high of 79 percent of the variance in the dependent (endogenous) variables.[77] Each of the endogenous models has at least one instrument that is statistically significant at the 5 percent level, and several additional instruments that appear to have explanatory power, as evidenced by t-scores greater than 1. At the same time, of the 21 instruments used, all but 2 achieve significance in at least one of the reduced form models, and the remaining 2 have t-scores greater than 1 in some of the models. None of the instruments is significant when included as exogenous in the second stage estimation. The relationships between the endogenous outcome, resources, and management variables and their instruments warrant some description and comment.

Outcomes. With respect to the two endogenous outcome variables, LNOUTPUT (the log of the reciprocal of property loss relative to property value) and LNSTRFIR (the log of structure fires per household), the instruments that emerge as significant appear to uphold both the fire service literature that addresses the influence of environmental factors on fire incidence and the median voter literature that identifies the determinants of citizen demand for public services: LNOUTPUT is strongly and significantly related to citizen income and education levels, as both bodies of literature would suggest, as well as to

[77] As the R^2 values for the reduced form equations increase, these equations better predict the endogenous variables (i.e. they produce better instruments for the second stage), and the 2SLS estimation procedure works better.

other physical characteristics of buildings in the jurisdiction. LNSTRFIR depends most powerfully on the proportion of housing units served by a public water system. This negative relationship could indicate that fires in areas with stable and ample water supplies are extinguished before they can be classified as structure fires. WATER may

Table 7-6. First Stage Models Regression Results.

Dependent	LNOUTPUT	LNSTRFIR	STYLE	PERFORM	RECORDS	PERVOL	SPECEQ
Intercept	48.7842***	-13.1501*	27.5588^{+}	34.5041^{+}	41.2701**	1.4978*	2.4922
Instruments							
OCCWAR	-.0413*	.0116^{+}	-.0331	-.0094	.0426^{+}	-.0005	.0105
OCCCOM	-.0061	.0012	.0059	.0486^{+}	-.0743***	.0000	-.0444*
OCCIND	-.0105	.0220^{+}	-.0373	.1277*	.0717^{+}	.0005	.0258
OWNER	-.8857	1.1288	-6.7666^{+}	3.8864	-6.5120^{+}	-.4228*	3.5971
WOOD	-9.0255**	.6410	1.2475	-1.5354	3.5177	.2095	-2.4391
TRAILR	-1.2297	.2150	1.6297	-2.8834	-2.7646	.3158**	1.8449
UNEMPL	11.8099	-2.0812	-26.8996^{+}	40.4164^{+}	34.3935*	-.1263	18.3987
NONURB	-2.4104*	-.0526	-1.1261	-3.1157^{+}	.2715*	.0816^{+}	.6919
EDUCAT	9.9215***	-1.0398	-3.0749	2.8835	7.8081^{+}	.2835^{+}	-.0236
WATER	-1.3293^{+}	1.1053**	2.8441*	-3.0170^{+}	.8604	-.0179	.5365
LANFRM	.0037	-.0055^{+}	.0107^{+}	-.0012	-.0178*	.0004	.0197**
LANSCH	-.0152	-.0003	.0131	.0306	.0495^{+}	-.0020^{+}	-.0288^{+}
HYDRAN	.0001	-.0025	-.0253**	.0310**	-.0022	-.0009**	.0111^{+}
NOKIDS	.7944	2.3923	6.3582	-31.7394***	.3954	.4058^{+}	7.3883
CITYFD	-1.0841	.5892	.8090	2.4655	-2.4021^{+}	-.9927***	.3893
POOR	-10.3347^{+}	4.4767^{+}	-12.1706^{+}	-13.2743	-24.1751**	.3825	-8.5145
DENSITY	.0002	-.0002^{+}	-.0003	-.0006^{+}	-.0003	.0000**	.0002
LNINCMED	-4.0990***	.8096^{+}	-1.2568*	-1.6422	-2.8156^{+}	-.0280	.6228
TAXSHARE	-.1316	.1359^{+}	-.4850**	-.3913^{+}	-.4556*	-.0229**	.1862
FARMER	4.7634	-2.8610	47.6372^{+}	13.7236	48.5134**	-.2814	-12.2007
APART	18.1604^{+}	-.3710	10.4662	-6.7781	19.1410^{+}	-.0813	-1.7824
Exogenous							
LNPOP	.1749	-.5918***	-.0432	.3608	.4533^{+}	-.0002	-.6211*
CHEAP	-3.8192	1.6432	11.3351^{+}	9.4574	-13.8044*	-.2303	6.9172
VACANT	-3.6091^{+}	-.4212	-2.5203	7.1577^{+}	-5.7861^{+}	-.3877**	1.7232
LNOTHER	.0676	.2072**	-.3697^{+}	-.0441	.3026^{+}	-.0052	-.3036^{+}
LNTOTMA	.1782^{+}	.0421	-.0927	-.2437	.3972*	-.0031	.0945
R Square	.36	.36	.38	.20	.47	.79	.30
Observations	145	148	157	154	158	161	158

***** significant at the 1% level ** significant at the 5% level * significant at the 10% level $^{+}$ t > 1.000**

also represent other environmental conditions that correspond with a lower fire incidence, such as more buildings with automatic fire protection systems.

Resources. Two of the endogenous variables for which instruments were sought represent managerial choices about resources. These are PERVOL, the proportion of the labor force that is volunteer, and SPECEQ, the extent to which the department uses specialized equipment. Not surprisingly, PERVOL depends on several characteristics that describe whether or not the fire department protects an urban area –those that do so tend to have predominantly paid workforces, while more rural areas have more volunteers in their fire departments. This result is expected since more urbanized areas generally have higher emergency call volumes that would tend to overtax volunteer labor forces and make full-time personnel necessary. The configuration of the department workforce also appears to depend on factors that may capture the availability of volunteers. For example, NOKIDS is positively related to PERVOL, which may indicate that adults without children have more unencumbered leisure time to spend volunteering and also are free to leave without warning to respond to an emergency call.

The instruments for the use of specialized equipment exhibit less powerful relationships and do not have obvious intuitive interpretations. SPECEQ weakly but significantly depends on a greater proportion of farmland and fewer commercial occupancies in the jurisdiction, both indicators that more rural areas tend to be protected by departments that choose more specialized equipment. This may bear up anecdotal assertions that volunteer departments easily purchase more "gizmos" than they really need, because they tend to have more discretion over their budgets than do paid agencies that typically compete under more scrutiny in municipal budget processes.

Management. The three remaining management variables –STYLE (the extent to which department leadership is participatory), PERFORM (the extent to which the department engages in performance assessment), and RECORDS (the sophistication of the department's records management system)– each have instruments that exhibit powerful and significant influence. The RECORDS index depends most significantly on a lower proportion of poor people (but a higher proportion of unemployed people), more farmers (but less farmland), and lower proportion of commercial occupancies in a department's jurisdiction. The PERFORM index depends on a lower proportion of families without children, a greater proportion of the jurisdiction served by fire hydrants, and a higher proportion of commercial occupancies. Finally, the STYLE index corresponds to a lower proportion of the jurisdiction served by hydrants (but a greater proportion of housing units with public water), and also exhibits a negative relationship with the jurisdiction's median income and median house value.

Explanations for the relationships between the instruments and these three management variables are not readily apparent. In some cases, the instruments seem to indicate contradictory trends in the jurisdictions, as is particularly true for RECORDS, where the relationship to farmers is positive but to farmland is negative, and STYLE, where the relationship to public water is positive but to hydrants is negative. Nonetheless, some of the relationships seem sensible in light of speculation about the environmental pressures to which managers might respond. For example, the extent to which a fire department emphasizes performance assessment may be viewed as related to how complex its firefighting mission is, as represented by the presence of commercial buildings and the proportion of families with children (since juvenile populations are thought to correspond with more accidental and intentional fires). As another example, record-keeping may be more sophisticated in departments that are under more citizen scrutiny, as evidenced by wealthier and more educated populations in jurisdictions that rank higher on the record-keeping index.

These interpretations of the relationships between the endogenous variables and their instruments are admittedly conjectural, and alternatives can be readily hypothesized. The fundamental goal of the first stage estimations is not to untangle the complex influence of the instruments, however, but to predict the endogenous variables with instruments that are unrelated to the dependent variable in the second stage. This objective is clearly met, as each endogenous variable has at least one and in most cases several instruments with evident explanatory power. The story of direct interest is the relationship between cost and management, as revealed in the second stage.

7.4.2 Full cost model

The results of the 2SLS estimation are presented in Tables 7-7a, which includes all cases, and 7-7b, which excludes the two outlying cases discussed above. Of the sample of 173 observations, 131 and 129 observations were included in the second stage regressions, respectively, and the models explain 37 and 41 percent of the variance in the log of the cost of fire protection per capita, respectively. Both iterations of the 2SLS estimation are identical in terms of the variables (instruments, exogenous, and endogenous) included, and differ only by the presence or absence of the two outliers. The magnitudes of the coefficients in both iterations are very similar, and the signs of the coefficients are the same, but the standard errors are somewhat lower for the version that omits the outliers, as Tables 7-7a and b demonstrate.

Table 7-7a. Two-Stage Model Regression Results.

Variable	Coefficient	SE B	t-statistic
Intercept	12.9821***	1.8017	7.21
Log of total structure fires per housing unit	.5853**	.2527	2.32
Log of residential property value / fire loss	.1834**	.0811	2.26
Self-assessed ability to do performance monitoring/assessment	-.0951**	.0481	-1.98
Extent to which leadership is participatory	-.1097*	.0615	-1.79
Extent to which the FD has a formal record-keeping system	.0742	.0583	1.27
Proportion of the department's labor force that is volunteer	-1.3558***	.4865	-2.79
Extent to which the department uses specialized equipment	-.1325*	.0731	-1.81
Log of the jurisdiction's population	-.3613*	.2156	-1.68
Proportion of housing units with value less than $30,000	-4.5656*	2.6932	-1.70
Proportion of housing structures that are vacant	1.5390*	.8049	1.91
Log of total own-area calls of all types except structure fires	-.0557	.1141	-.49
Log of total mutual aid calls of all types	-.1334*	.0734	-1.82
Dependent variable is the log of per capita spending on fire protection			
R Square	.37		
Adjusted R Square	.31		
Observations	131		

Table 7-7b. Two-Stage Model Regression Results (two outlier cases omitted).

Variable	Coefficient	SE B	t-statistic
Intercept	12.7456***	1.6415	7.77
Log of total structure fires per housing unit	.5378**	.2345	2.29
Log of residential property value / fire loss	.1728**	.0758	2.28
Self-assessed ability to do performance monitoring/assessment	-.1225**	.0480	-2.55
Extent to which leadership is participatory	-.1169**	.0571	-2.05
Extent to which the FD has a formal record-keeping system	.1008*	.0555	1.81
Proportion of the department's labor force that is volunteer	-1.5578***	.4560	-3.42
Extent to which the department uses specialized equipment	-.1184*	.0664	-1.78
Log of the jurisdiction's population	-.3532*	.2003	-1.76
Proportion of housing units with value less than $30,000	-4.6979*	2.5267	-1.86
Proportion of housing structures that are vacant	1.6328**	.7727	2.11
Log of total own-area calls of all types except structure fires	-.0867	.1091	-.79
Log of total mutual aid calls of all types	-.0674	.0675	-1.00
Dependent variable is the log of per capita spending on fire protection			
R Square	.41		
Adjusted R Square	.35		
Observations	129		

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

The variables in the two-stage model take three basic forms. Some variables (the outcome variables, service responsibility variables, and population variable) are logged, some (the environmental factors and fire department labor force variable) are proportions, and some (the remaining management variables) are ordinal indices. Coefficients on the logged and proportional variables can be interpreted as elasticities, where their magnitude is the percentage change in the cost of fire protection per capita that corresponds with a 1 percent change in the variable in question. Interpretation of the coefficients on the ordinal variables is less intuitive. Since the distance between the values on the ordinal scales is not defined or constant, the magnitude of these coefficients has no clear meaning. Only the direction of the relationship may be inferred from these coefficients.

Overall, the results of the 2SLS analysis show that the cost of fire protection per capita depends significantly on the outcomes of a fire department's fire prevention and suppression activities, on some key aspects of a department's management practices, on the configuration of its workforce and equipment, and on some factors in its external environment. A department's non-firefighting service responsibilities do not appear to have a large or significant effect on costs, though there may be a weak negative relationship between the extent to which a department provides mutual aid support to other departments and the cost of fire protection to the citizens in its own jurisdiction. The relationships between cost and outcomes, the environment, management, and resources will be considered in turn. For simplicity, only the elasticities from the analysis excluding the two outlying cases are reported in the discussion.

Outcomes. Per capita cost (LNCOSTPC) is positively related to the number of structure fires per housing unit (LNSTRFIR) and to a department's output (LNOUTPUT, or the log of the ratio of property value to fire loss), both at the 5 percent significance level. The elasticities are 0.54 and 0.17, respectively. The number of fires is intended to measure the result of a fire department's fire prevention program, in that a better program is one in which more fires are prevented, as indicated by fewer fires. The results show that a 1 percent increase in the number of structure fires increases costs by over half a percent, all else equal. Loosely interpreted, this means that better fire prevention reduces costs, though it is not possible to specify by how much, since the number of fires that occur results both from a fire department's fire prevention activities and from environmental influences, in undetermined proportions. If the number of structure fires and the quality of fire prevention are assumed to be negatively related, then the findings may suggest the presence of economies to quality scale for fire prevention.

The output measure is intended to capture a department's effectiveness at fire suppression. A measure that centers on fire losses is an imperfect proxy for fire suppression activity. Nonetheless, jurisdictions whose departments put fires out faster will experience lower property losses than those whose departments take longer to put fires out. The suppression measure is also positively related to costs, all else equal. That is, the lower the fire loss relative to property value, the higher the cost per capita, suggesting that better fire suppression costs citizens more. This finding is consistent with Duncombe and Brudney's (1995) results, though they find a larger percent increase in costs with increased service quality. For the output variable, then, cost increases with outcomes, and diseconomies to quality scale appear to exist.

Environment. The cost of fire protection is associated with two important characteristics of the housing structures within a department's jurisdiction. First, the results show that a 1 percent decrease in the proportion of units with value less than $30,000 is associated with a 4.7 increase in cost. This is a somewhat weak finding, significant at the 10 percent level. This result contradicts the fire service literature, which suggests that cheaper houses are likely to be in poor condition and more susceptible to fire. Second, a 1 percent increase in the proportion of units that are vacant is associated with a 1.6 percent increase in cost (significant at the 5 percent level when the outliers are omitted, and at the 10 percent level when they are not). This is consistent with the fire service literature, which suggests that a greater number of fires and more damaging fires occur in vacant buildings, which tend to be more poorly maintained than occupied structures, often do not have operational fire protection systems like smoke detectors and sprinklers, and are frequently the targets of arson.

Finally, in addition to the nature of the housing stock, cost is related to another important characteristic of a department's jurisdiction: its population. The elasticity of per capita costs with respect to population is –0.35. This finding, significant at the 10 percent level, provides weak evidence that fire protection exhibits slightly increasing returns to population scale. This is different from the findings of Duncombe and Brudney (1995) and Duncombe and Yinger (1993), who find a positive elasticity. This finding is interesting because of its policy relevance: It indicates that current interest in consolidating fire departments may align with more efficient production of fire protection, though the findings are not strong enough to be considered more than suggestive.

Management. The results of the 2SLS analysis show that three management variables are significantly related to the cost of fire protection. The first management measure, an index of a given department's self evaluation of its performance monitoring and assessment capabilities, is negatively related to per capita costs and is significant at the 5 percent level both with and without the outliers in the analysis. This suggests that fire protection costs citizens less when their fire department evaluates the cost of providing services, measures how well it performs its services, and uses this information to make decisions. This finding is consistent with the public management literature that asserts that systems of managing for results contribute to better performance.

Total cost is also negatively related to participatory management. In other words, citizens spend less for fire protection in jurisdictions where fire department members have more input into managerial decisions. The style coefficient is significant at the 5 percent level when the outlying cases are included, and at the 10 percent level when they are not. This result conforms to much of the popular management literature that calls for empowerment of employees and delegation of discretion and lends support to government reform efforts that aim at less hierarchical management structures.

Finally, the extent to which a fire department maintains record-keeping systems for their equipment, personnel, training, service activity, and finances, and whether these systems are written or automated, is positively related to costs, though this relationship is significant only at the 10 percent level and only when the outliers are excluded from the analysis. This finding suggests that more administrative infrastructure is more expensive to citizens. This conforms to many notions of bureaucratic paperwork as time-consuming and cumbersome (i.e. costly). This does not, however, refute the intuition that records management is an important administrative function that facilitates tracking resource amounts, location, assignment, and condition, helps to prevent fraud and enhance accountability, and supports other management functions, such as compensation, budgeting, and professional development. Because the model does not control for these dimensions of management quality, and considers RECORDS to be a management input instead of an outcome, the sign on the record-keeping variable is difficult to interpret satisfactorily.

Resources. In cost function analyses factor prices are generally included as important determinants of costs. In this analysis, where the price of major capital items (such as fire trucks and stations) are assumed to be constant across jurisdictions and where wage equivalents are difficult to identify and measure for volunteer labor forces, two variables that represent managerial choices about the nature of a department's resources are included instead. These are the proportion of volunteers in the department's workforce and the extent to which a variety of specialized emergency equipment is used. As discussed above, since these resource decisions are managerial choices, they are treated as endogenous.

Both resource variables are significantly related to the cost of fire protection. The proportion of the labor force that is volunteer, significant in both analyses at the 1 percent level, exhibits an elasticity of -1.6. This result is not surprising since wage and benefit costs are known to be a major component of the budget of any organization with a paid labor force, but it makes clear that jurisdictions that rely on volunteer fire departments do indeed spend less on fire protection, even controlling for service quality. Interestingly, jurisdictions whose fire departments use a greater amount of specialized equipment also spend less on fire protection, as the negative coefficient on the SPECEQ index demonstrates, though this is significant at only the 10 percent level.

7.5 Conclusions

The objective of this chapter has been to formulate a simplified empirical version of the theoretical cost model developed in Chapter 4, and to apply this model to examine the production of fire protection using survey data drawn from the departments themselves in conjunction with data from external sources. Two-stage least squares regression analysis was employed to permit consistent estimation of this inherently simultaneous model. Various diagnostic procedures were used to assure the appropriate application of this technique.

The central interest of this analysis has been to begin to shed light on the role of management in public production. This mystery has not been thoroughly disentangled, but the results of the 2SLS analysis are striking because they substantiate the intuition that the costs of a public service depend in part on managerial practices and decisions with empirical evidence. By examining the first and second stage results, the association between environmental contingencies and service cost revealed in earlier public production and fire service work is upheld, but refined. This analysis suggests that the environment influences fire service outcomes both directly, as Bradford, Malt, and Oates (1969) suggested and others have subsequently demonstrated, and indirectly –through management actions that are associated with particular environmental conditions.

The next and final chapter of this dissertation discusses these findings with respect to the conceptual hypotheses posed in Chapter 4 and in light of the fire service policy trends identified in Chapter 3. On this basis, Chapter 8 consolidates the contributions of this project and proposes directions for future analysis.

CHAPTER EIGHT

IMPLICATIONS FOR LOCAL PUBLIC SERVICE POLICY AND RESEARCH

The claim that managerial behavior influences the outcomes of public organizations seems almost ridiculously obvious –the assumption that better management produces better results has long been the basis for change efforts in the public and private sectors alike. Nonetheless, this assertion and the reforms it spawns leave scholars uneasy and dissatisfied because the empirical evidence to substantiate them is thin. Especially as local governments are called to increasingly active roles in public policy-making and service delivery, the interest of scholars, citizens, and practitioners in understanding government performance has intensified. As a result, contemporary research agendas in the field of public management have turned to the questions posed in Chapter 1:

1. What is management?
2. How can management be operationalized in the context of public production?
3. How and why does management affect government performance levels?

This dissertation has sought to address these questions directly in hopes of shining some light on the black box of management to reveal its operation and impact in concrete empirical terms.

This work has tackled this objective via three distinct approaches: conceptual, qualitative, and econometric. This dissertation first spent time reviewing a diverse set of public management and public economics literature that comprises the state of knowledge about systems of public production and their performance. On this foundation, a conceptual model of public production was developed that relaxes the usual economic assumption of perfectly efficient production technologies and explicitly includes the ways in which management affects public expenditures. This model borrows from and represents an incremental advancement in a growing line of public economics research that has sought to develop realistic models of local public sector costs and demand. It also expands formative efforts in the field of public management to specify models of the relationship between management and program/policy outcomes.

The empirical context for this study has been the production of local fire protection. The fire service was a useful vehicle for confirming the validity of the new public production/cost framework developed in this study because, unlike many other public services, it has relatively well defined inputs and outcomes that can be measured using data that is maintained by public agencies. On the other hand, organizational and managerial characteristics, which this project has considered key to the ability of governments to translate resources into results, are not formally tracked by any central agency, and therefore these data were obtained directly from county governments, local fire departments, and fire chiefs through a series of written surveys and interviews.

Data from a sample of 173 fire departments in New York State were analyzed from a subjective perspective through systematic analysis of how public managers perceive various influences in their organizational environments using Q methodology. The data were also analyzed objectively within an economic framework that represents the simultaneous determination of the demand for and production of public services and specifies the influence of key managerial activities on this system. The econometric method employed was two-stage least squares regression analysis.

The goal of this chapter is to summarize the findings of this project in an attempt to present a coherent picture of its contributions to the extant body of scholarship and to policy-making efforts in the field of local fire service production. In particular, the findings of this study's multi-method analysis will be synthesized with respect to the hypotheses discussed in Chapter 4. This chapter will also consider the methods and findings of this study as a promising foundation for future research endeavors.

8.1 Summary of Results and Contributions

This dissertation has attempted to pursue some ambitious aims in understanding the influence of management in public production and remains far from an exhaustive analysis of this agenda. Nonetheless, it did construct and test a model of the local production of public services in ways that yield some interesting findings. Some of these findings will be consolidated in this section to demonstrate the extent to which this work has addressed the hypotheses advanced in Chapter 4 about managerial functions and the external environmental and internal organizational influences on managers. As the discussion below reveals, only some of the hypotheses posed were tested directly. Others were examined in part, and some represent opportunities for further exploration.

8.1.1 Synopsis of key findings

Of the nine hypotheses raised in this study, three were first posed about the impact of a fire department's external socio-political environment on its performance. Specifically, it was asserted that direct citizen contact with the fire service, pressure from local-level external governing bodies, and autonomy from fire service regulations and standards will each promote department efficiency and reduce a jurisdiction's loss due to fire. These hypotheses were not subject to a comprehensive test during the course of this study, but an important component of these proposed relationships did receive attention:

The extent to which fire chiefs perceive pressures from citizens, public officials, and the professional field was explored. Since organizational activities flow, at least in part, from managerial decisions, perception of pressure by decision-makers is the first link between an environmental condition and a change in performance. If perception exists, then response can follow, and, ultimately, the impact on outcomes can be felt.

The key findings from the subjective analysis of fire chiefs' perceptions relevant to these three hypotheses are that community attitudes, input from elected officials, and professional standards are among the most dominant sources of feedback to fire chiefs. Of these, professional standards were ranked as very important more often than were either of the other two. Chiefs vary widely in whether they feel positive or negative pressure from these sources. In general, though, the chiefs of paid departments tended to report that they lack the support of public officials and citizens, while chiefs of volunteer departments felt more positive about these relationships. These findings suggest that closer examination of the correlation between department structure, socio-political pressure, and fire protection outcomes is fertile ground for future research efforts.

Another hypothesis defined in Chapter 4 submits that the more diverse, numerous, and elevated a fire department's service responsibilities are, the less efficient the fire department will be, and the lower the jurisdiction's loss due to fire will be. This hypothesis was examined from two perspectives. First, during the subjective study described in Chapter 6, fire chiefs were asked to evaluate a statement about whether citizens expect too much from their fire department. In general fire chiefs reported in the negative, suggesting that they do not feel their department bears too heavy a service responsibility burden. Chiefs varied widely, however, in whether they think their departments have the type and amount of equipment they need to fulfill their missions, suggesting that despite their beliefs about what the fire service ought to do, they are constrained in their capacity to meet these goals.

This hypothesis was also tested by including service responsibility variables in the regression analysis of the fire protection cost function. Two variables were included: one that captured emergency and service calls that were not responses to structure fires and one to account for the number of calls that involved providing mutual aid to another agency. Both coefficients were small and their signs negative, which contradicts findings elsewhere in the literature. The findings here are weak, however, because only the mutual aid variable was significant at the 10 percent level, and only in one of the models. Nonetheless, the results hint that as fire departments respond to more calls that are not structure fires within their own jurisdictions their overall cost falls mildly, though controls for the quality of non-fire-related outcomes are not included in the model. The relationship between overall cost to citizens and the nature of and emphasis on emergency and non-emergency service responsibilities is clearly worthy of further attention. In particular, it will be very important to account for the tradeoffs of time and resources necessary to handle a diverse array of tasks, to account for the service quality in all mission areas, and to disentangle the monetary and non-monetary costs and benefits of mutual aid agreements.

The discussion in Chapter 4 also hypothesized that fire departments with more rigid, centralized, and hierarchical management will be less efficient and result in higher fire losses. Conversely, the more flexible, participative, and team-focused a department's management is, the more efficient it will be, and the lower the jurisdiction's loss due to fire will be. The subjective analysis in Chapter 6 shows that fire departments do vary in the extent to which their members contribute to administrative and operational decisions. Moreover, the groups of chiefs who describe more democratic decision-making in their departments also tend to report harsh internal managerial environments.

The regression analysis suggests there may be gains from participatory leadership, despite the fact that it appears to place the chief under a great deal of pressure from within his department. The significant negative coefficient on degree of participation indicates that as department members have more say over administrative decisions, the total expenditure on fire protection falls. It is tempting to surmise that fire department members feel a sense of responsibility to citizens and work to keep costs low, but this study provides no evidence about members' intentions. A future Q-study of fire department members perceptions would be an interesting counterpoint to the analysis of chiefs presented in Chapter 6.

Professional culture was also expected to influence fire department efficiency, and it was asserted that fire departments with older, better educated, better trained, and more experienced firefighters will be more efficient than fire departments with less knowledgeable and skilled firefighters, and their jurisdictions will experience lower losses due to fire. Moreover, fire departments with paid personnel were expected to have more knowledgeable and skilled firefighters that all-volunteer fire departments. Both the Q analysis and the descriptive statistics presented in Chapter 7 support this latter prediction. The Q results show that the group comprised entirely of chiefs from paid departments agrees most strongly with the statements that their workforces are trained, educated, experienced, and competent. The groups that included volunteers were more ambivalent or disagreed with these descriptions. Comparison of means across paid and volunteer departments also shows that firefighters in paid departments are more often college graduates and participate in many more hours of training per year than do volunteer firefighters.

The influence of a better trained and educated workforce on costs and outcomes cannot be discerned directly from this study. Some findings are suggestive, however. For example, the mean aggregate fire loss is lower in jurisdictions protected by paid departments than in those protected by all-volunteer departments, even though areas covered by paid departments experience many more structure fires than areas protected by volunteers. At the same time, it is clear from the 2SLS analysis that the higher proportion of paid firefighters a department has in its workforce, the more citizens pay for fire protection, even controlling crudely for the quality of fire prevention and suppression services they receive. Better specification of a broader array of fire service outcomes, coupled with better individual-level data about firefighter skills and performance would help to disentangle these relationships.

Three hypotheses about the quality of a fire department's management were advanced in addition to the contingencies addressed above. The first was that the more formalized and well-developed a fire department's strategic and resource planning ability is, the more efficient the fire department will be, and the lower the jurisdiction's loss due to fire will be. All four groups of chiefs in the Q study agree that planning to acquire and maintain the resources necessary to meet future service deliver needs is one of their most important responsibilities, and chiefs in three of the four groups do not feel too busy solving day-to-day problems to devote sufficient time to strategic planning. Moreover, most departments that participated in the written survey reported that they do a good job at capital and strategic planning, though many do not do this formally, as indicated by the fact that only about 20 percent have a written strategic plan and 47 percent have a written capital plan. Comparison of means indicates that paid departments do more planning than volunteer departments.

The link between planning and costs or outcomes was not tested directly in the regression analysis, but performance management, which is highly correlated with planning, was included in the estimated cost equation. This variable was significant and its coefficient negative, which may suggest that planning also has a downward influence on expenditures, if planning and performance management capacities track together. In fact, earlier exploratory estimations of equations that substituted planning for performance support this presumption. Small sample size precluded the inclusion of many of the possible management variables in the cost equation that was estimated. A larger data set may permit a more refined test of this hypothesis.

The second management-related hypothesis of interest was that fire departments with better-developed formal human resources, financial, and capital management systems will be more efficient and effective. Factor analysis shows that a department's assessment of its competence at financial and capital management is also related to its ability to do performance monitoring and assessment as planning was, and thus may be expected to have a similar relationship to expenditures. A more specific test of this hypothesis was accomplished by including a record-keeping index in the regression analysis. This index measures the extent to which a department maintains an array of formal written or automated records about its human, financial, and capital resources. If records management is seen as an important component of well-developed administrative systems, then the positive coefficient suggests that administrative infrastructure increases, rather than reduces, the cost of a given service quality.

This result should be viewed cautiously, as the records variable is sensitive and significant at only the 10 percent level. Nonetheless, this finding does bolster the view that bureaucratic systems are costly. It does not, however, contemplate the interaction between record-keeping and other management functions. That is, maintaining a records management system may increase spending on fire service organizations, but other management functions may not be as cost efficient if they could not draw on records. For example, performance assessment activities, which appear to lower the cost of fire protection, may not be possible without records of emergency response activity. Testing these relationships demands a more sophisticated model of management that is beyond the scope and capacity of the present study and available data.

Another interpretation of the record-keeping variable is that it is a management outcome, rather than a management practice or input. That is, the records variable may be the result of sophisticated managerial behavior. Defined thus, the result is as expected –a better outcome is associated with higher cost per capita. Casting the records variable in this way highlights a larger issue raised by this dissertation: Future empirical work must make a finer distinction between management capacity (an organization's systematized ability to gather and analyze knowledge about organizational processes, activities, and performance that facilitates coherent decision-making), management practices (the specific decisions managers make about how to administer their organizational resources), and management outcomes (the quality of an organization's resources and infrastructure that results from its administrative systems and processes). These are the fundamental components housed within the "black box." A full understanding of public production must account for the interaction among these components and their individual and collective impact on organizational outputs and policy outcomes.

Finally, the claim was made in Chapter 4 that fire departments that employ modern firefighting techniques and technology will be more efficient than fire departments that do not use modern approaches, and their jurisdictions will experience lower losses of life and property due to fire. Again, this issue received attention in both the subjective and objective analyses, but the most striking findings come from the 2SLS results for the variable that measures the extent to which a fire department chooses to use specialized emergency equipment. The coefficient on this index is negative and significant at the 10 percent level, indicating that the more types of specialized equipment a department uses, the lower the cost of fire protection.

This result may seem counter-intuitive, since equipment acquisition ought to increase resource costs. This index does capture both equipment that is available in-house (i.e. owned by the department) and equipment that can be accessed "free" through mutual aid, so the use of this equipment does not necessarily entail a monetary cost. In-house equipment is weighted more heavily in the index, however, so the paradoxical finding holds. The cost-saving effect of specialized equipment may result because these technologies permit the department to avoid spending money in other areas not represented in the model. For example, a fire department that has its own cascade system (an apparatus for filling breathing air bottles) does not have to pay to have its bottles filled by someone else. The cost of the cascade system may be more than offset by these savings, and thus a lower cost per capita for fire protection is realized.

8.1.2 Contributions to scholarship

This study advances our understanding of local public production, but its contribution to academe is also epistemological: This work helps to specify a way of characterizing and measuring management, thereby clarifying not only what we know about management but how we know it. This project aimed to identify fundamental dimensions of the nature of local government organizations and management and to incorporate them into an economic production framework for public services, and thus this research stands with one foot planted firmly in each of two theoretically distinct, methodologically dissimilar fields of study: public management and public economics. The key advantage of a project that bridges these fields is the opportunity to capture the power each affords the other in the study of government performance. At once, public economics offers public management a well-established methodological framework for estimating the costs of public production, while public management offers economics insight into previously omitted factors of collective behavior that partially determine costs and outcomes, thereby helping to reduce bias and increase flexibility in existing estimation methods.

The findings summarized above also advance the body of knowledge within both fields. In the realm of public management, the key gap this effort helps to fill is the empirical specification of the concept of management. Management has long been believed to influence the cost efficiency of public organizations, and several lines of literature have advanced theories and hypotheses about this relationship, but only a few studies have tested it quantitatively (a good example is Heinrich, 1999). This study has mounted such an empirical analysis and has found effects that verify that some management practices do indeed shape how cost efficient a local public organization is, holding service level and quality constant. It therefore helps to refine models such as that advanced by Lynn, Heinrich, and Hill (1999: 26), who present a reduced form function in which program outputs depend on environmental factors, clientele characteristics, treatments, structures, and management, by specifying and testing the influence of some aspects of the environment and management in the production of public services. Further, Lynn, Heinrich, and Hill's function suggests that an important extension of the work begun in this dissertation will be to test directly the relationship between policy outcomes (as dependent variables) and various aspects of management (as explanatory variables).

From the perspective of public economics, the contribution of this work is the development of a key aspect of a more realistic model of public production. While the model estimated in this study foregoes some of the very important subtleties of earlier cost function analyses, such as tax exporting, factor substitution, and intergovernmental grants, it adds the management practices that influence resource acquisition and deployment. Addressing managerial decision-making, organizational systems, and the behavior of clients, managers, and employees is an important step toward the estimation and analysis of technical efficiency in simultaneous production and cost models.

8.2 Policy Implications

This study primarily has aimed to address some important theoretical questions, by attempting to develop a rubric for modeling and measuring managerial behavior in the production of services. It did not have as its objective the exposition of recommendations for public policy and management practice. Nonetheless, the empirical context for this work has been a vital public service, fire protection, an arena in which many reforms are currently being proposed and implemented. This dissertation would be remiss if it did not raise some of the implications of its findings for decision-making about the configuration and administration of the organizations that provide fire protection.

The central implication of this research is that sophisticated, professional management can improve the fire service. The management variables that were tested in this analysis did affect the cost of fire protection. Conceptually, this is not surprising since the fire service has evolved from simple fire suppression into a set of complex missions. Managing a modern fire department carries with it challenges such as large but constrained budgets, expensive and sophisticated technologies, contentious workforces, multiple service responsibilities, and issues of liability, compliance with federal mandates, insurance standards, and professional guidelines. These demands imply that the fire service can no longer be sustained on the backs of old firefighters who get promoted to chief; it must now rest on professional managers educated in the development and administration of sophisticated management systems.

This work also lends cautious support to the trend toward employment of combination workforces. Typically, mixed staffing arrangements emerge when a volunteer department cannot meet its mission demands and hires paid firefighters and paramedics. The results suggest that the use of volunteers may offer cost-savings to paid departments, too. Since a higher proportion of volunteers reduces total expenditures even controlling for service quality, career departments could consider forming volunteer auxiliaries that would allow them to reduce the size of their paid workforces. Some departments have pursued such alternatives, but these practices are not widespread. Moreover, combination paid-volunteer workforces raise a host of thorny human resources management challenges with which the department's leadership must be prepared to contend.

Finally, many regions are considering consolidating the fire departments of several adjacent jurisdictions in hopes of realizing cost savings. Savings are expected to come from reduced administrative overhead, sharing of highly specialized and rarely needed resources, and more coherent distribution of capital equipment across a broad area. A few empirical analyses of the fire service have examined the issue of consolidation and concluded that returns to population scale are constant in the production of fire protection, with the implication that consolidation is not economically warranted. The present study is distinct from one earlier effort that specifically tested the hypothesis of increasing returns to scale, because it considers a broader array of organizational types, from very small, rural all-volunteer departments to large, all-paid city departments, whereas the earlier study looked only at paid departments. The present study finds weak evidence to of scale economies, suggesting that consolidation may in fact offer a more efficient production solution. It may be that consolidation is worthwhile under certain conditions that appear within this more diverse population.

8.3 Directions for Future Research

During the course of any involved research endeavor, the investigator is confronted with an ever-expanding array of unanswered questions and unresolved issues. Such was the case with this project, which spawned an extensive list of new ideas, puzzles, and proposals. Some of the larger conceptual directions for future work have already been mentioned. Here a few that seem within reach with further effort using the existing data set compiled for this study will be enumerated.

First, this dissertation has sought to generate better cost estimates for the production of fire protection than are obtained when management is omitted from the cost function. An important aspect of cost analysis, however, is factor prices, which were to a large extent ignored in the model estimated in this study. One reason factor prices were not included directly is that it is difficult to identify the price of volunteer labor, a key production input in the fire service. In essence, there is a need to develop a valid index that captures the price of volunteers. The survey developed and administered in support of this project asked several questions that may help to construct such an index. The number of missing values on these questions precluded this from being done for the cost function at hand, but it may be possible to conduct narrower tests to help develop an index that could be applied using a new data set in the future.

A second objective of this dissertation has been more careful characterization of management in empirical terms to support estimation of the influence of management on cost. The analysis of management that was accomplished is suggestive but limited because it rests on cross-sectional data. This represents an important constraint when attempting to evaluate a construct that has cumulative impact over time, as management does. Ideally, the model developed in this study would be re-estimated with panel data. In the short term, it is feasible to add expenditure data from prior years to the existing cross-sectional data set, which would permit the inclusion of a lagged dependent variable in the model to account for the impact of managerial behavior prior to the current year.

Finally, this study has accepted the well-substantiated assertions of the contemporary production literature that the environment influences public service outcomes. It has added to these models the influence of management. It has not, however, considered the likely interaction of management and the environment. That is, the influence of managerial practices on costs may be different under different environmental conditions. The creation and testing of interaction terms using the present model and data could help to clarify the contingent nature of managerial behavior and its influence on outcomes. The challenge of testing this proposition comes in interpreting variables created by multiplying a management index by an environmental variable measured as a proportion. Nonetheless, the notion that management in combination with the environment has a more profound impact that do either management alone or the environment alone or both independently is appealing and worthy of investigation.

8.4 Conclusion

This project has been a uniquely worthwhile endeavor for three important reasons. First, this research is theoretically useful because, while some factors that influence performance have been examined in limited ways for various local public services, a comprehensive model of government productivity had yet to be developed and tested. Second, this project is academically pertinent because it provided an opportunity to merge the perspectives and approaches of public economics and organization theory to better explain government behavior, and to add to the body of knowledge of both fields.

Finally, this work is relevant to contemporary policy design because, despite the vast number of fire departments in the United States and the multi-billion dollar annual fire loss, the level of and influences on fire service performance are not well understood. As a result, communities attempting to design optimal emergency services delivery systems do not have valid information on which to base their decisions. Similarly, fire departments do not understand what structural, managerial, or technological reforms will have the highest payoff in terms of better performance. This study thus has potential to enhance the ability of fire service practitioners and elected public officials to understand the issue of ultimate interest in public service provision: how well these government entities do what citizens want them to do.

APPENDIX 1: COUNTY FIRE COORDINATOR SURVEY INSTRUMENT

Please provide the following information for each of the fire departments in your county:

DEPARTMENT NAME					
STATE FDID:					
HOW IS THE DEPARTMENT ORGANIZED? (CITY, VILLAGE, FIRE DISTRICT, OR INDEPENDENT)					
DOES THE DEPARTMENT ALSO SERVE A FIRE PROTECTION DISTRICT?					
TYPE OF DEPARTMENT (PAID, VOLUNTEER, OR COMBINATION):					
SQUARE MILES PROTECTED:					
POPULATION PROTECTED:					
NUMBER OF PAID PERSONNEL:					
NUMBER OF VOLUNTEERS:					
NUMBER OF AERIAL TRUCKS:					
NUMBER OF PUMPERS:					
NUMBER OF TANKERS:					
NUMBER OF LIGHT RESCUE TRUCKS:					
NUMBER OF HEAVY RESCUE TRUCKS:					
NUMBER OF AMBULANCES:					

APPENDIX 2: FIRE DEPARTMENT SURVEY INSTRUMENT

FIRE DEPARTMENT OPERATIONS AND MANAGEMENT STUDY

SURVEY OF NEW YORK STATE FIRE DEPARTMENTS

May, 1999

Conducted by:

A. E. Kneedler, Project Director
Firefighter, EMT, Research Associate

Timothy S. Donahue, Survey Coordinator
Firefighter, Retired Fire Dispatcher

The Alan K. Campbell Public Affairs Institute
The Maxwell School of Citizenship and Public Affairs
Syracuse University, Syracuse, New York 13244-1090
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Fire Department Operations and Management Survey

This survey is part of a study of fire service management. It is designed to obtain information about how fire departments in New York State operate, how they are administered, how they use their resources, and how they make decisions. Many different types of fire departments are included in this study, including paid, volunteer, and combination departments, urban, suburban, and rural departments, and city, village, and independent fire departments and fire districts. The information obtained from this survey will be used in a careful analysis of how fire departments can use their limited resources most efficiently and effectively to meet the range of missions for which they are responsible. The results of this analysis can be very useful to fire departments trying to make many important, complicated decisions about the purchase and use of resources.

Your department has been selected to be included in this study. We hope that you will be willing to participate by filling out this survey. It should take about 60 minutes to complete. Please provide information that is as accurate as possible. If, in any case, you do not know exact figures, please provide your best estimate. **Feel free to write in comments or explanations to clarify your answers.** You may also attach any additional information you would like to provide.

This survey includes questions that ask you to provide details about your department's management practices and to rate your department's strengths and capabilities in a variety of areas. The value of this study depends on your candor in responding to these questions. We fully understand the sensitive nature of this information, and your responses to this survey will be kept strictly confidential. **The results of this survey will not be reported or released for your department individually without express written permission from the fire chief.**

If you have any questions, please contact:

Timothy S. Donahue, Survey Coordinator
(315) 469-7106
E-mail: tdonahue@ix.netcom.com

Thank you very much for your assistance. Without your help, this study would not be as successful or as beneficial to the fire service profession. We are very willing to provide the results of this study to all fire departments that participate.

PLEASE RETURN THE SURVEY AND ANY ATTACHED MATERIALS IN THE ENCLOSED BUSINESS REPLY ENVELOPE BY MAY 30, 1999. NO POSTAGE IS NECESSARY.

Please answer the following questions about your department's operations:

1. How is your fire department legally organized?
   - ❑ City (municipal) department.
   - ❑ Village department.
   - ❑ Independently Incorporated.
   - ❑ Fire district with elected commissioners.
   - ❑ Fire district governed by a town board.
   - ❑ Other (*please specify*):

2. Does your department protect a fire protection district under contract?
   ❑ No ❑ Yes

3. Does your department have a junior firefighter program or Explorer post?
   ❑ No ❑ Yes If yes, how many members does it have? ______

4. In what year was your department founded or incorporated? ______

5. How many active members does your department currently have? ______
   Please attach a copy of your department's organizational chart to this survey.

6. How many fire stations does your department have? ______

7. To which of the following organizations does your department belong or sponsor association memberships for department members? (*Please check all that apply.*)
   - ❑ Local benevolent association.
   - ❑ Local fire police association.
   - ❑ County fire chiefs' association.
   - ❑ County or regional volunteer firemen's association.
   - ❑ New York State Association of Fire Chiefs (NYSAFC).
   - ❑ Firemen's Association of the State of New York (FASNY).
   - ❑ Association of Fire Districts of the State of New York (AFDSNY).
   - ❑ New York Professional Firefighters Association (NYPFFA).
   - ❑ National Fire Protection Association (NFPA).
   - ❑ International Association of Fire Chiefs (IAFC).
   - ❑ Other: ______________________________

8. How large an area does your department protect (in square miles)? ______ sq. mi.
   How large a residential population does your department protect? ______ people

9. How many buildings *over* three stories tall are there in your jurisdiction?
   ❑ None ❑ 1-5 ❑ 5-10 ❑ 10-20 ❑ More than 20

10. What is your department's ISO rating? Rating: ______
    When was your department last evaluated by ISO? MM/YR: ______

11. How many department members hold elected office in your community? ______

12. How many working structure fires has your department fought in the past 3 years? ______

13. How many civilians have died in fires in your jurisdiction in the past 3 years? ______

14. About what percent of your jurisdiction has hydrants (*excluding* dry hydrants)? ______

15. Approximately what percentage of the *land area* your department protects falls into the following categories:

Urban	______	Rural (not farms or parks)	______
Suburban	______	School grounds/campuses	______
Farmland	______	Parkland	______

16. Approximately what percentage of the *occupancies* your department protects falls into the following categories:

Single- or two-family residential	______ %
Multi-family (*more than two*) residential	______ %
Retail, business, and commercial	______ %
Industrial and manufacturing	______ %
Other (*please specify*: ____________________)	______ %

17. How many of each of the following does your department protect?

Industrial or manufacturing plants	______
Warehouses	______
Shopping Malls	______

18. Which of the following services does your department have the necessary equipment, qualified personnel, and responsibility to provide? *Please check all that apply.*

❐ Fire suppression	❐ Medical first response	❐ Alarm monitoring
❐ Fire education classes	❐ BLS Ambulance response	❐ Call-taking/dispatch
❐ Building inspections	❐ ALS Ambulance response	❐ HAZMAT response
❐ Fire cause investigation	❐ Heavy rescue/extrication	❐ Water rescue
❐ Arson investigation	❐ High-angle rope rescue	❐ Other: __________

19. How many companies does your department have, by type?

Number of engine companies:	______	Number of EMS companies:	______
Number of truck companies:	______	Number of ambulance companies:	______
Number of rescue companies:	______	Number of squad companies:	______
Number of tanker companies:	______	Number of HAZMAT companies:	______

Other companies (*please specify*): ____

20. How many other departments or emergency services agencies does your department...
...*Provide* automatic mutual aid *to* for *fire* calls? ______
...*Provide* automatic mutual aid *to* for *medical or rescue* calls? ______
...*Receive* automatic mutual aid *from* for *fire* calls? ______
...*Receive* automatic mutual aid *from* for *medical or rescue* calls? ______

Please list the names of the departments or agencies with which your department has automatic mutual aid agreements:

____
____
____
____

21. What was your department's *total operating budget* for fiscal year 1998? $ ______
Please attach a copy of your department's budget to this survey.

22. About how much money did your department receive from the following sources last year?
Tax levies for fire services $ ______
Fees charged by the department for services $ ______
Charitable donations from individuals $ ______
Charitable donations from organizations $ ______
Grants from the federal or state government $ ______
The 2% fund (from private insurance companies) $ ______
Borrowing (issuing bonds or notes, or obtaining a bank loan) $ ______

23. How many personal computers does your department own? ______

24. Please provide information about your chiefs, company officers (captains and lieutenants), firefighters, and personnel who perform only medical functions, by filling in the appropriate totals by rank in the following table:

	CHIEF OFFICERS	COMPANY OFFICERS	FIRE-FIGHTERS	EMS-ONLY PERSONNEL
What is the total number?				
How many are volunteers?				
How many are full-time paid?				
How many are women?				
How many are minorities (non-white)?				
How many have served in the military?				
What is the average age?				
How many are high school graduates?				
How many hold a college degree?				
How many are NFPA 1001 certified?				
How many are EMT's (any level)?				
How many are paramedics?				

Please answer the following questions about your department's operations:

1. Please estimate how much of its *time and effort* your department devotes to the following:

Percentage of effort devoted to activities related to *fire suppression*:	______
Percentage of effort devoted to activities related to *fire prevention*:	______
Percentage of effort devoted to *other emergency* activities:	______
Percentage of effort devoted to *non-emergency* public services:	______
Percentage of effort devoted to activities related to *training*:	______
Percentage of effort devoted to activities related to *maintenance*:	______
Percentage of effort devoted to *administrative and business* activities:	______
Percentage of effort devoted to *social, recreational, or fund-raising* activities:	______

2. About how many times per year does your department conduct each of the following?

Social or recreational events for department members only:	______
Social, recreational, or fund-raising events open to the public:	______
Fund-raising mailings or telephone requests:	______
Mailings or advertisements aimed at recruiting volunteers:	______
Displays of fire equipment for the public:	______
In-school education classes for children:	______
Tours of the fire station for the public:	______
Building inspections:	______
Marching in parades:	______
Standing-by for a public event, such as a concert, fair, or fireworks display:	______
Standing-by for another department engaged in non-emergency activities:	______

3. Which of the following *best* describes the way your department generally runs its business? (*For this question and others like it, please make a mark where your department falls along the scale.*)

Autocratic	**Somewhat Participatory**	**Very Participatory**	**Democratic**	**Anarchy**
(Chief has complete authority to act without consulting members)	(Members have input in some areas)	(Members have input into most decisions)	(Members have equal say in all decisions)	(A free-for-all with no clear rules for decision-making)

4. In general, how many people and apparatus *initially* respond to a reported structure fire (either by department SOP or on average)?

Number of pumpers:	______	Number of chiefs:	______
Number of trucks:	______	Number of officers:	______
Number of tankers:	______	Number of firefighters:	______
Number of rescues:	______	Number of EMS personnel:	______
Number of cars or squads:	______	Other:	______

5. If your department has volunteer personnel, how many volunteers usually respond to the following types of call *on average*?

Medical or rescue calls during the day:	______
Medical or rescue calls at night:	______
Fire calls or other general alarms during the day:	______
Fire calls or other general alarms at night:	______

6. For about what percentage of calls is a second activation/dispatch required? _____ %

7. On the scale below, how would you characterize your department's relationship with the *elected leadership* of the community where it is located?

Very Positive	Somewhat Positive	Neutral	Somewhat Negative	Very Negative

8. On the scale below, how would you characterize your department's relationship with the *citizens* of the community it protects?

Very Positive	Somewhat Positive	Neutral	Somewhat Negative	Very Negative

9. To what extent would you say your department is in compliance with OSHA regulations?

Fully Compliant (in all areas)	**Very Compliant** (in many areas)	**Somewhat Compliant** (in some areas)	**Not very Compliant** (in a few areas)	**Not at all Compliant** (in no areas)

10. Please describe how well *you believe* your department is doing in the following areas by rating your department on a scale of 1 to 6, where 6 is the best, 1 is the worst, and N/A is not applicable, as shown on the following scale:

6 = Outstanding (very strong and effective, an area with lots of innovative activity)
5 = Excellent (very competent)
4 = Good (stable, but room for improvement)
3 = Fair (weak, but working to improve)
2 = Poor (weak, and not taking much action to improve)
1 = Very poor (very weak and ineffective, and giving no attention to this area)
N/A = Not applicable (department does not engage in this activity)

	Outstanding	Excellent	Good	Fair	Poor	Very poor	
Fire suppression	6	5	4	3	2	1	N/A
Fire cause and/or arson investigation	6	5	4	3	2	1	N/A
Building inspections	6	5	4	3	2	1	N/A
Hazardous materials response	6	5	4	3	2	1	N/A
Heavy rescue and extrication	6	5	4	3	2	1	N/A
Medical care	6	5	4	3	2	1	N/A
Specialized rescue (water, rope, ice, etc.)	6	5	4	3	2	1	N/A
Educating the community about fire safety	6	5	4	3	2	1	N/A
Pre-fire planning	6	5	4	3	2	1	N/A
Estimating property loss	6	5	4	3	2	1	N/A
Emergency communications	6	5	4	3	2	1	N/A
Supporting other departments with mutual aid	6	5	4	3	2	1	N/A
Responding to non-emergency service calls	6	5	4	3	2	1	N/A
Meeting the community's needs overall	6	5	4	3	2	1	N/A

Please answer the following questions about your fire department's labor force:

1. For each of the following positions or ranks held in your department, please indicate whether the office-holder is elected or appointed, and what the term of office is:

Governing body: ❒ Elected ❒ Appointed
Term: _____ months If appointed, who makes the appointment? ____________

Fire Chief (Car 1): ❒ Elected ❒ Appointed ❒ Hired via civil service
Term: _____ months If appointed, who makes the appointment? ____________

Deputy/Assistant Chiefs: ❒ Elected ❒ Appointed ❒ Hired via civil service
Term: _____ months If appointed, who makes the appointment? ____________

Captains: ❒ Elected ❒ Appointed ❒ Hired via civil service
Term: _____ months If appointed, who makes the appointment? ____________

Lieutenants: ❒ Elected ❒ Appointed ❒ Hired via civil service
Term: _____ months If appointed, who makes the appointment? ____________

Administrative officers (e.g. President, Vice President, Treasurer, Secretary):
❒ Elected ❒ Appointed ❒ Hired via civil service
Term: _____ months If appointed, who makes the appointment? ____________

2. To whom does the Fire Chief report directly (e.g. mayor, town council, commissioners)?

3. Does the Fire Chief receive formal, written performance evaluations?
❒ No ❒ Yes If yes, how often? Every ______ months
Who conducts them?

4. Does your department have *formal written criteria* that personnel must meet in order to hold or to be promoted to the following positions?

Fire Chief	❒ No written criteria	❒ Written criteria in place
Deputy or Assistant Chief	❒ No written criteria	❒ Written criteria in place
Captain	❒ No written criteria	❒ Written criteria in place
Lieutenant	❒ No written criteria	❒ Written criteria in place
Apparatus driver/operator	❒ No written criteria	❒ Written criteria in place
Firefighter	❒ No written criteria	❒ Written criteria in place

5. What percentage of your current members had *no prior emergency services experience* when they joined the department?
______ %

6. How long is the probationary period, if any, for new members? ______ months

7. Are new members required to participate in a training or orientation program?
❑ No ❑ Yes If yes, how long is it? ______ hours

8. Are new members required to pass an examination before they are removed from probation?
❑ No ❑ Yes If yes, is it: ❑ Written ❑ Hands-on ❑ Both

9. Does your department require its firefighters to pass physical agility or fitness tests (i.e. tests of strength and endurance, not medical tests)?
❑ No ❑ Yes If yes, how often? ❑ Only upon appointment.
❑ Annually.
❑ Every ______ years.

10. How many hours of training are conducted by your department per month, on average, in the following areas:
Fire suppression related training: ______ hours
Fire prevention related training: ______ hours
Medical and rescue related training: ______ hours
Hazardous materials related training: ______ hours
OSHA-mandated training: ______ hours
Training related to other operations: ______ hours

11. If your department is a combination department, how would you characterize the relationship between paid and volunteer members?

Very Positive & Cooperative	Somewhat Positive	Neutral	Somewhat Negative	Very Negative & Antagonistic

If your department has volunteers, answer questions 12 - 17. If not, skip to question 18.

12. Please estimate how much of its *total budget* your department devotes to the following:
Percentage of budget devoted to *recruiting* new volunteers: ______ %
Percentage of budget devoted to *social events* for volunteers: ______ %
Percentage of budget devoted to *awards* for volunteers: ______ %
Percentage of budget devoted to "*perks*" (e.g. hats, jackets, etc.) for volunteers: ______ %
Percentage of budget devoted to *retirement benefits* for volunteers: ______ %

13. How would you characterize the competence of your volunteer firefighters (based on factors such as experience, training, qualification, skills, and abilities)?

Very Competent Experienced Qualified	Somewhat Competent	Neutral	Somewhat Incompetent	Very Incompetent Inexperienced Unqualified

14. How many new volunteer members *joined* your department in the past year? ______

15. How many volunteers *left* your department in the past year?
Number that left voluntarily: ______
Number that were dismissed for poor attendance: ______
Number that were dismissed for other reasons: ______
Number that left for medical reasons: ______
Number that retired: ______

16. How many hours of training are volunteers required to attend in order to remain active, and within what time period must they meet this requirement?
Training hours: ________ Frequency: ❐ Monthly ❐ Quarterly ❐ Annually

17. How many calls are volunteers required to respond to order to remain active, and within what time period must they meet this requirement?
Number of calls: _______ Frequency: ❐ Monthly ❐ Quarterly ❐ Annually

If your department has paid employees, answer questions 18 - 24. If not, skip to question 25.

18. What is the annual base salary of an entry-level firefighter in your department? $ ______

19. How many new paid members were hired by your department in the past year? ______

20. How many paid members left your department in the past year?
Number that left voluntarily: ______
Number that were fired for cause: ______
Number that left for medical reasons: ______
Number that retired: ______

21. What individual or entity has *primary* responsibility for administering the process of hiring full-time paid personnel?

22. Are your paid firefighters covered under civil service laws? ❐ No Yes

23. Are your paid firefighters represented by a labor union? ❐ No Yes

24. How would you characterize the competence of your paid firefighters (based on factors such as experience, training, qualification, skills, and abilities)?

Very Competent Experienced Qualified	Somewhat Competent	Neutral	Somewhat Incompetent Inexperienced Uqualified	Very Incompetent

25. How would you characterize *morale* in your department?

Very Positive	Somewhat Positive	Neutral	Somewhat Negative	Very Negative

26. How good a job do you think your department does at *recruiting* new members/employees?

Very Good Recruiting efforts	Fairly Good	Neutral	Fairly Poor	Very Poor Recruiting efforts

27. How good a job do you think your department does at *retaining* its members/employees?

Very Good Retention efforts	Fairly Good	Neutral	Fairly Poor	Very Poor Retention efforts

28. How strong do you think your department's *training* program is?

Very Strong	Fairly Strong	Neutral	Fairly Weak	Very Weak
Innovative	Meets our needs		Needs some improvement	Limited
Frequent			Infrequent	

29. How good a job do you think your department does at providing *incentives* for its personnel to perform well and make positive contributions to the department?

Very Good	Fairly Good	Neutral	Fairly Poor	Very Poor
Many incentives	Some incentives		Few incentives	No incentives
Many rewards	Some rewards		Few rewards	No rewards

30. How often does your department's *board of commissioners* (or governing body) meet?

- ☐ At least weekly
- ☐ At least monthly
- ☐ At least semi-annually
- ☐ At least annually

How often do your department's *chiefs* meet?

- ☐ At least weekly
- ☐ At least monthly
- ☐ At least semi-annually
- ☐ At least annually

How often do your department's *officers* meet?

- ☐ At least weekly
- ☐ At least monthly
- ☐ At least semi-annually
- ☐ At least annually

How often do your department's *members* meet (about department business)?

- ☐ At least weekly
- ☐ At least monthly
- ☐ At least semi-annually
- ☐ At least annually

Please answer the following questions about your fire department's management and administrative activities:

1. Which of the following does your department have and when were they last revised?

   - ❐ A written statement of goals for the organization   Revised (MM/YR) __________
   - ❐ A written strategic plan to support these goals   Revised (MM/YR) __________
   - ❐ A formal, written constitution   Revised (MM/YR) __________
   - ❐ Formal, written by-laws   Revised (MM/YR) __________
   - ❐ Written SOP's or SOG's   Revised (MM/YR) __________
   - ❐ Pre-fire plans for major occupancies in its jurisdiction   Revised (MM/YR) __________
   - ❐ Written job descriptions for all positions   Revised (MM/YR) __________

2. Please indicate whether your department maintains any of the following records and files in on paper, using a computer system, or not at all. (*Check the appropriate box for each.*)

Financial records	❐ On paper	❐ On a computer	❐ Not maintained
Maintenance records	❐ On paper	❐ On a computer	❐ Not maintained
Equipment inventories	❐ On paper	❐ On a computer	❐ Not maintained
Medical files for personnel	❐ On paper	❐ On a computer	❐ Not maintained
Administrative files for personnel	❐ On paper	❐ On a computer	❐ Not maintained
Data about calls/responses	❐ On paper	❐ On a computer	❐ Not maintained
Department training records	❐ On paper	❐ On a computer	❐ Not maintained
Training files for personnel	❐ On paper	❐ On a computer	❐ Not maintained

3. How much money does the fire chief have discretion to spend (i.e. without first obtaining authorization from a higher authority)?

   $ ____________

4. What individual or entity (e.g. the mayor, town board, commissioners, etc.) has *primary* responsibility for *formulation* of your department's annual budget?

5. What individual or entity (e.g. the mayor, town board, commissioners, etc.) has *final approval authority* for your department's annual budget?

6. Does your department prepare audited financial statements?

   ❐ No   ❐ Yes   If yes, who conducts the audits?

7. Does your department have a formal financial management system that allows it to track expenditures against specific item authorizations on an ongoing basis?

   ❐ No   ❐ Yes

8. On average, how much does it *cost* the department to do the following:
Manage an average working structure fire (from response to overhaul)? $ ______
Manage an average motor vehicle accident (from response to patient transport)? $ ______
Manage an average medical call (from response to patient transport)? $ ______

9. Please rank the following in terms of their importance to your ability to assess your department's performance, where 1 is the source of knowledge you rely on the most, 2 is the source you use next most, and so on. **Only rank those sources that you *actually use*.** If you do not *actually use* a particular source, simply write "N/A" for "not applicable."

_____ Numerical data collected by your department about its activities.
_____ Information provided by an independent consultant or auditor.
_____ Feedback from the community through formal surveys of citizens.
_____ Your general awareness of the community's attitudes about your fire department.
_____ Feedback from the community's elected leaders.
_____ Feedback from your department's commissioners or other board of governors.
_____ Feedback from the County Fire Coordinator and/or the New York State OFPC.
_____ Your knowledge of fire service professional and performance standards.
_____ Comparison with the performance and activities of other departments.
_____ The opinions of fire department members about how the department is doing.
_____ Trade journals (such as *Fire Chief* or *Fire Engineering*).
_____ The opinions of apparatus and equipment vendors.
_____ Other (please specify): ________________________________

10. Please describe how well *you believe* your department is doing in the following areas by rating your department on a scale of 1 to 6, where 6 is the best, a 1 is the worst, and N/A is not applicable, as shown on the following scale:

6 = Outstanding (very strong and effective, an area with lots of innovative activity)
5 = Excellent (very competent)
4 = Good (stable, but some room for improvement)
3 = Fair (weak, but working to improve)
2 = Poor (weak, and not taking much action to improve)
1 = Very poor (very weak and ineffective, and giving no attention to this area)
N/A = Not applicable (department does not engage in this activity)

Outstanding	Excellent	Good	Fair	Poor	Very poor		
Strategic planning	6	5	4	3	2	1	N/A
Financial management (accounting, budgeting, etc.)	6	5	4	3	2	1	N/A
Capital planning	6	5	4	3	2	1	N/A
Knowing what it costs to provide a service	6	5	4	3	2	1	N/A
Using computers and other automated technology	6	5	4	3	2	1	N/A
Measuring how good a job it is doing	6	5	4	3	2	1	N/A
Using data about performance to make decisions	6	5	4	3	2	1	N/A
Keeping accurate, current records	6	5	4	3	2	1	N/A

Please answer the following questions about your department's equipment:

1. Does your department have a written capital plan for major projects, such as the purchase of apparatus and the construction of buildings?

   ☐ No ☐ Yes If yes, when was it last updated (MM/YR)? ______
   How many years does it cover? ______

2. What individual or entity has primary responsibility for capital planning for the department (e.g. the fire chief, the commissioners, the town board, etc.)?

3. How does your department *usually* finance major capital purchases (buildings, apparatus)?

   ☐ With debt instruments (municipal bonds) issued by the department or on its behalf.
   ☐ With loans from local banks or financial institutions.
   ☐ Using a departmental capital reserve or sinking fund.
   ☐ By paying cash from the department's operating budget.
   ☐ Other (please specify) ______

4. If and when municipal bonds are used to finance capital purchases, who issues them?

   ☐ The fire department.
   ☐ The city, town, or village government.
   ☐ Other (please specify) ______

   What is this issuing entity's bond rating? ______

5. What individual or entity (e.g. the mayor, town board, commissioners, etc.) has *final approval authority* for purchasing capital equipment for your department?

6. Does your department have a replacement plan and schedule for its durable equipment?

   ☐ No ☐ Yes

   If yes, which of the following are covered? *(Please check all that apply.)*

   ☐ Hose.
   ☐ SCBA.
   ☐ Major tools/appliances.
   ☐ Major medical equipment.
   ☐ Communications equipment (e.g. radios, pagers).
   ☐ Personal protective (turn-out or bunker) gear.
   ☐ Motorized equipment (e.g. pumps, fans, generators).
   ☐ Other major items: ______

7. To which of the following specialized equipment does your department have ready access?

Thermal imaging camera	☐ In-house	☐ Via mutual aid	☐ Not available
Class A foam	☐ In-house	☐ Via mutual aid	☐ Not available
Hazardous gas detector	☐ In-house	☐ Via mutual aid	☐ Not available
PPV Fans	☐ In-house	☐ Via mutual aid	☐ Not available
Air bags	☐ In-house	☐ Via mutual aid	☐ Not available
Hydraulic extrication tools	☐ In-house	☐ Via mutual aid	☐ Not available
Aerial apparatus	☐ In-house	☐ Via mutual aid	☐ Not available
Cascade system	☐ In-house	☐ Via mutual aid	☐ Not available

Please provide the following information for the person who completed this survey:

NAME: ______________________
FIRE DEPARTMENT JOB TITLE: ______________________
FIRE DEPARTMENT NAME: ______________________
CONTACT TELEPHONE NUMBER: ______________________
E-MAIL ADDRESS: ______________________
FIRE DEPARTMENT WEB SITE: ______________________

We are interested in understanding several details about how fire departments operate that are difficult to ask about in a written survey.

Would you be willing to be willing to be interviewed about your thoughts, ideas, and perspective about your department and the fire service in general?

- ❐ Yes, I would be willing to be interviewed.
- ❐ No, I would not be willing to be interviewed.

If you would be willing to be interviewed, please indicate the times and days that would normally be the most convenient for one of us to contact you. *Please check all that apply*:

- ❐ During the day, on:

- ❐ Monday
- ❐ Tuesday
- ❐ Wednesday
- ❐ Thursday
- ❐ Friday
- ❐ Saturday
- ❐ Sunday

- ❐ In the evening, on:

- ❐ Monday
- ❐ Tuesday
- ❐ Wednesday
- ❐ Thursday
- ❐ Friday
- ❐ Saturday
- ❐ Sunday

IN THE ENVELOPE PROVIDED, PLEASE SEND:

- **THE COMPLETED SURVEY.**
- **A COPY OF YOUR DEPARTMENT'S BUDGET.**
- **A COPY OF YOUR ORGANIZATIONAL CHART.**

NO POSTAGE IS NECESSARY.

APPENDIX 3: Q SURVEY INSTRUMENT

FIRE DEPARTMENT OPERATIONS AND MANAGEMENT STUDY

FIRE CHIEF QUESTIONNAIRE

October, 1999

Conducted by:

Amy E. Kneedler, Project Director
Firefighter, EMT, Research Associate

The Alan K. Campbell Public Affairs Institute
The Maxwell School of Citizenship and Public Affairs
321 Eggers Hall, Syracuse University
Syracuse, New York 13244-1090
Phone: (315) 443-9743 Fax: (315) 443-9734

INTRODUCTION

I am an Instructor of Public Administration and a Ph.D. Candidate in the Public Administration Department at Syracuse University. I am also a Senior Research Associate at the Alan K. Campbell Public Affairs Institute at Syracuse University. I have seventeen years of paid and volunteer professional experience in a variety of emergency services.

I am asking you to participate in a component of a research project, entitled *The Fire Department Operations and Management Study*, which I am conducting at the Alan K. Campbell Public Affairs Institute at the Maxwell School of Citizenship and Public Affairs at Syracuse University. Your participation would involve completing the attached exercise, which takes **20-30 minutes** and requires you to rank order several statements about your job as a fire chief according to whether or not you agree with them. This sheet will explain the study and the exercise to you.

The Fire Department Operations and Management Study seeks to identify and carefully analyze the ways in which fire departments acquire and deploy resources to provide a range of emergency services. In particular, I am trying to understand how political, financial, technological, and other constraints affect the level of service departments are able to provide. A benefit of this analysis is that it can help fire chiefs better understand the productivity implications of the decisions they make under these constraints.

Your participation in this exercise is completely voluntary, so you may choose to participate or not. You may also withdraw from this exercise at any time without prejudice. By completing the attached form, you consent to having the information you provide be used for academic research purposes. The information you provide on this form will be kept strictly confidential.

The responses you supply during this exercise will be combined with answers from several other fire chiefs. These data will be analyzed using a statistical procedure known as Q-method, is a technique that permits underlying trends in beliefs and attitudes to be discerned and categorized using an array of individual responses to a process that involves ranking a series of statements.

The information I collect through this exercise will help me analyze the kinds of positive and negative pressures fire chiefs feel as they work to lead and manage their departments. The exercise involves ranking several statements according to how strongly you agree or disagree with them. You should consider how true you think each statement is for you personally in the context of managing your own fire department. This exercise should take about 20-30 minutes to complete.

I appreciate your willingness to participate in this study. A report of my analysis will be made available to you when the study is complete. Please feel free to ask questions about the research or this exercise, if you have any. I will be happy to explain anything in greater detail if you wish. You may also contact me later at:

Amy E. Kneedler
Alan K. Campbell Public Affairs Institute
Maxwell School of Citizenship and Public Affairs
321 Eggers Hall, Syracuse University
Syracuse, NY 13244 (315)443-9743

DIRECTIONS

You have been provided with 40 cards numbered from 1 to 40. Each card has a statement written on it. They are in no particular order. You have also been provided with a record form.

These directions lead you step-by-step through a systematic process for ranking the cards according to how strongly you agree or disagree with the statements on them. Please consider how true you feel each statement is **for you personally in the context of managing your own fire department**.

STEP 1. Begin by reading the cards one at a time. As you read them, place them in 3 piles. Those cards you agree with, place in one pile. Those cards you disagree with place in a second pile. Those cards you feel neutral about or have no opinion about, place in a third pile.

STEP 2. Next, select the three cards from your "disagree" pile with which you *disagree most.* Write the numbers of these cards in the three spaces provided under the –3 (most strongly disagree) column on your record sheet.

STEP 3. From the cards remaining in your "disagree" pile, select the next 5 you most disagree with, and write the numbers of these cards in the –2 (strongly disagree) column on your sheet. If you do not have enough cards in your "disagree" pile to fill the column, select the most disagreeable cards from your "neutral" pile to fill it.

STEP 4. From the cards remaining in your "disagree" pile, select the next 7 you most disagree with and write the numbers of these cards in the –1 (disagree) column on your sheet. Again, if you do not have enough cards, select the most disagreeable cards from your "neutral" pile to fill the column.

STEP 5. If you have leftover cards in your "disagree" pile, place them in your "neutral" pile. At this time, *do not* write in the 0 (neutral) column on your record sheet.

STEP 6. Now, go to your "agree" pile and select the three cards with which you *agree most.* Write the numbers of these cards in the three spaces provided under the +3 (most strongly agree) column on your record sheet.

STEP 7. From the cards remaining in your "agree" pile, select the next 5 you most agree with, and write the numbers of these cards in the +2 (strongly agree) column on your sheet. If you do not have enough cards in your "agree" pile to fill the column, select the most agreeable cards from your "neutral" pile to fill it.

STEP 8. From the cards remaining in your "agree" pile, select the next 7 you most agree with and write the numbers of these cards in the +1 (agree) column on your sheet. Again, if you do not have enough cards to fill the column, select the most agreeable cards from your "neutral" pile to fill it.

STEP 9. If you have leftover cards in your "agree" pile, place them in your "neutral" pile.

STEP 10. Now, write down the numbers of the remaining cards (that is, those in your "neutral" pile) in the 0 (neutral) column on your record sheet. When you are finished, you should have no cards left over and no blank spaces on your answer sheet.

STEP 11. Finally, please answer the questions on the bottom half of the record sheet.

-3 MOST STRONGLY DISAGREE (3 CARDS)	-2 STRONGLY DISAGREE (5 CARDS)	-1 DISAGREE (7 CARDS)	0 NEUTRAL (10 CARDS)	+1 AGREE (7 CARDS)	+2 STRONGLY AGREE (5 CARDS)	+3 MOST STRONGLY AGREE (3 CARDS)
___	___	___	___	___	___	___
___	___	___	___	___	___	___
___	___	___	___	___	___	___
	___	___	___	___	___	
	___	___	___	___	___	
		___	___	___		
		___	___	___		
			___			
			___			
			___			

1. Please note the three statements you most ***disagreed*** with (those in the –3 column). Briefly explain why you disagreed with these statements so strongly.

2. Please note the three statements you most ***agreed*** with (those in the +3 column). Briefly explain why you agreed with these statements so strongly.

PLEASE PROVIDE THE FOLLOWING INFORMATION:

[*This information is for sample analysis purposes only –to protect confidentiality, your responses will be identified* only by a numerical code*, and this record form will be destroyed.*]

Name: ______________________________ Age: ________

Fire department: ___________________ Number of years in the fire service: __________

Number of years as a fire chief (including deputy or assistant) with this department: ____

Number of your family members that have ever been involved in the fire service: ______

Do you live in the jurisdiction your department protects? _______ If so, how long? ___

Profession or current job title: ______________________________

Years of college attended, if any: _____ Major course of study/degree earned: ________

APPENDIX 4: CENSUS IMPUTATION SCHEME

PROBLEM:
To be able to control for environmental conditions that may affect the production of fire protection, we would like to know some census information for each fire jurisdiction. Fire jurisdictions and census tracts are not aligned, however. That is, they do not have common boundaries, except fortuitously. There are no existing standard approaches for imputing census values for fire (or any similar) jurisdictions.

IMPUTATION SCHEME:
Rules for estimating the number of elements of a given census category in a fire jurisdiction are explained below. Note that there are two types of census data relevant to this study that must be imputed. Most are total numbers of elements of a given census category, such as the number of housing units, the number workers in a household, and so forth. In two cases, census data take the form of median values for each census tract. These are median household income and median owner-occupied house value.

For these imputation rules, let:

$\hat{X}_{f_z}$ = Number of elements of a given census category in fire jurisdiction z (estimated)

X_{c_n} = Number of elements of a given census category in census tract n (1990 Census)

$\hat{M}_{f_z}$ = Median value for a given census category in fire jurisdiction z (estimated)

M_{c_n} = Median value for a given census category in census tract n (1990 Census actual)

$\hat{A}_{f_z c_n}$ = Area of fire jurisdiction z contained in census tract n (estimated)

A_{f_z} = Area of fire jurisdiction z (reported)

A_{c_n} = Area of census tract n (1990 Census actual)

P_{f_z} = Population of fire jurisdiction z (reported)

P_{c_n} = Population of census tract n (1990 Census actual)

This permits the following definitions:

$\hat{A}_{zn} = \hat{A}_{f_z c_n} / A_{f_z}$ = Proportion of fire jurisdiction z contained in census tract n (visual estimate)

$\hat{A}_{nz} = \hat{A}_{f_z c_n} / A_{c_n}$ = Proportion of census tract n contained in fire jurisdiction z (visual estimate)

$P_{zn} = P_{f_z} / P_{c_n}$ = Ratio of the population of fire jurisdiction z to the population of census tract n

Therefore:

$\hat{A}_{zn} * P_{zn}$ = Estimated proportion of the population of fire jurisdiction z contained in census tract n

PROCESS FOR DETERMINING RELEVANT AREAS AND POPULATIONS:

1. Obtain a map of the fire jurisdictions in each county from the county fire coordinators. For each fire jurisdiction, visually estimate from the map what proportion of that jurisdiction is in each census tract to get $\hat{A}_{zn}$. If a map of the fire jurisdictions is unavailable for a given county, determine the approximate location of each fire department, and estimate which census tracts probably contain each fire jurisdiction. In cases where a fire jurisdiction appears to span more than one census tract, assume that the fire jurisdiction's population is distributed equally across all the census tracts involved.

2. Obtain the population each fire department protects, P_{f_z} from the county fire coordinators and/or from the fire department surveys. If figures are available from both sources, and they conflict, use the figure from the fire coordinator. Also, the 1990 Census population figures are considered more reliable than the population figures reported by either fire coordinators or fire departments, which are often rough guesses, so in cases where a fire jurisdiction exactly aligns with census tract boundaries, use the census population figures. If P_{f_z} is unknown (i.e. was not reported by the county fire coordinator or fire department), then for each census tract visually estimate from the map what proportion of that census tract is in each fire jurisdiction to get $\hat{A}_{nz}$. Then estimate the population using:

$$\hat{P}_{f_z} = \sum_{n=1}^{n} [\hat{A}_{nz} * P_{c_n}] = \text{Population of fire jurisdiction } z \text{ (estimated if not reported)}$$

Substitute this value for P_{f_z} where necessary.

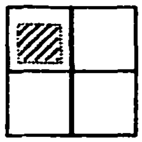
GENERAL APPROACH TO IMPUTATION OF CENSUS VALUES:

To estimate the number of elements of a given census category in a fire jurisdiction, we will use the general rule:

$$\hat{X}_{f_z} = \sum_{n=1}^{n} (\hat{A}_{zn} * P_{zn} * X_{c_n})$$

This rule is limited because it does not assure that the sum of the populations of the proportion of the various fire jurisdictions contained in a census tract equals the actual population of that census tract. Since these estimates will be used to calculate ratios for use in further analysis, this limitation is probably not very important.

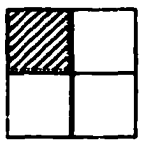
SPECIFIC CASES: There are five relationships that occur between fire jurisdictions and census tracts. The application of this approach to these relationships follows. The accompanying diagrams demonstrate each case graphically, each showing four census tracts, the boundaries of which are solid lines, and a single fire jurisdiction, which is hatched.



CASE 1: *The fire jurisdiction is contained within a census tract.*

RULE 1a: $\hat{M}_{f_z} = M_{c_n}$

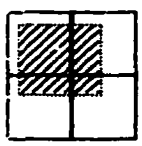
RULE 1b: $\hat{X}_{f_z} = P_{zn} X_{c_n}$



CASE 2: *Census boundaries and the fire jurisdiction coincide.*

RULE 2a: $\hat{M}_{f_z} = M_{c_n}$

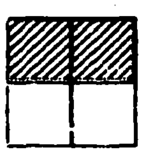
RULE 2b: $\hat{X}_{f_z} = X_{c_n}$



CASE 3: *The fire jurisdiction contains parts of multiple census tracts.*

RULE 3a: $\hat{M}_{f_z} = \sum_{n=1}^{n} (\hat{A}_{zn} M_{c_n})$

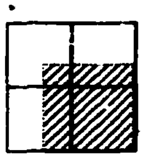
RULE 3b: $\hat{X}_{f_z} = \sum_{n=1}^{n} (\hat{A}_{zn} P_{zn} X_{c_n})$



CASE 4: *The fire jurisdiction contains multiple entire census tracts.*

RULE 4a: $\hat{M}_{f_z} = \sum_{n=1}^{n} (1/P_{zn} * M_{c_n})$

RULE 4b: $\hat{X}_{f_z} = \sum_{n=1}^{n} X_{c_n}$



CASE 5: *The fire jurisdiction contains at least one entire census tract and parts of other census tracts.*

RULE 5a: $\hat{M}_{f_z} = \sum_{n=1}^{n} (\hat{A}_{zn} M_{c_n})$

RULE 5b: $\hat{X}_{f_z} = (S+T)$, where $S = \sum_{n=1}^{n} (\hat{A}_{zn} P_{zn} X_{c_n})$ for the census tracts partially contained in the fire jurisdiction, and $T = \sum_{n=1}^{n} X_{c_n}$ for the census tracts entirely contained in the fire jurisdiction.

APPENDIX 5: HAUSMAN SPECIFICATION TEST FOR SIMULTANEITY

A version of Hausman's specification error test can be used to test for the presence of simultaneity. This is accomplished by first estimating the reduced form models for the endogenous variables in the structural model. The residuals from these regressions are then included as independent variables in the structural cost model, and this model is estimated.

The results of the full and reduced model regressions of the structural cost model are as follows:

	FULL		REDUCED	
Variable	B	t	B	t
(Constant)	11.7817	7.7842	9.9836	10.7230
LNSTRFIR	0.5862	2.5872	0.3174	3.8663
LNOUTPUT	0.2090	2.7243	0.0896	2.5591
PERFORM	-0.0708	-1.7284	-0.0040	-0.2298
STYLE	-0.0905	-1.6331	-0.0553	-2.6786
RECORDS	0.0546	0.9460	0.0213	0.8666
PERVOL	-1.4821	-3.8050	-1.1411	-3.6262
SPECEQ	-0.0931	-1.4236	-0.0512	-1.7455
LNPOP	-0.3167	-1.7425	-0.4170	-3.9423
CHEAP	-3.7966	-1.7330	-5.4208	-3.1897
VACANT	1.4580	2.3290	0.5459	1.1922
LNOTHER	-0.0213	-0.2266	0.1131	1.4681
LNTOTMA	-0.1219	-2.0228	-0.0631	-1.1264
Residual 1	-0.1705	-1.9325		
Residual 2	-0.3228	-1.3192		
Residual 3	0.0375	0.6166		
Residual 4	0.0818	1.8249		
Residual 5	-0.0533	-0.7797		
Residual 6	0.8349	1.2475		
Residual 7	0.0431	0.5963		
	SSE	DF	SSE	DF
Regression	39.3297	19	35.5231	12
Residual	35.9508	106	40.4215	115
Total	75.2806	125	75.9446	127
R square	0.5224		0.4678	
R square (Adjusted)	0.4368		0.4122	

The null hypothesis that the coefficients on all of the residuals is zero is tested with a partial F-test, where F is given by:

$$\frac{(SSE_R - SSE_F)/(K-L)}{SSE_F/(n-K-1)}$$

Where the values are as follows:

SSE_R	=	Error sum of squares from the reduced model (without the residuals)	= 40.4215
SSE_F	=	Error sum of squares from the full model (with the residuals)	= 35.9508
K	=	Number of explanatory variables included in the full model	= 19
L	=	Number of explanatory variables included in the reduced model	= 12
n	=	Number of observations	= 126

For this study:

$$F = \frac{(40.4215-35.9508)/(19-12)}{35.9508/(126-19-1)} = 1.88$$

The critical values of F are: $F_{0.05\,(7,106)} = 2.09$ and $F_{0.10\,(7,106)} = 1.77$

Since $F > F_\alpha$ at the 10% level of significance, we can reject H_0, and conclude that simultaneity is present in the model.

APPENDIX 6: CORRELATIONS AMONG PREDETERMINED VARIABLES

	OCCWAR	OCCCOM	OCCIND	OWNER	WOOD	TRAILR	UNEMPL	NONURB	EDUCAT	WATER	LANFRM	LANSCH	HYDRAN
OCCWAR	1.000	.141	.329	-.045	-.196	-.146	.062	.103	-.038	.254	-.120	.188	.228
		.067	*.000*	*.558*	*.010*	*.056*	*.418*	*.182*	*.624*	*.001*	*.123*	*.015*	*.003*
OCCCOM	.141	1.000	.429	-.043	-.284	-.253	-.174	.127	.215	.293	-.204	.208	.316
	.067		*.000*	*.582*	*.000*	*.001*	*.024*	*.099*	*.005*	*.000*	*.008*	*.007*	*.000*
OCCIND	.329	.429	1.000	.069	-.231	-.176	-.157	.114	-.024	.350	-.097	.308	.336
	.000	*.000*		*.372*	*.003*	*.022*	*.042*	*.141*	*.760*	*.000*	*.215*	*.000*	*.000*
OWNER	-.045	-.043	.069	1.000	.018	-.064	-.406	-.123	.167	-.039	.158	-.005	.044
	.558	*.582*	*.372*		*.817*	*.404*	*.000*	*.108*	*.028*	*.608*	*.040*	*.948*	*.564*
WOOD	-.196	-.284	-.231	.018	1.000	.634	.361	-.156	-.527	-.707	.474	-.200	-.598
	.010	*.000*	*.003*	*.817*		*.000*	*.000*	*.041*	*.000*	*.000*	*.000*	*.009*	*.000*
TRAILR	-.146	-.253	-.176	-.064	.634	1.000	.326	-.162	-.533	-.620	.357	-.010	-.491
	.056	*.001*	*.022*	*.404*	*.000*		*.000*	*.033*	*.000*	*.000*	*.000*	*.900*	*.000*
UNEMPL	.062	-.174	-.157	-.406	.361	.326	1.000	.179	-.490	-.245	.009	-.111	-.242
	.418	*.024*	*.042*	*.000*	*.000*	*.000*		*.019*	*.000*	*.001*	*.904*	*.152*	*.001*
NONURB	.103	.127	.114	-.123	-.156	-.162	.179	1.000	-.050	.269	-.146	.095	.242
	.182	*.099*	*.141*	*.108*	*.041*	*.033*	*.019*		*.512*	*.000*	*.059*	*.220*	*.001*
EDUCAT	-.038	.215	-.024	.167	-.527	-.533	-.490	-.050	1.000	.430	-.242	-.045	.388
	.624	*.005*	*.760*	*.028*	*.000*	*.000*	*.000*	*.512*		*.000*	*.002*	*.558*	*.000*
WATER	.254	.293	.350	-.039	-.707	-.620	-.245	.269	.430	1.000	-.359	.181	.799
	.001	*.000*	*.000*	*.608*	*.000*	*.000*	*.001*	*.000*	*.000*		*.000*	*.019*	*.000*
LANFRM	-.120	-.204	-.097	.158	.474	.357	.009	-.146	-.242	-.359	1.000	-.095	-.358
	.123	*.008*	*.215*	*.040*	*.000*	*.000*	*.904*	*.059*	*.002*	*.000*		*.220*	*.000*
LANSCH	.188	.208	.308	-.005	-.200	-.010	-.111	.095	-.045	.181	-.095	1.000	.164
	.015	*.007*	*.000*	*.948*	*.009*	*.900*	*.152*	*.220*	*.558*	*.019*	*.220*		*.033*
HYDRAN	.228	.316	.336	.044	-.598	-.491	-.242	.242	.388	.799	-.358	.164	1.000
	.003	*.000*	*.000*	*.564*	*.000*	*.000*	*.001*	*.001*	*.000*	*.000*	*.000*	*.033*	
NOKIDS	-.168	-.121	-.063	.202	-.081	-.123	-.066	-.308	.117	-.087	-.026	-.013	-.030
	.028	*.117*	*.418*	*.008*	*.290*	*.107*	*.386*	*.000*	*.126*	*.255*	*.736*	*.872*	*.695*
CITYFC	.498	.122	.225	-.222	-.255	-.262	.132	.528	-.054	.339	-.228	.125	.362
	.000	*.115*	*.003*	*.003*	*.001*	*.000*	*.084*	*.000*	*.484*	*.000*	*.003*	*.106*	*.000*
POOR	.142	-.176	-.061	-.480	.418	.287	.558	.322	-.470	-.127	.139	-.017	-.126
	.065	*.022*	*.431*	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*	*.095*	*.072*	*.823*	*.100*
DENSITY	.361	.238	.194	-.092	-.464	-.477	-.127	.330	.167	.515	-.349	.147	.540
	.000	*.002*	*.012*	*.227*	*.000*	*.000*	*.096*	*.000*	*.028*	*.000*	*.000*	*.057*	*.000*
LNINCMED	-.067	.170	.012	.516	-.522	-.464	-.560	-.244	.682	.234	-.195	.002	.255
	.387	*.027*	*.873*	*.000*	*.000*	*.000*	*.000*	*.001*	*.000*	*.002*	*.011*	*.981*	*.001*
TAXSHARE	-.018	-.123	-.012	-.107	.546	.520	.161	.020	-.470	-.369	.251	.029	-.349
	.814	*.112*	*.881*	*.163*	*.000*	*.000*	*.034*	*.798*	*.000*	*.000*	*.001*	*.713*	*.000*
FARMER	-.208	-.245	-.209	-.027	.629	.491	.236	-.134	-.460	-.555	.601	-.123	-.499
	.006	*.001*	*.006*	*.721*	*.000*	*.000*	*.002*	*.079*	*.000*	*.000*	*.000*	*.114*	*.000*
APART	.201	.195	.155	-.161	-.433	-.326	-.164	.194	.255	.504	-.260	.036	.424
	.008	*.011*	*.044*	*.035*	*.000*	*.000*	*.031*	*.010*	*.001*	*.000*	*.001*	*.641*	*.000*
LNPOP	.385	.349	.301	.203	-.565	-.428	-.327	.205	.395	.503	-.284	.217	.527
	.000	*.000*	*.000*	*.007*	*.000*	*.000*	*.000*	*.007*	*.000*	*.000*	*.000*	*.005*	*.000*
CHEAP	-.010	-.244	-.056	-.060	.520	.300	.334	.171	-.486	-.261	.184	-.015	-.276
	.897	*.001*	*.467*	*.431*	*.000*	*.000*	*.000*	*.024*	*.000*	*.001*	*.017*	*.851*	*.000*
VACANT	-.144	-.117	-.232	-.808	.215	.257	.430	-.120	-.251	-.310	-.010	-.113	-.303
	.059	*.131*	*.002*	*.000*	*.004*	*.001*	*.000*	*.116*	*.001*	*.000*	*.899*	*.145*	*.000*
LNOTHER	.361	.355	.328	.169	-.544	-.356	-.353	.102	.326	.451	-.244	.295	.489
	.000	*.000*	*.000*	*.027*	*.000*	*.000*	*.000*	*.183*	*.000*	*.000*	*.002*	*.000*	*.000*
LNTOTMA	.007	.129	.006	.169	-.140	.055	-.227	-.076	.016	.004	-.055	.193	-.012
	.925	*.102*	*.944*	*.030*	*.072*	*.481*	*.003*	*.329*	*.837*	*.956*	*.487*	*.014*	*.876*

Two-tailed significance values are in italics.

	NOKIDS	CITYFD	POOR	DENSITY	LNINCMED	TAXSHARE	FARMER	APART	LNPOP	CHEAP	VACANT	LNOTHER	LNTOTMA
OCCWAR	-.168	.498	.142	.361	-.067	-.018	-.208	.201	.385	-.010	-.144	.361	.007
	.028	*.000*	*.065*	*.000*	*.387*	*.814*	*.006*	*.008*	*.000*	*.897*	*.059*	*.000*	*.925*
OCCCOM	-.121	.122	-.176	.238	.170	-.123	-.245	.195	.349	-.244	-.117	.355	.129
	.117	*.115*	*.022*	*.002*	*.027*	*.112*	*.001*	*.011*	*.000*	*.001*	*.131*	*.000*	*.102*
OCCIND	-.063	.225	-.061	.194	.012	-.012	-.209	.155	.301	-.056	-.232	.328	.006
	.418	*.003*	*.431*	*.012*	*.873*	*.881*	*.006*	*.044*	*.000*	*.467*	*.002*	*.000*	*.944*
OWNER	.202	-.222	-.480	-.092	.516	-.107	-.027	-.161	.203	-.060	-.808	.169	.169
	.008	*.003*	*.000*	*.227*	*.000*	*.163*	*.721*	*.035*	*.007*	*.431*	*.000*	*.027*	*.030*
WOOD	-.081	-.255	.418	-.464	-.522	.546	.629	-.433	-.565	.520	.215	-.544	-.140
	.290	*.001*	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*	*.004*	*.000*	*.072*
TRAILR	-.123	-.262	.287	-.477	-.464	.520	.491	-.326	-.428	.300	.257	-.356	.055
	.107	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*	*.001*	*.000*	*.481*
UNEMPL	-.066	.132	.558	-.127	-.560	.161	.236	-.164	-.327	.334	.430	-.353	-.227
	.386	*.084*	*.000*	*.096*	*.000*	*.034*	*.002*	*.031*	*.000*	*.000*	*.000*	*.000*	*.003*
NONURB	-.308	.528	.322	.330	-.244	.020	-.134	.194	.205	.171	-.120	.102	-.076
	.000	*.000*	*.000*	*.000*	*.001*	*.798*	*.079*	*.010*	*.007*	*.024*	*.116*	*.183*	*.329*
EDUCAT	.117	-.054	-.470	.167	.682	-.470	-.460	.255	.395	-.486	-.251	.326	.016
	.126	*.484*	*.000*	*.028*	*.000*	*.000*	*.000*	*.001*	*.000*	*.000*	*.001*	*.000*	*.837*
WATER	-.087	.339	-.127	.515	.234	-.369	-.555	.504	.503	-.261	-.310	.451	.004
	.255	*.000*	*.096*	*.000*	*.002*	*.000*	*.000*	*.000*	*.000*	*.001*	*.000*	*.000*	*.956*
LANFRM	-.026	-.228	.139	-.349	-.195	.251	.601	-.260	-.284	.184	-.010	-.244	-.055
	.736	*.003*	*.072*	*.000*	*.011*	*.001*	*.000*	*.001*	*.000*	*.017*	*.899*	*.002*	*.487*
LANSCH	-.013	.125	-.017	.147	.002	.029	-.123	.036	.217	-.015	-.113	.295	.193
	.872	*.106*	*.823*	*.057*	*.981*	*.713*	*.114*	*.641*	*.005*	*.851*	*.145*	*.000*	*.014*
HYDRAN	-.030	.362	-.126	.540	.255	-.349	-.499	.424	.527	-.276	-.303	.489	-.012
	.695	*.000*	*.100*	*.000*	*.001*	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*	*.876*
NOKIDS	1.000	-.362	-.385	-.189	.322	-.449	-.026	-.329	-.030	-.105	.155	-.046	.126
		.000	*.000*	*.013*	*.000*	*.000*	*.731*	*.000*	*.700*	*.169*	*.042*	*.546*	*.105*
CITYFD	-.362	1.000	.311	.742	-.242	.038	-.216	.298	.378	.036	-.106	.368	-.137
	.000		*.000*	*.000*	*.001*	*.620*	*.004*	*.000*	*.000*	*.642*	*.165*	*.000*	*.079*
POOR	-.385	.311	1.000	-.007	-.808	.330	.378	-.019	-.279	.641	.323	-.322	-.290
	.000	*.000*		*.931*	*.000*	*.000*	*.000*	*.806*	*.000*	*.000*	*.000*	*.000*	*.000*
DENSITY	-.189	.742	-.007	1.000	.073	-.069	-.382	.538	.574	-.163	-.251	.530	.020
	.013	*.000*	*.931*		*.337*	*.364*	*.000*	*.000*	*.000*	*.033*	*.001*	*.000*	*.799*
LNINCMED	.322	-.242	-.808	.073	1.000	-.447	-.412	.115	.431	-.628	-.419	.423	.237
	.000	*.001*	*.000*	*.337*		*.000*	*.000*	*.132*	*.000*	*.000*	*.000*	*.000*	*.002*
TAXSHARE	-.449	.038	.330	-.069	-.447	1.000	.383	.047	-.265	.320	-.033	-.210	.013
	.000	*.620*	*.000*	*.364*	*.000*		*.000*	*.540*	*.000*	*.000*	*.664*	*.006*	*.863*
FARMER	-.026	-.216	.378	-.382	-.412	.383	1.000	-.359	-.471	.400	.220	-.452	-.143
	.731	*.004*	*.000*	*.000*	*.000*	*.000*		*.000*	*.000*	*.000*	*.004*	*.000*	*.066*
APART	-.329	.298	-.019	.538	.115	.047	-.359	1.000	.359	-.195	-.248	.362	.050
	.000	*.000*	*.806*	*.000*	*.132*	*.540*	*.000*		*.000*	*.010*	*.001*	*.000*	*.519*
LNPOP	-.030	.378	-.279	.574	.431	-.265	-.471	.359	1.000	-.308	-.432	.803	.208
	.700	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*	*.000*		*.000*	*.000*	*.000*	*.007*
CHEAP	-.105	.036	.641	-.163	-.628	.320	.400	-.195	-.308	1.000	.079	-.438	-.094
	.169	*.642*	*.000*	*.033*	*.000*	*.000*	*.000*	*.010*	*.000*		*.304*	*.000*	*.231*
VACANT	.155	-.106	.323	-.251	-.419	-.033	.220	-.248	-.432	.079	1.000	-.374	-.128
	.042	*.165*	*.000*	*.001*	*.000*	*.664*	*.004*	*.001*	*.000*	*.304*		*.000*	*.100*
LNOTHER	-.046	.368	-.322	.530	.423	-.210	-.452	.362	.803	-.438	-.374	1.000	.265
	.546	*.000*	*.000*	*.000*	*.000*	*.006*	*.000*	*.000*	*.000*	*.000*	*.000*		*.001*
LNTOTMA	.126	-.137	-.290	.020	.237	.013	-.143	.050	.208	-.094	-.128	.265	1.000
	.105	*.079*	*.000*	*.799*	*.002*	*.863*	*.066*	*.519*	*.007*	*.231*	*.100*	*.001*	

Two-tailed significance values are in italics.

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