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Volunteer Fire Organizations and Volunteer Firefighters: An Economic Perspective and Valuation for the State of Montana

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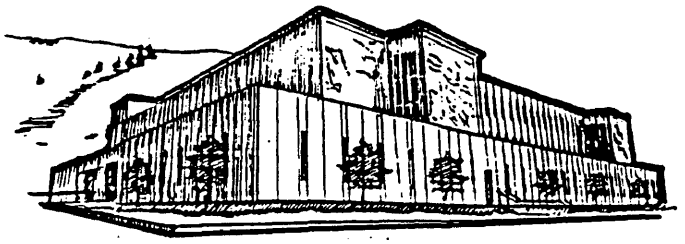

VOLUNTEER FIRE ORGANIZATIONS AND VOLUNTEER FIREFIGHTERS: AN ECONOMIC PERSPECTIVE AND VALUATION FOR THE STATE OF MONTANA

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In Montana, there are approximately 468 volunteer fire organizations and an estimated 8845 volunteer firefighters. The number of hours contributed by volunteers to the cause of fire protection is substantial. Within this study, the empirically determined economic value of volunteer firefighters to the State of Montana was modeled and calculated. Deriving accurate estimates of economic value was generated through two models using data collected from a survey of volunteer fire agencies in Montana.

Method #1 took a direct approach by assessing the total time in hours contributed to local fire protection efforts by volunteers, imputing an hourly wage rate, and then multiplying that figure by the aggregate volunteer firefighter time. Method #2 took a statistical approach by estimating a econometric derived demand function for volunteer firefighters. The area underneath the estimated demand schedule was computed. A second measure of the economic value of volunteer services was then developed.

Both models resulted in similar estimates. Method #1 resulted in an estimated economic value of $12.4 million dollars while method #2 was 12.2% larger at $14.1 million. These figures are conservative due to both models' inability to capture certain volunteered hours as well as the omission of several fire training times. These economic service value measures reflect a considerable contribution by volunteer firefighters and indicate the significant positive return realized from a community's investment in local fire protection.

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Many others deserve recognition because my sacrifice was undoubtedly also theirs. The night walks past the quiet old neighborhood basketball court with Andy Cherullo were more often than not an invaluable forum for figuring out what the hell I wanted to do in my life. I thank you for being there Andy. The friendship of Dave Larson and his computer expertise were much appreciated. His insight and enthusiasm about computers dared me to leap into the 21st century. My parents were giving, as always, with both their concern and resources and it is the former that was most important. I must thank Toonces the cat for her undying persistence in acquiring the property rights to my lap. She kept company with me at the writing table until I was finished while also giving a new definition to the word contentment. Lastly, for Lisa, My wife and best friend forever, who undoubtedly shared in the majority of my daily frustrations and insecurities and actually stayed sane through the completion of this thesis, I offer a lifetime of thanks. This thesis could only be dedicated to you.

Introduction

"Most attempts at establishing a monetary value of volunteering do a great disservice by vastly underestimating the equivalent worth of volunteer work." — G. Neil Karn

Organizations employing volunteer labor facilitate a very important role within society. Not only do they provide a social medium by which members of a community can come together and join forces but they also make possible the provision of a valuable good or service that otherwise might not be available. Volunteer contributions to society represent an integral factor in the production and delivery of many public and social services. The extent of their influence ranges from the mundane cleaning of the local homeless shelter to the highly energized technical provision of emergency medical aid.

Volunteer fire departments in the State of Montana number well over four hundred. Summation of the area and population protected by these organizations directly reflects their extensive impact and the critical need for the service they provide. Looking at volunteer fire departments allows the opportunity to investigate the nature or makeup of these organizations, their integration and role within the community, and the production of a very important public good — fire protection services — by volunteer labor.

The main focus of this thesis will be to accurately measure the economic worth or value of volunteer labor used in the provision of fire protection

services to the State of Montana. In addition, appropriate attention will be directed towards detailing Montana's structure and classification system regarding fire protection services. Also of interest are questions regarding volunteer fire department's funding and capital acquisitions, as well as statistics revealing general human capital characteristics such as experience, average age, and membership totals. Finally, since there is very little literature concerning the economic aspect of volunteer related issues, a further avenue of this thesis will be to summarize and critique what has been done to date and to suggest some designs for future research.

1.1 Background in Volunteerism

A useful and simple definition of a volunteer is: A person who contributes or donates his/her time, energy, and abilities to the production of a valued good(s) or service(s) without the incentive of remuneration. The term "remuneration" is used to indicate a monetary form of reward or compensation such as wages. It goes without saying that a volunteer does in fact receive benefits (psychological, etc.) for their effort. What the above definition does is eliminate the volunteer label where there are any direct *money* payments for rendered services.

A more specific and encompassing definition comes from David Horton Smith (1981, pg 22-23) who describes the volunteer as:

> **An individual engaging in behavior that is not bio-socially determined (e.g., eating, sleeping), nor economically necessitated (e.g., paid work, housework, home repair), nor socio-politically compelled (e.g., paying ones taxes, clothing oneself before appearing in public), but rather that is essentially (primarily) motivated by the expectation of psychic benefits of some kind as a**

> result of activities that have a market value greater than any remuneration received for such activities.

Notice that by the wording of his definition, monetary compensation is not explicitly excluded. Because there is significant variation among individuals' perceptions of the market value for a given activity, there is the potential for the situation where a person might be remunerated, over and above the amount of his/her expenses, for services rendered but that the amount of the payment might not equal what they perceive as a fair market value thus not qualifying the work as volunteered. Examples of this could be an individual serving a tour in the Peace Corps or a Lifeguard Instructor for the Red Cross. Regarding the amount of payment, they might better be regarded as a "low paid worker" rather than a "volunteer."

The former (simpler) definition allows the opportunity to look at what is referred to as "pure volunteers"[1] which are simply people receiving no monetary payment in any form whatsoever, for their donated time and energy. Concerning volunteer firefighters, the notion of remuneration can, at times, become clouded. Due to variations in volunteer fire department structure and composition it is unclear at times just what constitutes or should be considered a direct money payment for services. It may be that in some instances the simpler definition will suffice, but, in another situation Smith's more encompassing description is more relevant. For example, in many volunteer fire organizations, firefighters are paid a nominal fee ranging from two to five dollars when they respond to an emergency call. This could arguably be regarded as merely covering the volunteer's incurred travel expenses and not

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[1] Smith, David H. (1981). Altruism, Volunteers, and Volunteerism. *Journal of Voluntary Action Research*, 10, 21-36

considered a wage-based form of remuneration. A more ambiguous situation results when considering certain volunteer fire departments and Emergency Medical Response (EMR) team members who can receive hourly wages of between five and ten dollars when responding to a medical or fire emergency.[2] It might be argued that this latter form of remuneration represents a wage, albeit undoubtedly undervalued, and thus qualifies the EMR member or volunteer firefighter as a "low paid worker" rather than a "true" volunteer. For the remainder of this paper, the simple definition of a *volunteer* given at the beginning of this section will suffice and its reference during discussions will be assumed.

Volunteers can be found in all types of organizations. Volunteer input is noted primarily throughout the nonprofit sector[3] but is increasingly being found within public agencies. In a world where increasing demands are being made of local services and public budgets are being retrenched or, at least, constrained to the point of significant potential losses in quality control, the use of volunteers becomes a cost effective way to address optimal inconsistencies in service provision.[4] Indeed, were it not for the use of volunteers some programs would undoubtedly be incapable of maintaining their current levels of provision. Within the nonprofit sector the perception that employment of volunteer services represents an efficient resource or asset in the battle against costs has long been a staple input in their daily operations.

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[2] It should be noted that this situation is somewhat rare and that EMR personnel as well as volunteer firefighters in this situation are normally only paid for their time spent responding to a particular incident, *not* for time spent waiting at the station or on standby.

[3] Steinberg, Richard. (1990). Labor Economics and the Nonprofit Sector: A Literature Review. *Nonprofit and Voluntary Sector Quarterly*, 19(2), 151-169

[4] Brudney, Jeffrey L. (1990). Expanding the Government-by-Proxy Construct: Volunteers in the Delivery of Public Services. *Nonprofit and Voluntary Sector Quarterly*, 19(4), 315-328
Sundeen, Richard A. (1990). Citizens Serving Government: The Extent and Distinctiveness of Volunteer Participation in Local Public Agencies. *Nonprofit and Voluntary Sector Quarterly*, 19(4), 329-344.

Public governments have been adopting a similar strategy and are increasingly looking at alternative delivery approaches using volunteer labor.[5] In economic terminology this trend of joint cooperation between volunteers and government employees in the provision of public services has been given the label "coproduction."[6]

Prompting this interest in using volunteers are several valuable tangible and intangible benefits. The tangible advantages represent direct gains to the organization and take the form of a more cost-effective service delivery and a level of service more in line with it's demand. Another physical benefit of using volunteers is the chance to experiment with alternative delivery styles or policy methods without obligating a significant amount of resources or funds. In addition, the benefit of maintaining a qualified pool of potential applicants to choose from should a paid position become vacant represents yet another tangible reward.[7]

Intangible benefits are somewhat elusive and harder to quantify, but nonetheless are as much or more important than their physical counterparts. The most significant intangible benefits are the substantial amount of specialized skills and unique knowledge that volunteers bring to an organization. Dubbed "the volunteer differential,"[8] it can stand for the formal teaching experience and interpersonal skills brought to the local YMCA, the superior carpentry ability brought to a Habitat for Humanity building project,

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[5] Valente, Carl F. and Lydia D. Manchester. *Rethinking Local Services: Examining Alternative Delivery Approaches.* Management Information Service Special Report, Number 12. Published by International City Management Association, March 1984.
Comment in Brudney and Warren. (1990).

[6] Brudney and Warren, 1990, page 49.

[7] Brudney, Jeffrey L. (1990). Expanding the Government-by-Proxy Construct: Volunteers in the Delivery of Public Services. *Nonprofit and Voluntary Sector Quarterly*, 19(4), Winter, 315-328.

[8] Karn, G. Neil. (1982-3). Money Talks: A Guide to Establishing the True Dollar Value of Volunteer Time (Part I). *The Journal of Volunteer Administration*, 1(1), Winter, 1-17

or the mechanical aptitude of a person donating his/her time to the local volunteer fire department with equipment badly in need of a tune-up or repair. Brudney (1990) reveals yet another intangible advantage in his comment that volunteers "present the organization with fresh perspectives for evaluating existing practices and recognizing promising alternatives." Volunteers are not connected to the organization in the same fashion as paid employees and can point out operational inefficiencies as well as make suggestions without the fear of economically disabling consequences (e.g., being fired).

Recent history reveals volunteerism taking its current form beginning in the 1960's with the social reform movement (VISTA, Peace Corps, etc.) and received an additional boost from the fiscal stresses of the 70's.[9] The Reagan legacy of the early 80's attempted to reiterate this theme as evidenced in the President's comment addressing the ambition to "restore in our time the concept of voluntary service, of cooperation of private and community initiative."[10] The later half of the decade saw increasing emphasis being put on donations of both time and money. With the "Points of Light" campaign, sponsored by the Bush administration, came a renewed stake in the interest of volunteering. Although it was primarily marketed as an altruistic plan designed to bring strength back to the concept of "community", the motivations derived from the obvious dividends of alleviating fiscal stress around the country can hardly be ignored.

[9] Brudney, Jeffrey L. and Robert Warren. (1990) Multiple Forms of Volunteer Activity in the Public Sector: Functional, Structural, and Policy Dimensions. *Nonprofit and Voluntary Sector Quarterly*, 19(1), 47-58

[10] Originally quoted in National Civic Review, May 1983, page 262 and cited in:
Duncombe, Sydney. (1986). Volunteers in City Government: Getting More than Your Money's Worth. *National Civic Review*. September-October, 291-301.

In general, volunteers are found extensively throughout a variety of organizations and positions ranging from the highly complex to the simple. The role that they encourage and reflect within society represents an immense contribution to the efficient and effective provision of many social programs. In the 1987 Gallup Volunteerism Survey it was revealed that nearly 45.3 percent of the adult population in the United States had volunteered in some capacity to an organization.[11] Using the Gallup survey data, Hodgkinson and Weitzman, in a 1988 article for the Independent Sector, estimated the total amount of time donated to be 14.9 billion hours annually. To put this number into perspective, dividing it by 2080 hours (the number of hours credited as full-time-equivalent — FTE) equates the nearly 15 billion volunteer hours donated annually into nearly 7.2 million FTE jobs. In 1987 the civilian labor force was approximately 120 million. The number of FTE volunteer jobs constitutes nearly six percent of the total civilian labor force. Furthermore, regarding the figure mentioned above of 14.9 billion donated hours, if *everyone* (120 million people) in the civilian labor force were to volunteer then the annual hours donated per person would amount to 124 hours. To put this figure in weekly terms, the average volunteered hours would be 2.38 which is not an unfathomable amount. To add a further dimension, one can refer back to the total population volunteerism rate of 45.3 percent. In this case, considering again *only persons included* in the civilian labor force, the average weekly hours volunteered per person are effectively doubled and amount to nearly 5 hours a week. These

[11] Brudney, Jeffrey L. and Robert Warren. (1990)

figures serve to shed considerable light on the impact of volunteer services and the enormous level of benefaction received by society from their efforts.

Over the period from the mid 1960's to the mid 1980's both the consistency and level of volunteers has changed dramatically. Participation rates for women rose from 21 to 28 percent while for men it grew from 15 to 30 percent.[12] It used to be the case that volunteers were primarily women but, in recent decades economic conditions, such as the increased incidence of single parents or a household's need for two incomes to survive, have made it necessary for women to increasingly enter the workforce. At the same times, the feminist movement boosted women's ambitions to expand their educational and employment opportunities which has resulted in a significant decrease in the available level of time donations from the traditional "housewife" volunteers. In addition, work days were shrinking and work schedules were becoming more flexible which meant that an increasingly broader cross section of a working community would be available to volunteer.[13] With changes in employment history, families and lifestyles, and dramatic economic shifts over time, the composition of the pool of volunteers has become much more diversified and, in the process, has aligned itself with contemporary themes of equality of burden and access. In other words, women are no longer regarded as the primary target of volunteer recruitment. The volunteers of the 80's and 90's embody a complex and diverse mixture of individuals from all age groups, educational backgrounds, experience levels, and racial heritages.

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[12] Romero, Carol Jusenius. (1986). The Economics of Volunteerism: A Review. In "Productive Roles in an Older Society / Committee on an Aging Society." National Academic Press, pages 23-50.

[13] Handbook: Managing Volunteer Personnel. Included in material from a March 1990 conference in Missoula sponsored by the Montana Disaster and Emergency Services and titled "Developing Volunteer Resources."

What motivates a volunteer to donate his/her energy and talents is both an elusive and dynamic question.[14] Table 1.1 gives a chronological answer to the question "Why People Volunteer?" by utilizing periodic survey responses collected from 1969 to 1985. Generally speaking, the most popular reasons to volunteer continue to be the need to help others as well as an overall enjoyment and interest in the work. Interestingly, the use of volunteering to gain work experience that could be used to help obtain future employment realized an increase from 1 or 2 percent in the late 1960's and 70's to over 10 percent for the first half of the 1980's.

In economics the two basic models whose function it is to determine the incentives or motivations for volunteering are the Investment and Consumption models.[15] The consumption model simply posits that the donation of time is utility driven for an individual volunteer. In other words, a volunteer derives positive utility or a sense of satisfaction from the consumption of volunteered time. Consumptive aspects of volunteered labor are vast and different for each individual. For some people issues such as potential power and leadership possibilities provide the enticement to volunteer, while for others a more passive consumptive goods basket such as acceptance, sense of commitment, and feelings of usefulness is more relevant.[16]

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[14] In light of the emphasis of this paper the topic of donations of money is not considered nor discussed with the issue of volunteered time.

[15] Menchik, Paul L. and Burton A. Weisbrod. (1987). Volunteer Labor Supply. *Journal of Public Economics*, 32, 159-183

[16] Reddy, Richard D. and David H. Smith. (1973). Why Do People Participate in Voluntary Action? *Journal of Extension*, Winter, 35-40

TABLE 1.1 WHY PEOPLE VOLUNTEER

Commonly Cited Reasons	*Survey 1*	*Survey 2*	*Survey 3*	*Survey 4*
Wanted To Help Others	54 %	60 %	45 %	52 %
Find Work Interesting	29	49	35	36
Know Involved People	NA	16	23	26
Religious Concerns	NA	NA	21	27
Gain Work Experience	1	2	11	10
Wanted To Keep Busy	2	2	6	10
Help Keep Taxes Down	NA	NA	5	3

Surveys / Polls:

1. Lou Harris and Associates, Volunteers Look at Corrections, 1969.
2. ACTION, Americans Volunteer - 1974,75.
3. Gallup Poll, Americans Volunteer, 1981.
4. Gallup Poll, Americans Volunteer, 1985.

The investment model looks at the incentives for volunteering from a different perspective. Rather than regard the donated time as a "one shot deal" where benefits are consumed directly through the act of volunteering, the investment model develops the idea that "volunteer work is not a utility bearing good in itself, but rather is an activity that raises one's future earning power by providing work experience and potentially-valuable contacts."[17] In other words, volunteering provides a practical vehicle for obtaining useful work experience that can materialize into significant future employment gains. In all likelihood both models are probably applicable in some degree or percentage to an individuals choice of whether or not to volunteer and how many hours to donate. Some forms of volunteer activity are undoubtedly characterized more by one model than the other. For instance, volunteering to answer phones and do filing at the local YWCA is probably explained more through the

[17] From page 162, Menchik and Weisbrod, 1987.

consumption model, while a computer programmer's decision to volunteer his/her services to the task of automating the management of a city's property database presumably reflects an investment in valuable work experience. The pattern developed here is one where as a volunteer task becomes increasingly more technical the higher the chance that the primary motive for volunteering is investment based. Both the investment and consumption models serve as a valuable platform for understanding the mechanics of the decision to volunteer.

The emphasis of this paper is on the benefits and advantages of employing the services of volunteers in the provision of fire protection to Montana's rural communities. The overall thesis objective is to describe, quantify, and translate the tangible and intangible benefits into practical, valid, and convincing dollar estimates. Deriving a reliable measure of the economic value of these services will be accomplished through several methods.

1.2 Proposed Research

"Don't overlook the many capabilities of your firefighters. They can make a volunteer fire department the envy of career department administrators who sometimes have to plead for funds to buy advice that volunteer administrators get for nothing." — Dick Sylvia, American Fire Journal, August 1987

The study of volunteer fire organizations represents a unique challenge to deciphering the underlying mechanisms driving the perpetuation of fire protection service delivery by volunteers. Very little work has been done to estimate the value of volunteer labor contributions. Useful methods remain

scarce and are often subject to criticism. As was mentioned earlier, the main thrust of this thesis is to develop a method(s) to measure the economic value of volunteer services contributed to fire protection and prevention within the state of Montana. Looking at this one segment of the voluntary sector can help to control and minimize errors due to aggregating across different organizations which use volunteers. The task is to first describe where the voluntary sector fits into the general framework of goods and services analysis.

Volunteer fire organizations, claims of autonomy aside, have characteristics most similar to those of a public service agency. In fact, due to increasing costs, sources of funding are increasingly being generated from taxes levied on property rather than less stable means such as donations. The ability to assess property within a geographical area provides a fire department with the security of a relatively stable operating budget from year to year. In contrast, donations and fund-raisers tend to result in greater fluctuation of the annual level of funds generated and therefore constrain the delivery of fire protection services. In gravitating to this property tax form of fund generation, volunteer fire protection agencies adopt further the characteristics of a public good enterprise. In addition, the connection between the state government and the local volunteer fire department is strengthened by legal codes defining everything from how fire departments may collect their annual budgets to specifying the minimum training level an individual volunteer firefighter must complete every year.

The idea that volunteer fire departments have characteristics most similar to that of public agencies is neither more illuminating nor more

comforting because theories concerning public goods supply and demand have also been wanting. But, nonetheless it represents a logical starting point for analyzing a very distinctive and previously understudied sector of "public-like" good provision.

The study of the voluntary nonprofit sector is more difficult because traditional laissez-faire capitalist theories fail to provide accurate models of behavior. Theories of efficient provision of goods and services by the private sector emphasize the effectiveness of the market mechanism. By allowing supply and demand forces to interact the market price adjusts continually to ensure an allocation and distribution of goods and services that effectively reflects the preferences of the market players.[18] Unfortunately, whether all or some of the assumptions made for private firm behavior are applicable to the public arena is debatable and requires more study. This problem is magnified further when trying to explain the operating behavior of volunteer run organizations which, while retaining characteristics most similar to that of the public good providers, still maintain an important degree of structural and organizational autonomy.

For the public and voluntary/nonprofit sectors, there either exists no valid market or an inefficient one at best by which to reveal an accurate measure of product worth or value. The reasons for this shortcoming are found within the definition of public goods and services. To retain such a classification, a good or service must satisfy the properties of nonexcludability and nondiminishabilty. The former characteristic maintains that the costs of

[18] It should be noted that this concept includes the strong assumption that income, which serves to gauge the ability to purchase goods as well as the willingness to pay certain prices for them, is distributed normally and equitably.

excluding or preventing certain individuals from consuming a particular good or service are either impossible to conceive or so expensive as to render it impractical. The latter concept simply posits that one person's consumption of the good or service does not diminish or lessen another individual's ability to consume at the same level. It should be noted that almost no good or service meet the criteria mentioned above one hundred percent, but, rather that they are explained in significant proportion by these conditions.

It is the lack of an adequate market price mechanism to accurately reflect buyer and seller preferences that creates problems in explaining and valuing such goods and services. Through the inability to exclude persons from consuming a good or service and the nondiminishabilty factor, there results an individual incentive not to pay for a public good while still receiving it's benefits. This occurrence is known as the "free rider problem" and is a primary reason why goods and services are provided by public governments rather than through private modes of provision. As a result of this difficulty, public goods and services tend to be underproduced which further hinders an accurate valuation of their welfare and the price of their output.

1.2.1 THE DATABASE

To derive a good measure of the economic value contributed by volunteer firefighters to the provision of fire protection services in the state of Montana, these and other factors need to be addressed. The proposed methods to estimate economic value where an inadequate market exists will use a database compiled from a recent survey of volunteer fire departments in

Montana.[19] Information compiled from the survey focused on three major areas. The first was "membership" which provided details about active member firefighters such as their age, years of experience, extent of special training, and time spent on fire-related activities. "Equipment" was the second area emphasized. It furnished valuable information on the number of fire protection engines or equipment, their type or classification, age, and whether it was purchased new or used.[20] Lastly, data was collected on "organizational" characteristics which included distinctive features such as type of organization, area and population served, yearly budgets and their respective sources, mutual aid agreements, people and equipment expected to be present on a "standard response", and ISO (Insurance Services Organization) fire rating. The ISO rating is an indexed number designed to measure the fire-fighting capability of a particular organization and serves as a natural proxy for the quality of fire protection services provided by a particular fire department.[21]

From this survey data, the first task will be to detail the extent or size of the volunteer ranks within volunteer fire departments. This can be done initially by analyzing the survey sample with respect to membership data and then extrapolating to the entire state of Montana. This serves the purpose of providing a reliable foundation for quantifying the value of efforts contributed by volunteer firefighters.

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[19] Survey conducted by Dr. Michael Kupilik and the author in February, 1991.

[20] Whether equipment is purchased new or used is an important distinction when concerning the capital assets held by volunteer fire departments. Because many organizations survive on fixed or limited budgets their search for reliable equipment necessarily includes the "previously owned" or used market for fire protection engines and supplies.

[21] The ISO number can range from 1 to 10 with 1 being the best rating possible and 10 meaning essentially that there are no fire protection services available within a particular area.

1.2.2 METHODS AND MODELS TO DETERMINE ECONOMIC VALUE

This information base compiled from the survey makes it possible to derive the value of volunteer firefighting efforts in the state of Montana. Two different methods of approach will be used. The first approach involves measuring the economic value or worth of volunteer firefighters not just in terms of volunteer firefighter numbers but rather incorporating factors such as training and response times into the equation. This method attempts to isolate the marginal contribution made by the average volunteer firefighter.

The second method of approach involves estimation of an econometric model of the derived input or factor demand equation for volunteer labor. It is derived in the sense that a volunteer fire department's demand for firefighters comes from the community's demand for fire protection services. The derived demand curve estimated within this paper will attempt to explain variation in the level of volunteer firefighters (the dependent variable) by variations in departmental characteristics (e.g. number of engines, number of fires, annual operating budget, availability of training, and ISO number, and so on), socioeconomic attributes (e.g. assessed property value in region, median family income, etc.), and demographic factors (e.g. population and area served by the fire department).

The crux of the problem with estimating such a demand function for volunteers is how the salary or wage variable is specified. For employment in the private sector and, to an extent, in the public sector, a wage or price variable for labor is fairly accessible, but, volunteers receive a zero wage for their efforts.[22] This is problematic since standard economic theory postulates

that, for efficiency and cost minimization to be considered relevant, the marginal wage rate of labor should be equal to it's marginal contribution. Following this logic, if a volunteer receives a zero wage rate it consequently then implies that their marginal contribution or marginal product of labor is also zero. This is quite likely to be untrue because the actual value of volunteer labor is in fact a positive number whether or not someone incurs that cost. The question then becomes how to adequately measure the value of a volunteer firefighter's contribution to a fire department.

One strategy for approximating the marginal product for volunteer firefighters, where no adequate market exists, is to impute a shadow wage or salary variable. Since data was collected on the department (not individual firefighter) level, the imputation is essentially an average wage calculated for each fire department. The difficulty is in devising an imputation technique that creates for each department a specific average salary or wage measurement that thoroughly accounts for the individual characteristics and differences among fire departments. A heroic task indeed, but, nonetheless one necessary if successful estimation of the derived demand curve remains the goal.

With the derived demand curve estimated it is then possible to determine the value of the total benefits donated to the state of Montana by volunteer firefighters. This is accomplished by using the area under the derived demand schedule. The measure of the area underneath the curve and to the left of the actual quantity of volunteer labor supplied represents, in theory, the total benefits or total consumer surplus derived by the state of

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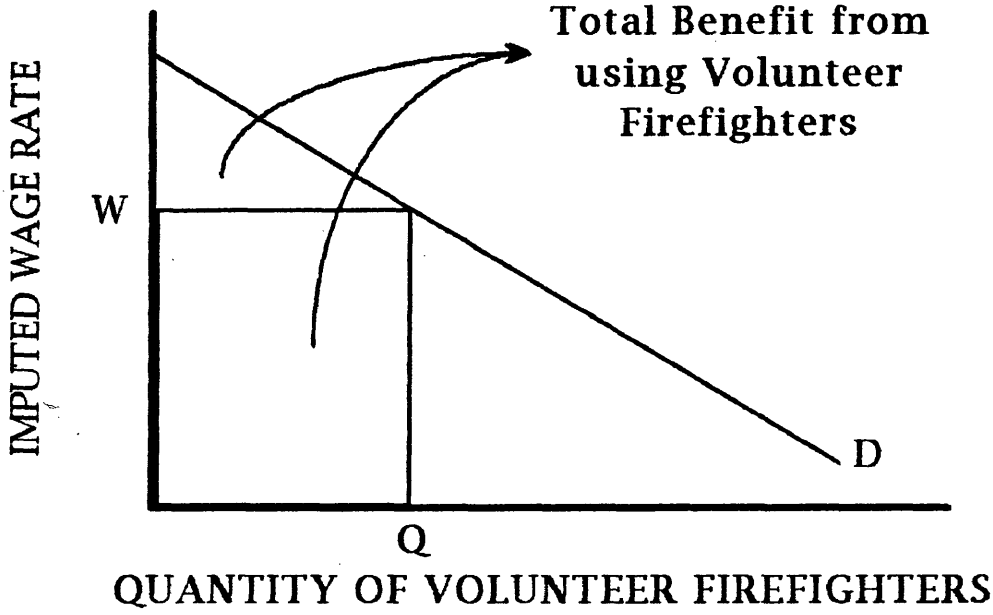
[22] Weisbrod, B.A. and P.L. Menchik. (1987). Volunteer Labor Supply. *Journal of Public Economics*, 32, 159-183

Montana from the utilization of volunteer labor in the provision of fire protection services. Graphically, this area is depicted in figure 1.1 below.

FIGURE 1.1 HYPOTHETICAL DERIVED DEMAND SCHEDULE



This thesis will compare the two techniques of calculating the value of the benefits contributed by volunteer firefighters, detailed previously in this section, by comparing and contrasting each approach with respect to it's statistical validity, robustness, and accuracy.

1.3 Expected Research Findings

Intuitively, due to Montana's vast geographical area combined with it's relatively small population and economy, its not surprising that the number of volunteer fire protection organizations is quite large. The rural nature or

make-up of the state illustrates the low tax base throughout different regions and the resultant need for volunteer fire departments. Most areas in Montana realistically lack the necessary resources and abilities to maintain a paid fire department but are still able to support a very well-equipped volunteer fire department largely because of the contributions from volunteer firefighters. Indeed, it was revealed through a survey of paid fire departments[23] in the state of Montana that labor costs can consume anywhere from 83 to almost 93 percent of their operating budget. This figure alone does much to illustrate the benefits to be realized through the use of volunteer labor in the provision of fire protection services. These intuitions imply that any measures of the economic value contributed by volunteer firefighters to Montana should be considerable.

The main indicators of the validity and relevance of the regression based approach are the sign and significance of the imputed wage coefficient, statistical strength of the model, and the magnitude of the area under the integrated derived demand schedule. The benefit of this method over the first is it's ability to account for more variables and better reflect the true economic value of volunteer firefighting services. Furthermore, problems or inconsistencies with the wage imputation technique are plausible culprits for inconclusive results derived from both methods. With no "tried and true" method advanced through recent studies it is difficult to say with confidence which wage imputation tactic embodies the most correct approach. It is

[23] This survey was conducted in April/May of 1992 by the author. It included similar questions asked of volunteer fire departments in an earlier survey done by Dr. Michael Kupilik and the author but was structured so as to obtain certain features and characteristics of paid agencies in more detail such as budget cost and response type breakdowns.

possible that the results may indicate that other variants of this strategy as well as entirely new methods be employed to better analyze this complex element of the voluntary sector.

It should be noted that a significant portion of this thesis is to be essentially descriptive in nature. Topics to be explored include the magnitudinal impacts, structural concerns, and organizational characteristics of fire service provision within Montana. All these areas of investigation will emphasize an economic perspective such that the underlying issues of public goods and labor demand and supply will dictate the narrative depiction of the conditions driving and forming the current configuration of volunteer fire protection services in the state of Montana.

1.4 Thesis Organization

This thesis is divided into six chapters with three appendices arranged and detailed as follows:

Chapter 1 - Introduction

> This is the introductory chapter which presents the principal thesis topics and provides a general background in public, nonprofit, and voluntary sector economics as well as a thorough portrait of current and past trends in the use of volunteers.

Chapter 2 - Volunteer Fire Organizations and Fire Protection in Montana

> In this section the structure and organization of volunteer fire departments in the State of Montana is thoroughly outlined and detailed. Everything from classification typology to relevant legislation is discussed.

Chapter 3 - Literature Review and Theoretical Perspectives

> The literature review will encompass all pertinent articles and books detailing both their contributions and weaknesses. In

addition, this section will cover what theoretical concerns need to be considered, their relevance, and impact on this study.

Chapter 4 - Data Sources and Descriptives

This chapter reveals where the necessary data for this paper was collected as well as it's potential strengths and weaknesses. Also provided are summary measures describing and detailing the role and magnitude of volunteer fire departments and firefighters in Montana.

Chapter 5 - Modeling Methods, Applications, and Results

The two techniques of deriving a value for volunteer firefighting services in Montana are explained, calculated, and tested with regards to adequacy and validity concerns.

Chapter 6 - Conclusions and Recommendations for Future Research

This chapter assesses the value of the results and posits ideas on how future gains in economic analysis of the voluntary sector might be accomplished. It will also explore any important policy implications.

A comprehensive bibliography is included detailing the entire range of resource material utilized for this thesis. Appendix A reproduces the survey questionnaire and appendix B contains a complete variable definition list. Finally, appendix C includes a complete list of fire departments in the state of Montana arranged by organization type (e.g. Rural Fire District, Volunteer Fire Company, Fire Service Area, Volunteer Fire Department, etc.).

Volunteer Fire Departments In Montana

Volunteer fire departments in the United States are often associated with the traditional themes of modern day volunteerism and public service. Incorporated within their structure and operations are strong beliefs in community, altruism, and solidarity. In addition, volunteer fire agencies symbolize "democracy, patriotism, and grass roots organizational autonomy."[1] Primarily, these organizations are located in less populated rural areas and small towns. Local or rural government jurisdictions often have neither a large enough tax base nor the necessary citizen demand to warrant a paid fire department, therefore, an alternatively organized fire department that runs efficiently and cheaply using volunteer labor is a cost effective, well valued, asset to the community. It is just within the last 20-30 years that volunteer fire organizations have been receiving the recognition and respect they deserve. In addition, within the last twenty years there has been a reorganization as well as an evolution in the structure of volunteer fire departments. Not only has the equipment available to volunteer fire agencies become safer and more efficient but, also, the organizational standards for volunteer firefighters has grown to include a significant amount of required technical training in fire, chemical, and medical related emergency response tactics. Volunteer fire organizations and their member firefighters all over the country are increasingly responding to a

[1] Jacobs, A.H., 1976, and Perkins, K.B., 1987.

wider variety of incidents, receiving training comparable to paid fire fighters, and doing far more than just "putting the wet stuff on the red stuff."

To provide visual and empirical support for the extent and magnitude of the fire services provided by volunteers, as well as, paid firefighters in the United States, table 2.1 gives the responses of 38 states to a survey on fire service demographics. There was a total of 29,755 fire departments and 1,079,087 member firefighters for the states responding to the survey. These numbers translate into an average of 783 fire departments per state with the average number of firefighters per department equaling 36.27. These figures denote the inclusion of paid firefighters, but with that accounted for, the averages reported from these fire service demographics are consistent with the data collected for this thesis. One shortcoming of the above mentioned survey was that the difference between the definition of P.O.C. (Paid-On-Call) and Volunteer Firefighters was not standardized and therefore it was felt that some states may have inappropriately miscounted the number within each group. It is likely that a good portion of those classified as P.O.C. would, in reference to the definition outlined in chapter one, be regarded as volunteer firefighters. This assumption is due to the fact that while it is true that many volunteer and volunteer/paid fire agencies offer some form of compensation for the efforts of their volunteer members, the amount of the payment is generally quite limited. Payments serve more as a helpful recognition of service or as a recompensation of travel expenses rather than as a remuneration designed to reflect the marginal value of a volunteer firefighter's donated time. Using this form of payment to delineate a firefighter as Paid-On-Call would not be legitimate and

may misrepresent the firefighter's true service motives in the context of the definition of Volunteerism as explained in chapter one.

TABLE 2.1 FIRE SERVICE DEMOGRAPHICS

STATE	*# FD'S*	*#FF'S*	*%PAID*	*%VOL*	*%P.O.C.*	*%METROS*
Alabama	1,000	30,000	10	90	0	3
Alaska	218	5,600	10	0	90	3.5
Arkansas	830	15,000	10	90	0	2.4
California	1,200	56,000	59	41	0	n.i.
Colorado	400	12,500	34	66	0	25
Connecticut	340	30,000	20	80	0	5
Florida	1,100	48,000	33	67	0	n.i.
Georgia	970	37,272	35	65	0	11
Hawaii	9	1,582	100	0	0	62
Idaho	260	5,000	12	88	0	2
Illinois	1,250	44,000	20	80	0	11
Indiana	953	28,000	5	80	15	4
Iowa	886	25,000	7	93	0	2
Kansas	780	13,200	20	80	0	6.8
Kentucky	757	17,573	10	90	0	5
Louisiana	563	25,000	20	80	0	7
Maine	475	12,000	10	90	0	n.i.
Massachusetts	371	23,000	50	5	45	15
Michigan	1,044	29,750	18	0	82	6.2
Minnesota	822	20,000	10	0	90	4.1
Mississippi	559	8,526	25	75	0	n.i.
Missouri	900	23,000	20	80	0	n.i.
Montana	370	7,600	5	95	0	n.i.
Nevada	190	12,500	15	85	0	10
New Jersey	794	38,343	17	82	1	4
New Mexico	300	7,000	5	87	8	2
New York	1,863	135,000	15	84	1	10.8
North Carolina	1,285	45,000	6	94	0	0.8
North Dakota	408	9,000	0	n.i.	n.i.	3.3

STATE	# FD'S	#FF'S	%PAID	%VOL	%P.O.C.	%METROS
Ohio	1,260	45,000	25	75	0	7.8
Oregon	350	11,000	20	80	0	9
Pennsylvania	2,600	125,000	3	97	0	2
South Carolina	650	18,000	20	80	0	0
Tennessee	600	18,000	n.i.	n.i.	n.i.	22.2
Texas	1,912	53,291	30	70	0	n.i.
West Virginia	437	10,750	9	91	0	0
Wisconsin	891	30,000	25	50	25	n.i.
Wyoming	158	3,600	10	90	0	n.i.
TOTALS →	29,755	1,079,087				

Source: Survey conducted by Gerald E. Monigold, Associate Professor and Director of the Illinois Fire Service Institute at the University of Illinois, for the Administrative Study of State Fire Training Programs. This table was part of several pieces of information sent by FEMA (Federal Emergency Management Agency) located in Emmitsburg, Maryland on December 16, 1991.

Notes:
1. #FD's means total number of fire departments (paid and volunteer).
2. #FF's means total number of fire fighters (paid and volunteer).
3. P.O.C. means total number of fire fighters classified as "paid-on-call."
4. n.i. means "not indicated."

Suffice it to say, though, that the results do indicate a significant involvement and contribution made by volunteer firefighters to the provision of fire protection and prevention services throughout the states surveyed. Skipping the likely outliers of Massachusetts and states reporting zero volunteer firefighters, the average percent of volunteers[2] employed per state was 80%. Individual state percentages of volunteers ranged from 41% reported by California to 97% for Pennsylvania. It is worth noting that Montana ranked 2nd highest among the responding states with 95%.

[2] This measure reflects the ratio of volunteers employed in the delivery of fire protection and prevention services to the total number of firefighters within a state.

2.1 Classification System For Fire Protection Agencies In The State Of Montana

To begin the task of assessing the impact of volunteer fire organizations on the state of Montana's fire protection system, it is necessary that a clear picture of the fire industry's organizational structure be drawn. There are six classifications of fire departments in Montana. The comprehensive list includes:[3]

[1] Volunteer Fire Company (VFC)
[2] Volunteer Fire Department (VFD)
[3] Rural Fire District (RFD)
[4] Fire Service Area (FSA)
[5] Paid Fire Department (FD)
[6] County Rural Fire Department

2.1.1 VOLUNTEER FIRE COMPANY (VFC)

The Volunteer Fire Company (VFC) label delineates fire departments formed in an unincorporated area by filing a Certificate of Organization with their respective County Clerk. In contrast to unincorporated, an incorporated city or town means simply that some legally recognized form of government has been organized. Examples of the powers of such an organized municipality are:[4]

- Enact ordinances and resolutions;
- Sue and be sued;
- Contract with persons and/or corporations;
- Pay debts and expense;
- Borrow money;
- Hire, direct, and discharge employees.

A VFC represents the organization of a group of people and some firefighting equipment, but, has no legal jurisdiction and essentially no tax base. The term

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[3] List and definitions obtained from Kelly Close, Department of State Lands, Coordination Center in Missoula, Montana.
[4] Taken from Montana Codes Annotated (MCA), Part 41, Municipalities, Section 7-1-4124

"essentially" is used because it is possible for a VFC to be part of, or belong to, a Rural Fire District (RFD) and, therefore, indirectly realize a small tax base for budgetary fund derivation. Ignoring this possibility, generating the annual budget to cover the years expenses for a VFC must stress creativity and is accomplished primarily through the use of fund-raisers that attempt to illicit donations of "money, materials, and manpower."[5] VFCs tend to be relatively small departments with only one engine or pumper truck per company. The unincorporated area or town population they serve is also limited; typically consisting of less than a thousand outlying residents.

2.1.2 VOLUNTEER FIRE DEPARTMENT (VFD)

VFD is the label given to a volunteer fire agency formed within an incorporated city or town. It should be noted that all first and second class cities[6] must, by law, have a paid municipal fire department. MCA[7] Section 7-33-4109 provides an exception to this rule such that it allows second class cities to supplement their paid fire department(s) with volunteer firefighters and Volunteer Fire Departments. Due to Montana's demographic dispersion, VFD's are primarily formed within third class cities and towns. A VFD, through the city's governing body, has the capability to levy a tax on the property within the incorporated district which allows the department access to a reliable source of annual funds. As you might expect, VFDs are found in larger cities

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[5] Montana Department of State Lands, Manual #606, Volunteer Fire Companies, written and compiled by John Pilsworth, Rural Fire Forester.

[6] Classification of Municipalities, MCA Part 41, Section 7-1-4111:
First Class >> Every city having a population of 10000 or more,
Second Class >> Every city having a population of less than 10000 and more than 5000,
Third Class >> Every city having a population of less than 5000 and more than 1000,
Town >> Every municipal corporation having a population of less than 1000 and more than 300.

[7] MCA stands for Montana Codes Annotated; containing all the legal codes for Montana.

and towns with respect to VFCs and generally have a greater number of volunteer member firefighters and a larger inventory or array of firefighting equipment.

2.1.3 RURAL FIRE DISTRICT (RFD)

Related to the VFC but conceptually different, the Rural Fire District (RFD) designation refers to a fire department that is formed in an unincorporated area. According to MCA 7-33-2101:

> **The Board of County Commissioners is authorized to establish Fire Districts in any unincorporated territory or town upon presentation of a petition in writing signed by the owners of 50% or more of the privately owned lands included within the proposed district, who constitute a majority of the taxpayers who are freeholders of such area and whose names appear on the last completed assessment roll (state, federal, and county land can be included in the district acreage but not in the 50 percent requirement).**

The basis for this appellative is founded in the annual need by volunteer fire organizations to generate a consistent and sizable operating budget. The concept of the RFD was designed to address the shortfalls and operational inability's of Volunteer Fire Companies. In fact, it is the case in Montana that VFCs are increasingly upgrading to an RFD or FSA (Fire Service Fee Area, to be detailed next) classification specifically to expand and improve their firefighting capabilities. Unlike VFCs, Rural Fire Districts have the capability to levy a tax on the property determined to be contained within it's jurisdictional boundaries. In this sense the RFD parallels the Volunteer Fire Department. The primary intention of the RFD title is to provide unincorporated communities with a vehicle by which to raise the necessary funds to cover their yearly fire protection costs. It should be noted that both a RFD and VFD do not have to be

an actual firefighting unit, but rather, can essentially just represent a funding entity through which third-party contracted fire protection may be procured.

2.1.4 FIRE SERVICE AREA (FSA)

A relative newcomer to the scene is the Fire Service Area (FSA). Conceived and legislated within the last 5-10 years, it was intended to address the deficiencies of Volunteer Fire Companies, as well as, the potentially unfair representation of certain citizens in the petition for developing a Rural Fire District. Fire Service Areas are organized pursuant to MCA 7-33-2401 where it states:

> Upon receipt of a petition signed by at least 30 owners of real property in the proposed service area, or by a majority of the owners of real property if there are no more than 30 owners of real property in the proposed service area, the Board of County Commissioners may establish a fire service area within an unincorporated area not part of a Rural Fire District in the county to provide the services and equipment set forth in 7-33-2402.

Similar in function to VFDs and RFDs, FSAs are set up to facilitate area residents with two options regarding the provision of adequate fire protection services to a community. The Fire Service Area can be an actual firefighting organization or can serve merely as a funding entity designed to raise funds used to contract out fire protection services with another agency.

Derivation of funds under FSAs is conceptually different than the process used by RFDs and VFDs. An FSA assesses an annual fee on the structures within the designated service area. In contrast, the RFDs method is to levy a tax on the property determined to be in the district. The assessed fee is a flat rate on structures whereas the tax levied on a parcel of property is calculated with regards to that property's taxable valuation. One might argue

that the FSA fee charged to residents is essentially a tax of sorts and they would be right to a degree. But, for the intricate and often irrationally complex world of accounting, it is not regarded as a tax.

The benefits of the Fire Service Area classification over the VFC and RFD designations are several. First, in the process of petitioning the County Commissioners to approve the formation of a Rural Fire District, the requirement that the owners of 50% or more of the land within the proposed fire district must sign the petition gives individuals holding large tracts of land/acreage disproportionate power in affecting the final decision of whether a fire district should be pursued. This can lead to problems of equal representation regarding decisions involving new fire equipment purchases and new levies. To counterbalance the scales more equitably, petitioning for the establishment of a Fire Service Area requires that only 30[8] (not 30 percent) of the owners of real property in the proposed boundary must sign the petition. This decree empowers a wider degree of residents over decisions to initially form a FSA ,as well as, over future choices to upgrade fire equipment. But, as a shortfall, it is fairly easy to demonstrate that the flat fee charged to residents owning real property under a Fire Service Area will be inherently unequal and regressive in nature. Currently, given the structure and way fees are assessed under a FSA, the taxes levied within a RFD are more equitably distributed. The reason the burden distribution under a RFD is more fair stems from the case where as the land and property owned increases, reflecting both a rise in the property holder's potential loss and ability to contribute his/her share of the

[8] It should be noted that the figure of 30 is unaffected by the individual amounts of acreage owned by any one property holder. Also, this need be only a majority of owners of real property if there are no more than 30 owners total of real property in the proposed service area.

burden, so too does the amount they are taxed. To cite a real life example, a Fire Service Area located in eastern Montana charges each resident, judged to be within the jurisdictional boundaries, an annual fee of $45.00 per structure. To use an extreme case, the inequality under the Fire Service Area fee assessment process stems from the instance where a house valued at over a million dollars is charged the same rate as another one valued at $75,000. In contrast, under a Rural Fire District the tax bill would be allowed to increase as the number of structures or improvements and acreage owned by an individual or business grew. A major criticism is that the fee structure under a Fire Service Area does little to address the issues of "ability to pay" or the "benefit principle."[9]

Although there is the opportunity to develop a graduated fee scale such that the fee associated with a particular structure could be weighted by it's taxable value, it doesn't appear that this will be the case in the near future as most of the FSAs currently maintain a more or less straight fee assessed on the structures within it's jurisdiction. To be fair, though, a set fee on every structure provides a very efficient, low cost method of assessment collection. The only information needed to compute a property holder's liability is the number of structures to be protected on his/her land.

Despite it's weakness' the primary benefit realized under a Fire Service Area is founded within it's ability to circumnavigate I-105.[10] With the constraints of I-105 coupled with burgeoning costs, as well as a rising demand

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[9] Musgrave, Richard A. and Musgrave, Peggy B. *Public Finance In Theory And Practice* (McGraw-Hill, Inc., 1989). Fifth Edition, Chapter 13, pages 218-232

[10] I-105 was a referendum, passed by the Montana legislature, that froze the level at which property within the state could be taxed.

for public services, budgets throughout the state of Montana have been increasingly pressured to become more and more creative about their funding sources. The growing demand for fire protection services is a real phenomenon due, in part, to the rise in value of man-made structures and natural resources.[11] Since the assessed fee is not a tax by the accounting definition, it does not fall prey to the restrictions imposed by I-105. Therefore, the Fire Service Area undoubtedly looks quite attractive to the County Commissioners faced with visually declining resources, growing demands for services, and a budgetary source that is declining in real terms every year.

The fee charged by a FSA can also grow from year to year to meet the changing demands put on the local volunteer fire agency. RFDs unfortunately were hit fairly hard by I-105. In fact, the Missoula Rural Fire District, the largest Rural Fire District in the state of Montana, was forced to make severe retrenchments in the spring of 1992.[12] Until they finally passed an initiative allowing the property tax to increase within their district, further cutbacks were assuredly eminent. It was a tense time for all involved — the residents, volunteer firefighters, and paid firefighters (who stood to lose their jobs!) — and attested to the strain fostered by the cap on property taxes.

2.1.5 PAID FIRE DEPARTMENT (FD)

Rounding out the classification system utilized in the state of Montana, the Paid (municipal) Fire Department (FD) refers to fire departments employing

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[11] Department of State Lands, Fire Suppression Manual #800 and #900, particularly section 900.03 "Cooperative County Fire Suppression Guidelines."

[12] In addition to being adversely affected by I-105, the Missoula Rural Fire District lost part of it's tax base to recent property annexations by the city of Missoula. The Missoula City Fire Department subsequently assumed fire protection coverage over the annexed property.

some, if not all, paid firefighters. There are ten fully paid fire departments in Montana found in the first class cities (see footnote six for description) in Montana. In addition, there are an estimated 10 to 20 fire departments found primarily in second class cities that maintain a mix of volunteer and paid firefighters. The level or number of paid personnel varies in a fire department utilizing volunteer labor in conjunction with paid firefighters. Some have only a paid chief and an assistant, while others maintain a chief, assistant and enough paid firefighters to staff an entire shift. They often cover the day shift as it is always harder to forecast the number of volunteers who might respond to an emergency in the daytime hours of 7am-6pm because of jobs and job related engagements. This type of fire department is not of primary concern for the purposes of this thesis, but, when necessary, topics pertinent to the discussion, such as a contrast between paid fire departments and volunteer fire organizations, will be elaborated.

2.1.6 COUNTY RURAL FIRE DEPARTMENT (CRFD)

Last is the designation of the County Rural Fire Department which will be referred to as CRFD, although there is no widely accepted acronym known. CRFDs denote a county-wide organization set up for state/county cooperative fire protection efforts. They can include members and equipment already claimed through existing fire departments, service areas, or districts. They are called to service in times of need — for example, a major forest fire that was threatening a significant amount of structures. The benefits of this cooperative relationship are advantageous to both the county/state government as well as

to the volunteer fire organization. The state donates refurbished firefighting equipment to needy fire agencies in return for the agreement by those departments to respond to fire-related emergencies or provide firefighting apparatus if so requested by the state.

2.2 Structural, Organizational, And Legal Considerations

2.2.1 Structural Dimensions

All fire departments have their organizational composition influenced by several factors:[13]

- Number of certified member firefighters;
- Number and type of equipment or apparatus;
- Size of area protected;
- Type of Protection;
- Qualifications of the firefighters;
- External variables.

For the purposes of this discussion, VFCs, VFDs, RFDs, and FSAs will comprise the main focus.

Volunteer Fire Companies (VFCs), in comparison with the other types of departments, are the most diverse in their structural operations primarily because they experience the most variation in the factors listed above. The number of member firefighters, as well as, the number and type of firefighting equipment for VFCs within Montana can fluctuate significantly. Volunteer Fire Companies can range from a homemade fire truck with an irrigation pump and a few untrained volunteers to fairly sophisticated companies sporting several firefighting trucks (maybe even one purchased through the county cooperative

[13] Detailed within the Department of State Lands Manual, #606, "Volunteer Fire Companies," section 606.3, page 4.

fire agreement program) in decent shape and a well-trained volunteer firefighting crew numbering in the mid twenties.

Rural Fire Districts and Fire Service Areas, being conceptually similar but maintaining different fund generation practices, have generally less variation in their structural characteristics as compared to VFCs. Rural Fire Districts are formed in larger communities with a considerable tax base and typically have a larger number of trained volunteer firefighters. Other characteristics associated with RFDs include several fire engines for use in a variety of applications and a sizable area protected under their jurisdiction. In addition, there is a host of external variables affecting the provision of fire protection services by RFDs ranging from dirt roads, limited or no hydrant use, and substantial dispersion of property within their boundaries. FSAs being relatively new have not had time to offer any general descriptions to be made. Further discussion of the FSAs structure is postponed until chapter four.

VFDs often limit their effective fire protection boundary to specifically include just the property determined to lie within the city's jurisdiction in which the VFD is located. In this sense, VFDs often maintain smaller protection boundaries than RFDs, VFCs, and FSAs, but, operate among a more dense pattern of residential and business structures. An exception to this rule are coexistent volunteer fire agencies that have evolved in several areas where the boundaries of the RFD and VFD ran up against one another. In essence there was just one large fire department which served both the residents within the incorporated city or town and, also, the population residing in the unincorporated area lying outside of the city limits. These departments are

quite well off and seem to thrive on their dual role within the community. Often, either the VFD or the RFD owned and controlled the fire equipment and fire hall. The organization maintaining little control or ownership contracted out with the other for their fire protection. This consolidation allowed the purchase of high quality fire engines with greater pumping capacity and also saved on training costs for volunteers because only one set of firefighters was used to provide service to both the incorporated and unincorporated regional areas. Furthermore, only one fire hall was needed so costs for additional housing were eliminated.

2.2.2 Training and Equipment Requirements

As mentioned earlier, required training and expectations for volunteers has been steadily expanding. Today's emergency scene has become complicated by intensifying medical responsibilities, toxic and hazardous chemical materials, and the increasingly technical delivery of traditional fire protection services.

Currently, in Montana, the annual required minimum amount of training for a member volunteer firefighter is 30 hours. Upon formal documentation of this training the volunteer firefighter is credited with one year of service. The number of years of credited service is used to calculate a volunteer's pension award amount when he/she retires. With the tremendous increase in fire departments becoming "First Responders" to medical emergencies, an entirely new and additional arena of training has emerged. In paid fire departments it is essentially mandatory to complete the EMT (Emergency Medical Technician)

course. This class requires a significant investment of time and energy. Many volunteer firefighters are now taking the First Responder course which is the precursor to the EMT class but takes half the time to complete. It takes 60-70 hours to complete the First Responder course and 110-120 hours to finish the EMT class. The number of volunteers qualifying as EMT has also been steadily increasing. In addition, a four hour HazMat (Hazardous Materials) class is now essential training for new volunteers. Such major investments in training time reveals the serious tone and considerable value generated by the volunteer firefighters in the state of Montana.

Concerning adequate firefighting equipment, Montana's volunteer fire organizations are, in general, well outfitted. Of all the fire departments that the author has seen, heard about, and talked to in the process of writing this thesis, the recurrent theme was one of significant community support enabling the department to acquire a array of fire apparatus sufficiently exceeding the recommended minimum standards. When purchasing fire apparatus, it is always advisable to buy new if at all possible. This may be closer to reality for some volunteer fire agencies since recent legislation has expanded on the ability of the County Commissioners to sell bonds. Under MCA 7-33-2109, the newly added section states:

> **A Rural Fire District may borrow money by the issuance of bonds to provide funds for the payment of all or part of the cost of buying or maintaining fire protection facilities and apparatus, including emergency response apparatus, for the district.**

This legislation provides RFDs with a means to purchase quality fire equipment through the authorized sale of Bonds. No longer will RFDs have to forego acquiring needed equipment or safer, more efficient, and technologically

advanced fire apparatus due to the inability to raise the initial funds. Ultimately, the ability to issue Bonds could bring a whole new face to the delivery of fire protection services in rural Montana.

Undoubtedly, buying new is not an available option to everyone, so in their case the recommendation is that they acquire, as a minimum for structure protection in an area without fire hydrants, an engine (truck) with a 300 gallon tank and 500 GPM pump.[14] In rural areas where fire hydrants are often nonexistent, it is recommended that at least a 1000 gallon water tender and a portable tank, to be used in water shuttling operations, be purchased.

2.2.3 Mutual Aid Agreements

MCA 7-33-2108 defines a mutual aid agreement as "an agreement for protection against natural or manmade disasters." Mutual aid agreements can be entered into by the fire district trustees with other legally recognized fire fighting authorities or agencies. Essentially they are specific agreements detailing under what conditions the agreement takes effect, what equipment and how much manpower will be sent, and to what effect will their role consist of. The relevant list of authorities with which mutual aid agreements may be entered includes:

1. Other fire districts;
2. Unincorporated municipalities;
3. Incorporated municipalities;
4. State agencies which have fire-prevention services;
5. Private fire-prevention agencies;
6. Federal agencies.

[14] If there is fire hydrant hookup capability, then the minimum standard increases to a 750 gallon tank.

2.2.4 Insurance Programs / ISO Ratings

Obtaining insurance, particularly liability insurance, continues to be difficult. For already financially strapped volunteer fire agencies, if it is possible at all, the cost of acquiring such insurance is usually quite expensive. But, with questions of liability and the specter of significant litigation costs insurance can represent a worthwhile investment. Good Samaritan Laws do protect volunteer firefighters from being liable for their actions during a fire or medical emergency for most situations. But there have been several cases where a volunteer fire department or firefighter has been found negligent and significant legal costs assessed against the department.

ISO stands for Insurance Services Organization. The ISO is responsible for developing the fire rating that is associated with a particular fire department. The Fire Protection Rating has a range of 1-10. A rating of 10 means that there is essentially no organized fire protection within an area. With a rating of 10, insurance would be extremely expensive. Paid fire departments usually fall in the range between 3-5. VFCs on the other hand, often get ratings of 10-8. They just don't have the necessary equipment or efficient, plentiful water source to help lower their score. RFDs and VFDs hover between 6 and 8 mostly. They are more well-equiped than VFCs and usually can utilize a semi-efficient source of water whether its through a small number of fire hydrants or just using large water tenders and portable tanks.

An interesting note was passed along from Angelo Petroni, retired volunteer Fire Chief of the Terre Verde RFD, who related his experience with the ISO rating and the ability to carry insurance on their fire department. As

the ISO rating for a fire department drops from 10 to 8, the fire agency will be able to realize the greatest decrease in insurance premiums. When Terre Verde RFD dropped from a 10 to an 8 rating they could nearly double the amount of insurance carried for the same price. Alternatively, the drop from 8 to 5 doesn't result in as significant a decrease in premiums or increase in the amount of coverage that can be carried at that price.

2.2.5 Volunteer Fire Fighters' Compensation Act

To round out this discussion of volunteer fire organizations in the state of Montana, it is worthwhile to address the Volunteer Firefighters Compensation Act (VFCA). The VFCA can also be referred to as a Length of Service Award Program (LOSAP). LOSAP is a more general term and pertains to the whole range of benefit programs rather than those associated only with volunteer firefighters.

The VFCA is a pension program designed to provide retirement and disability benefits to member volunteer firefighters belonging to fire departments located in unincorporated regions or communities in Montana. The original intention of this award program was to recognize the extent of volunteer firefighter efforts in the delivery of fire protection services to rural Montana. In Montana the VFCA was legislated into existence in 1973 with a monthly benefit amount of $50.00 paid to a retiring volunteer firefighter having 20 years of recognized service. From there the monthly pension award amount fluctuated from year to year reaching a maximum of $142.76 and

ending at the current amount of $120.00. Currently, the monthly benefit amount is set once every two years.

The popularity of Length of Service Award Programs have been on the rise. In addition to Montana, many other states have enacted similar programs for volunteer firefighters or are in the process of drafting length of service award legislation. This recent popularity has occurred for several reasons. First, due to expanding demand for fire protection services, as well as growing expectations and a steadily increasing number of training requirements, the difficulty in recruiting and retaining qualified volunteers has increased greatly. Secondly, considering the magnitude of the benefits derived within communities having volunteer fire organizations, it is argued that pension benefits are a just and reasonable reward in response to the effort put forth by volunteers.

LOSAPs are seen as a valuable instrument for eliminating possible firefighter drains within volunteer fire departments. They increase the supply of potential volunteers by providing an enticement for a larger number of interested persons to join. In addition, LOSAPs are an incentive for current member volunteer firefighters to remain with the fire department by increasing their opportunity cost of leaving (i.e. the value of his/her lost pension benefits). In situations where programs rewarding volunteer service are established, experience has shown there to be resultant increases in both the number of new volunteers interested in becoming members and the number of retained qualified volunteer firefighters.[15] LOSAPs also encourage member volunteers to

[15] Wyrwas, David F. Volunteer Compensation: Small Reward For A Big Commitment. *The International Fire Chief*, June 1984, 27-28

invest in better training which will make them more productive. They offer an excellent vehicle with which to partly recompense volunteer firefighters in light of the savings accruing to the community from their donated time. Lastly, these award programs serve to expand the quality of fire protection services supplied to a community.

Literature

This study of volunteer fire departments combines several economic theoretical approaches. Of primary importance are the postulates of labor economics. Deriving an estimate of the value of volunteer firefighter services contributed to Montana requires an analysis of the labor market interactions for volunteers. Appropriate attention to volunteer firefighter demand and supply determinants as well as the reasons and incentives for volunteering is essential to fully address the merits of labor economic theories in explaining the case at hand. In addition, public sector and urban economic analysis apply directly to volunteer provision of fire protection because such services are most notably similar in form to collective or publicly provided services. Of particular concern are the approaches to valuing public goods and services where there exists no effective market by which supply and demand can interact and, thus, reveal or determine a measure of purchase price. Lacking such a direct market, as is often afforded private goods and services, proxy measures proposed through urban and labor economic theory must be examined as to their applicability and robustness when applied to the market for fire protection delivery through modes utilizing volunteer labor.

This chapter will address the related literature as it pertains to Labor Economics and Public Sector analysis. Unfortunately, concerning general volunteer issues and characteristics, there has been a significant lack of hard

empirical attention paid by the economics field[1], therefore, the range of related literature material was sufficiently broadened to include similar paid firefighter issues. Theoretical concerns relevant to this paper will be explored regarding their specification, interpretation, and application. It is hoped that such a composite review of diverse literature will provide adequate depth as well as shed considerable light on the yet untried task of estimating the value of volunteer firefighter services to the State of Montana.

3.1 Studies On Paid Firefighters And Government Provision Of Fire Protection Services

The subject of paid government provision of fire protection will be addressed first. Such studies were available in greater numbers and contained many useful theories and methods. The derived labor input demand model specification used in this thesis was taken from Trejo (1991) which dealt with unions in the public sector and their resulting effects on the level of municipal employment within police and fire departments.

Public[2] production of fire protection occurs primarily because of failures by the private sector to be an efficient supplier. There are two primary reasons for this failure.[3] First, collective provision of fire protection is necessary due to market deficiencies such as the relatively high cost or inability of legally excluding free riders (those individuals or groups who would derive benefit from a public good or service while circumventing or neglecting to pay their share of the provision costs). Secondly, the aspect of nondiminishability —

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1 The available *economic* literature specifically relating to volunteer firefighters was essentially nonexistent.
2 "Public" in this context is synonymous with local government.
3 Often referred to as the "nonexcludability" and "nondiminishability" criterion for labeling Public Goods or Services.

where one person's consumption of fire protection, for the most part, does not detract from or lessen the ability of others to consume fire protection services in equal amounts — further provokes consumers to understate their true demand because they can receive the same level of benefits regardless. Nondiminishability is largely due to the random nature of major fire emergencies. Seldom does a second fire erupt while one is already in progress therefore the assumption of nondiminishability characterizing fire protection seems reasonable. This is especially true for rural communities where volunteer fire organizations are primarily located. Rural settings are characterized by a lower degree of residential and commercial building crowdedness. In contrast, metropolitan settings have a higher building density.

In addition to the two primary indicators of public involvement, the supply of fire protection can result in a natural monopoly which implies that it should therefore be regulated. It is often quite inefficient for more than one producer to furnish a collectively defined good or service because the added cost to the public from supporting two or more bureaucracies each maintaining its own management hierarchy causes higher average production costs. Also, the natural monopoly results from further inefficiency costs incurred by developing a complex system of boundaries designating geographical areas served by either one department or another, as well as conflicting interdepartmental policies and regulations. Fire protection for an entire town, especially in small rural communities, is furnished most notably by one agency.

Ahlbrandt (1973) provides an interesting argument against the natural monopoly. He contends that without sufficient competitive forces or at least the "threat" of possible competition, local fire departments do not always reflect the communities' preferences and can be inefficient. His reasoning is derived mainly from political and bureaucratic tendencies towards excessive budget growth and slow new-technology utilization rates.

Peter Steiner alludes to the fundamental reasons why certain public services such as fire protection are provided collectively rather than through a private producer with the statement:

> **For private goods there is a market through which individuals can make their effective demands for goods felt, and in the context of an enterprise system whenever the aggregate of such individual demands warrant, there is incentive for private producers to meet these demands. Collective goods differ in that (as we have seen) private markets fail to respond to real effective demands; thus collective action is required to satisfy individual demands. The devices of government can provide the form of collective action that substitutes for private markets in channeling resources to meet the aggregate of individual demands.[4]**

The benefit or incentive for local, county, and state governments to either actively provide the service in question or simply subsidize it's production is derived from their ability to finance "public" goods or services by levying taxes[5]. By eliminating the free-rider problem, this process can more effectively account for consumer preferences than a private firm could.

Unfortunately, there is a major disadvantage with studying public services, especially fire protection. Empirically quantifying a reliable and efficient measure of output is often elusive and tenuous in its ability to accurately represent all the pertinent inputs in the production process. This is

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[4] Peter Steiner, 1977, The Public Sector And The Public Interest, In the book *Public Expenditure And Policy Analysis*, edited by Robert H. Haveman and Jullius Margolis, 2nd edition, Rand McNally, pg 41.

[5] Browning, Edgar K. and Jacquelene M. Browning. *Microeconomic Theory And Applications.* Scott, Foresman And Company, 3rd Edition, 1989, pg 584-600.
Ahlbrandt, Roger S. *Municipal Fire Protection Services: Comparison Of Alternative Organizational Forms.* SAGE Publications Inc., 1973.

especially true for fire protection because the proper output measure should reflect the losses prevented by a fire department. In an mathematical representation of this idea forwarded by Malcolm Getz (1979), the output for a fire department is generally described by:

$$\text{Quantity of Fire Protection} = E\left[\text{Loss W/O Fire Dept}\right] - \text{Actual Cost}$$

The inherent problem with measuring the level of fire protection stipulated in the above equation lies in the question of how to empirically measure the loss that would occur without a fire department to provide protection, or in other words, how to measure something that might have happened but didn't.[6] Throughout the literature there was no clear consensus on the specific form of a valid proxy variable and, instead, several different measures were often used. But, as the upcoming discussion will point out, the ability to utilize various output proxies may be more of a benefit than a weakness for the econometric ability to derive robust estimates of public sector parameters concerning fire protection.

The next two subsections will detail several aspects of the literature dealing with the delivery of fire protection services by bureaucratically organized and directed paid fire fighting entities.

3.1.1 Demand And Supply Of Paid Fire Protection Services And Paid Firefighters

Demand and production concerns were the most researched topics in the literature regarding fire protection services delivered through departments

[6] Hirsch, Werner Z. *Urban Economic Analysis.* McGraw-Hill, 1973, pg 317.

utilizing paid firefighters. Of primary interest are studies or papers by Southwick and Butler (1985), Vernez (1976), Ehrenberg (1973), and Trejo (1991); all of which will be discussed in turn. Other valuable papers not covered within this chapter include Chaiken and Rolph (1971), Schwab and Zampelli (1987) and Duncomb (1991). In addition, several articles, not dealing directly with fire protection but rather the demand and supply of public goods and services in general, including Borcherding and Deacon (1972), Ohls and Wales (1972), Perkins (1977), Deacon (1977), and Grosskopf and Hayes (1983, 1986), made significant contributions to the overall understanding of public sector demand and supply analysis.

Southwick and Butler (1985) conducted a simultaneous demand and supply analysis of fire protection in a sample of 65[7] major U.S. cities. They criticize previous studies for using only one fire loss measure and for employing ordinary least squares (OLS) estimating techniques. To make the empirical analysis sensitive to data quality differentials several fire loss measures were employed in their analysis rather than just one. In addition, to address any resulting inaccuracies or biases from OLS, they utilize two stage least squares (2SLS) regression analysis to account for any endogenous relationship between the determinants of the estimated demand and supply equations. Of interest is their argument for using firefighter hours to reveal community demand and the number of fires per capita to accurately proxy the output of a fire department. Findings from their study included a potentially significant bias entering previous research that failed to properly account for

[7] This sample reflects data collected from 65 out of the 95 largest cities in the United States.

simultaneity between the demand and production relationships. In addition, using several fire loss measures provided the authors significant flexibility in developing models with the sensitivity to address any data quality differentials[8]. Unfortunately, there is a significant drawback to these results. With the data collected from a sample of the largest cities in the United States, it's inferential capability is limited or relevant to only a select group of cities having similar characteristics.

Vernez (1976) is an older paper but contains useful summaries of public sector analysis literature, as well as, a list of possible explanatory variables to be used within public good demand and supply models. The list of potential variables for the supply side are broken down by service output quantity and quality, input factor prices, and service conditions. Considering the demand side, the variable list is organized into categories emphasizing community fiscal capacity, community tastes/preferences, intergovernmental revenues, rate of population growth, and political factors and fragmentation.

Vernez cites a statistical procedure worthy of endeavor but not yet undertaken in the literature beyond his 1976 survey. A previous study had a large number of demographic and socioeconomic measures and successfully used factor analysis to reduce 20 variables down to just 7 primary categories. From this technique, one can generate a summary set of indices from a large number of variables and use these directly within a regression model.[9] This is potentially very beneficial whenever concerns over necessary degrees of

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[8] They make this contention by positing that variables serving as significant predictors of all the fire loss measures are likely to be better explanatory gauges than inconsistent predictors.

[9] This valuable procedure was brought to my attention by Professor Rod Brod in a graduate social statistics class.

freedom arise due to a limited sample size and large number of collinear explanatory variables.

In addition, Vernez mentions another study that attempted to estimate a derived labor input demand equation for police officers. Per capita police labor was regressed on wage, per capita property value, several per capita crime rate variables, employment in manufacturing, public transportation use rates, population, and area measurements. The R^2 was 0.49. Surprisingly, the wage variable was not statistically significant. Although comparatively simplistic by today's econometric standards it provided helpful hints as to the nature and shape of a factor demand relationship.

The classic Ehrenberg (1973) study attempted to show the changes in police and fire fighter wages due to union efforts and, also, the type of municipal government structure, e.g. city manager, commissioner, or mayor. Of particular interest in relation to this thesis topic, was his discussion on the derived demand for firefighters. Ehrenberg describes the derived demand relation as a "function of the price of the service, the communities 'tastes' for the service, and the communities ability to pay." His list of independent variables to be included within the derived demand model is still quite popular as was evidenced in most all of the related public sector employment demand studies done since then.

Echoing the tenets of Ehrenberg was Trejo's (1991) reexamination of the positive effect of public sector unions on municipal employment. Within the econometric designs of the paper, Trejo empirically develops structural

estimates of the derived demand for police and fire protection workers. His model specification for labor demand is:

$$\log(Employment) = \eta_i \log(Salary) + \delta_i Unionization + \beta_i X + \varepsilon_i$$

The subscript "*i*" differentiates between police and fire protection estimates. "X" represents a vector of demographic and socioeconomic variables. With R^2 measures of .846 for police and .751 for fire fighter employment, this model was well supported by the data. This was ultimately the model specification used, albeit with a few modifications, within the designs of this thesis. The two largest tests of using Trejo's model are devising and using a wage imputation technique for volunteer firefighters and whether variables relevant to paid firefighters are equally significant when applied to volunteers.

3.1.2 Efficiency And Cost Concerns

When considering the labor input value in the production of a public good or service, it is valuable to assess the efficiency of a certain agency with respect to how well it minimizes operating costs and employs resources in the most productive combinations. Getz (1979) compiled an entire book entitled "The Economics of the Urban Fire Department." It was thoroughly researched and well written. Essentially, Getz conducted an efficiency study of fire departments. He concentrated on the human element — firefighters — because "when full-time firefighters are used exclusively, labor costs including fringe benefits may exceed 90 percent of the total costs of fire service delivery."[10]

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[10] Getz (1979), pg 15.

With such a pivotal role as well as a high price tag, Getz contended that studying utilization patterns among firefighters is quite useful for determining the overall effectiveness of the fire department in meeting the community demands put on it. He used ordinary least squares (OLS) as well as two stage least squares (2SLS) regression analysis to measure the degree in which fires and the estimated value of the damages due to fires are explained through changes in demographic and fire department characteristics. 2SLS is employed to address the potential simultaneity bias indicated in the discussion of Southwick and Butler (1985). Getz found evidence that the structure of traditional fire departments may be inefficient. Likely sources of inefficiency include the slow adoption rates for new technology by the fire protection industry, poor administrative management of fire protection agencies, and a factor input utilization rate linked to an availability of funds rather than it's related productivity.

Before Getz, Ahlbrandt (1973) estimated the empirical cost function facing bureaucratically controlled fire departments to address concerns of efficiency. He found evidence of inefficiency. And in support of Getz, the source he cites as the culprit is the bureaucratic nature of managing the fire protection industry. He suggested that "real benefits to the community"[11] could result from the privatization of fire protection services. In deference to the tenets of economic theory positing fire protection as most efficiently provided through bureaucratic agents, he used Scottsdale, Arizona as a model case. The local government in Scottsdale contracted their fire protection needs through a

[11] Ahlbrandt, Roger S., 1973, Efficiency In The Provision Of Fire Services. *Public Choice*, 16, pg 15

private firm at the time of his study. He essentially compared a fully paid public fire protection system to a fully paid privatized system. Ahlbrandt supported his contention by empirically showing that the Scottsdale private contractor could attain cost advantages over a bureaucratic fire department of approximately 47 percent. He further said that the Scottsdale fire department adopted new technology at a faster rate than their bureaucratic counterparts and, also, actively developed new fire fighting equipment that was unique to the demands of their local emergency fire situations.

3.2 Volunteer Labor Resources And The Provision Of Fire Protection Services

Primarily the literature dealing with issues concerning volunteers, in the general sense, was largely descriptive in nature. Of these, there was a fair number of papers discussing varied topics from who and why people volunteer to the aspiring role in society of the voluntary sector. Regarding volunteer firefighters and volunteer fire protection agencies, the amount of available research was significantly smaller.

3.2.1 General Volunteerism Issues

Steinberg (1990) provides an fair review of the literature, regarding volunteerism, completed to date. His concern is with labor economics and its impact on explaining the utilization of volunteer labor by various organizations, especially those within the nonprofit sector. Essentially he posits that little has been done in the way of empirically estimating the demand for volunteer labor and, unfortunately, he is correct. Very limited research has

been initiated thus far and the topic remains quite fertile for study. In contrast, research on the supply of volunteer labor has been slightly more pronounced. In particular, Steinberg notes the respected studies by Menchik and Weisbrod (1981, 1987). Concerning the economic value of volunteer labor, he makes a valid point in noting that compensation imputation methods or shadow wage determinations must be careful to distinguish "whether they are talking about the opportunity cost[12] of donor time, the value of volunteer production to the firm[13], or the social welfare value (which incorporates both concepts)." This issue will be discussed further in section 3.2.3.

A recent topic that has been gaining momentum is the idea of "coproduction." Essentially it is one facet of the "government-by-proxy construct."[14] Volunteer labor is used in staffing responsible and independent positions. Volunteers work together with bureaucratic officials to efficiently deliver certain local goods or services. Using volunteer labor can help a public agency maintain consistent production levels and help lower or, at least, stem the tide of large cost increases. With this potential benefit arising at a time when budgets are being retrenched and product or service quality is shrinking, many local governments are finding renewed optimism. Papers covering this topic include Saidel (1989), Brudney and Warren (1990), Brudney (1990), and Sundeen (1990).

Other important works emphasizing the economic perspective on volunteerism include Gassler (1990), Sundeen (1990), Menchik and Weisbrod (1987), Romero (1986), Wolozin (1974), and Stinson and Stam (1976).

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[12] The wage given up by volunteering instead of working.
[13] The marginal product contributed by the volunteer to the organization's production process.
[14] Brudney (1990).

3.2.2 Volunteer Fire Departments And Volunteer Firefighters: Structure And Organizational Characteristics

Articles specifically dealing with Volunteer Fire Protection Agencies were in short supply. In fact, only 6 papers were found that primarily emphasized volunteer fire departments and their member firefighters. Of those six, four were sociological studies and two were quasieconomic. "Quasi" is used to indicate that the economic base underlying the paper's tenets is not strongly stated nor very clear. The reason for mentioning this lack of related literature is to bring further attention to the underresearched nature of this subject matter.

Perkins (1989, 1990), a sociologist, has probably done the most complete research, to date, regarding volunteer fire departments. He primarily studies volunteer firefighters with regard to sociological issues such as autonomy, integration, norms, power, and community. From a sample survey totaling 3188 volunteer firefighters, Perkins developed a table of average firefighter attributes. This table is reproduced in table 3.1. Since the surveyed firefighters were from 250 fire departments randomly selected from the states of Alabama, Delaware, Minnesota, Oregon, and Texas, the empirical averages given in table 3.1 should be fairly representative of the country as a whole. In fact, data collected for this thesis reported that the average age and years of service for volunteer firefighters in Montana were approximately 40 and 9½ years, respectively. Its encouraging that Perkins reports similar age and years of experience measures, from his sample data, of 36.9 and 10.1, respectively. Bear in mind that this numerical comparison reflects only the averages for male volunteer firefighters. On the whole, his data indicate that volunteer

firefighters tend primarily to be white males in their mid to upper thirties with either some college experience or having graduated from high school.

In addition to his valuable firefighter demographic data, Perkins also collected fire department characteristics. Departmental size averaged 36 members and typically most (97% of those reporting) of these were responsible for protecting "small cities with populations between 10000 and 49999." Finally, the annual mean number of fire calls was 150.

In Perkins (1990), the subject matter is broadened to include not just volunteer fire protection agencies but, also, Emergency Medical Service (EMS) corporations. His data regarding fire departments is largely drawn from Perkins (1989). One interesting point, that has failed to make its way into the current literature, is the changing face of fire department responsibility. Perkins alludes to this by discussing the increasing demands being put on volunteer firefighters and EMS units to be trained in responding to more and more complex and sometimes dangerous emergency situations. He views the volunteer, in all situations whether medical or fire protection capacity, as an extremely valuable asset to the community and in light of the budget recessions facing most local governments, he suggests that utilizing community volunteers in constructively designed coproduction teams and agencies represents a tool by which localities could provide public goods or services into the future while minimizing losses in output quantity and quality.

The two other papers of interest were Lenard, et.al, (1981) and Burns and Guidry (1983). The first study simply attempted to forecast the likely need or demand for a certain level of fire protection within a geographical area and

then suggest the relevant equipment needed, i.e. fire truck and other apparatus, and it's ensuing cost or burden to be assessed on the community. The second article summarized descriptive statistics characterizing nonmetropolitan municipal volunteer fire departments in Louisiana. A particularly interesting summary measure, for volunteer departments protecting cities with a population less than 3000, was that the yearly equipment purchase and maintenance costs comprised 42 percent of all operating expenditures.

This supports the common intuition that a volunteer fire department's expenditures are largely opposite compared to a paid fire department. Paid agencies realize most of their annual expenditures through labor costs in the form of wages and fringe benefits. Volunteer departments, on the other hand, incur their greatest costs through equipment purchases and maintenance since labor is essentially free.

There are some trends that may be closing this gap. With increasing demand expectations being put on volunteer fire departments to maintain fairly extensive, complex training requirements there will be a need for these departments to offer some sort of incentive to retain their qualified firefighters. The incentive being adopted rather rapidly throughout the various states is the Length Of Service Award Program (LOSAP) which most often takes the form of a volunteer firefighter's pension plan. A pension plan results in greater costs being shouldered by the local community. It is in this sense that labor costs for volunteer fire departments may be on the rise. The extent of this potential increase is a good question to be considered in future research.

TABLE 3.1 CHARACTERISTICS OF VOLUNTEER FIREFIGHTERS

Characteristic	Average Age	Average Years of Service	% of Total	Total # of Firefighters
Sex				
Male	36.9	10.1	96.7%	3,079
Female	35.2	4.1	3.3%	106
Race				
White	37.1	10.1	96.3%	3,064
Minority	31.8	5.7	3.7%	119
Level of Education				
Grade School	49.9	12.9	1.7%	54
Some High School	39.3	11.7	6.9%	221
High School Graduate	36.9	10.5	42.9%	1364
Some College	35.4	8.9	34.1%	1,084
College Graduate	36.2	9.1	10.4%	330
Graduate School	41.7	9.9	4.0%	128
Occupation				
Managers, Administrators, Professionals	38.9	11	19.4%	606
Technical, sales, Support	36	9.4	16.8%	523
Service	35.8	9.4	12.2%	380
Farming, Forest, Fishing	37	7.5	2.8%	86
Production, Craft, Repair	35.9	9.7	23.3%	726
Operators, laborers	35.7	9.2	19.3%	602
Other	43.2	12.9	6.3%	196

Source: Perkins, K. B. 1989. Volunteer FireFighters in the U.S.: A Descriptive Study. *Nonprofit And Voluntary Sector Quarterly*, 18(3), (Fall), pg 269-77

3.2.3 Determining A Value For Volunteer Firefighter Service Hours

Measuring the economic worth of a volunteer fire fighter's service hours is a tenuous process. There are three different perspectives[15] that can aid in the determination of occupational worth: Value to society; Fair return on Human Capital; and Economic value added. A description of each is contained within figure 3.1 which was reproduced from Greene (1989). Although for the focus of this thesis study, the Economic value is of primary importance, other valuation approaches are presented to indicate that these alternative methods may lead to potentially different determinations. It could be that the measured economic value added is lower than the value to society, if it were known. A primary reason behind this possibility lies in the economic measurement technique not having the ability to capture the value of public externalities resulting from the production process. The economic value would be less than the value to society if it failed to accurately account for any benefits resulting from positive externalities. This is a realistic situation because often the external benefits are intangible and quite difficult to quantify.

Two useful studies dealing with the imputation process of determining a value for nonmarket time were done by Leuthold (1981) and Ferber and Birnbaum (1980). Both detail the two popular approaches — Market Cost and Opportunity Cost — used to assign a wage or price measure to nonmarket production or jobs not having explicit markets of determination. The first method establishes a price measure by looking at what it would cost to hire someone to do the work in question. The second uses the potential wage that

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[15] Greene, Robert J. Determinants Of Occupational Worth: Understanding The Elements That Define Job Value. *Personnel Administrator*, August 1989, pg 78-82

could be earned by an individual in the labor market as a means of valuing their nonmarket time.

For the designs of this thesis, the market cost method of imputing a wage scale for volunteer firefighters was applied. Essentially this amounted to the use of paid fire fighter wages in valuing volunteer fire fighter service hours contributed to the community. Data necessary to attempt the opportunity cost approach required more individual-specific information than was available at the time of this study.

Two articles[16] responsible for contributing the technique employed to impute a shadow wage measure for volunteer firefighters within this thesis came from Karn (1983). Karn endeavors to develop a thorough method capable of accurately and consistently quantifying "the value of volunteer contributions." Within his "equivalency model" or "true value assessment process", Karn recommends that "the true value of volunteering be fixed at the fair market value or purchase price of parallel paid services." The benefit is that this process establishes a value of the actual volunteer time contribution rather than measuring what the person or volunteer could be earning in the paid labor market. In other words, it develops a value that isolates the worth of the job and all it's requisite requirements while minimizing the variations that might arise from individual volunteer quality differentials which would assuredly impact the process within the opportunity cost approach framework. Be careful not to confuse the volunteer quality differential, mentioned above,

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[16] The two papers are:
Karn, G. Neil. Money Talks: A Guide to Establishing the *True* Dollar Value of Volunteer Time, Part I. The Journal of Volunteer Administration, 1(1), Winter 1982/1983, pg 1-17
Karn, G. Neil. Money Talks: A Guide to Establishing the *True* Dollar Value of Volunteer Time, Part II. The Journal of Volunteer Administration, 1(1), Spring 1983, pg 1-19

Figure 3.1. Categories of Occupational Worth

VALUE TO SOCIETY
Defined as contribution to society's welfare

Determined by:
- ✓ Social priorities.
- ✓ Relevance of work to social priorities.
- ✓ Visibility of work.
- ✓ Imputed importance to society.

FAIR RETURN ON HUMAN RESOURCES
Defined as sufficient return to convince adequate number to make investment

Determined by:
- ✓ Difficulty of attaining.
- ✓ Cost of attaining.
- ✓ Opportunity cost.
- ✓ Specificity of application.
- ✓ Who pays for acquisition.

ECONOMIC VALUE ADDED
Defined as marginal contribution of labor to product value

Determined by:
- ✓ Technology.
- ✓ Organizational size/industry.
- ✓ Labor/capital substitution function.
- ✓ Labor as a percentage of total costs.
- ✓ Criticality of skills.
- ✓ Level/elasticity of product demand.

Source: Greene, Robert J. Determinants Of Occupational Worth: Understanding The Elements That Define Job Value. *Personnel Administrator*, August 1989, pg 78-82

with the "volunteer differential." The former refers to *individual* volunteer differences such as education or experience levels, while the latter concept addresses the benefits derived by using volunteer resources, as a *whole*, to facilitate the provision of a certain service or good.

Regarding the "True Value Assessment Model" forwarded by Karn, there are essentially eight steps to consider. The description of this process coincides with figure 3.2.[17] Steps I and II entail determining which paid job classification is most relevant and then including it's base yearly salary and hourly wage. Step III involves calculating the total amount of the Fringe Benefits received annually through the paid job being used as an equivalent position. Fringe benefits are important within the construct of valuing volunteer service contributions because they represent a significant portion of the worth of an equivalent job classification. Karn argues that neglecting their impact would seriously underestimate the true value of volunteer services. Step IV sums the annual base salary and the total value of any fringe benefits to derive a measure of the total annual compensation package.

From there, steps V, VI, and VII establish the yearly standard number of work hours characterizing the equivalent position in question and, also, distinguish between those hours actually worked and the hours not physically worked but still paid. The process subtracts the hours that are paid but not worked from the total hours to determine the number of physically worked hours within the period of one year. This figure is desirable because volunteers do not get paid holiday, sick, or personal leave days off. Finally, step VIII determines the actual imputed hourly wage rate to be used in valuing volunteer service hours. Within this thesis, this process will be used to determine the appropriate shadow wage that should be applied to volunteer firefighters. This will be the variable used for representing the purchase price within the derived

[17] Source: Karn (1983), pg 17 (Part I and II).

Figure 3.2. True Value Assessment Computations

I. Choosing An Equivalent Paid Classification

_____

_____

II. Annual Salary For Equivalent Paid Classification

Salary	_____
Hourly Wage	_____

III. Value Of Benefits Package

FICA	_____
Retirement	_____
Health Insurance	_____
Life Insurance	_____
Workman's Compensation Insurance	_____
Other Benefits: _____	
_____	(+) _____
Total Value Of Benefits	(=) _____

IV. Value Of Total Compensation Package

Annual Salary	_____
Benefits Package	(+) _____
Total Annual Compensation	(=) _____

V. Established Annual Work Hours For Agency

_____ Hours/Week × 52 Weeks _____

VI. Hours Paid But Not Worked Annually

Annual Leave	_____
Paid Holidays	_____
Paid Sick Leave	(+) _____
Total Hours Paid But Not Worked	(=) _____

VII. Hours Actually Worked Annually

Established Annual Hours	_____
Hours Paid But Not Worked	(+) _____
Actual Annual Work Hours	(=) _____

VIII. Total Imputed Hourly Wage Rate

Total Compensation(÷)Actual Annual Work Hrs (=) _____

Source: Karn (1982-83), page 17, part I and II.

input demand model used in Trejo (1991).

Concerning the value of volunteer firefighter services, one last article deserves attention. Wagner (1990) conducted an accounting exercise in determining the tax savings accruing annually to the State of Delaware due to volunteer fire protection agencies. Essentially, he assesses the extent to which fire protection services are provided through volunteer efforts and then evaluates the cost that would be incurred by converting all the volunteer fire departments into state-operated paid fire departments. His results indicated that a significant increase in property taxes would be necessary to effect such a transformation.

Unfortunately, Wagner's methods and conclusions are open to criticism. To be fair, this approach does give one an upper bound with which to assess the impact of volunteer fire protection services. But such a measure assuredly overestimates the actual value being contributed by volunteers. The primary reason for this is due to the erroneous application of the proposed transformation. In other words, in most, if not all cases, the community would never consider such a drastic measure in the first place and would either refuse to pay such a large tax increase[18] and accept the added risk of being unprotected or would relocate to regions where their preferences were better represented through the local tax structure. In essence, the criticism is that such a conversion of volunteer fire departments to paid is unrealistic in nature and it is therefore hard to think of Wagner's results as "savings." In more

[18] Wagner's (1990) results indicated that such a statewide conversion would cost a person owning a $75000 dollar home approximately $427.50 more each year.

appropriate wording, his results should indicate that "volunteers add services worth 'X' amount of dollars"[19] annually.

3.2.4 Length Of Service Award Programs And Rewarding Volunteer Firefighters

In 1973 Montana enacted the Volunteer Firefighter's Compensation Act. It serves as a pension plan remunerating volunteer firefighters after the completion of a set number of dedicated service years.

For the most part, the literature concerning volunteer firefighter pension issues was positive. Most articles largely attempted to support the contention that LOSAPs serve to help alleviate the exodus of skilled volunteers due to greater work and training pressures as well as the increasing dangers inherent in the work environment. This is, in fact, the most often cited reason for enacting LOSAP legislation. Many fire departments point to volunteer retirement compensation as being the primary weapon used to retain qualified firefighters. Volunteer fire departments often have significant investments, such as training costs, in certain members. In addition, further support is provided by the argument that LOSAPs are just or well-deserved rewards for a long career of public service.

There has been a trend towards reduced volunteer firefighter enrollment in the last ten years. Despite a strong "spirit of volunteerism.....there are signs that manpower is down."[20] Wyrwas (1991) points to the increasing need by volunteer fire departments to carry liability insurance. In addition, training requirements made of volunteers are approaching levels present in paid fire

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[19] Karn (1982), pg 3.
[20] Wyrwas, David F. *Handbook on Recruiting and Retaining Volunteers.* September 1991.

departments. Volunteer firefighters provide a near indispensable service and therefore policies such as Length of Service Award Programs deserve attention and respect by the benefiting community.

Other articles praising the merits of volunteer firefighter pension plans include Saly (1983) and Garza (1991). Gus Welter, a charter member of the Bloomington (MN) Fire Department and secretary of the Minnesota State Association of Volunteer Firefighters, sums up the general sentiment in his comment that turnover rates among members belonging to his fire department for longer than five years have stabilized in Bloomington and that most people leaving the organization do so within three to four years of their initial inception. He attributes much of the faltering exodus to the lucrative Bloomington Length of Service Award Program.

Interestingly, Perkins (1989) attempted to measure which characteristics or attractions motivated volunteer firefighters to join a department. There were five categories of interest, one of which included pensions, benefits, and income advantages. This particular category received the smallest number of responses with only 0.8 percent of the respondents listing it as their first reason for volunteering as a firefighter. But one has to question whether response bias might have been a factor since one of the other optional categories included "service to the community." Its quite likely that there might be a higher propensity to list "service" as a primary incentive because of the altruistic character commonly used to describe volunteers. So the respondents could have answered the question putting unfair weight on what

they perceived as the politically correct answer rather than list a monetary incentive which could contradict the original theory of volunteering.

The issue remains whether Length of Service Award Programs enhance the current structure of volunteer fire departments. Evidence to date indicates a positive overall advantage to be gained from it's presence.

4

Data Sources And Montana Descriptives

"The government are very keen on amassing statistics. They collect them, add them, raise them to the nth power, take the cube root and prepare wonderful diagrams. But you must never forget that everyone of these figures comes in the first instance from the village watchman, who just puts down what he damn well pleases." — Anonymous, Quoted in Sir Josiah Stamp, *Some Economic Factors in Modern Life*

To analyze and produce economic service value measures for volunteer firefighters, a database was compiled primarily from a survey mailed to all volunteer fire agencies within the state of Montana. Additional demographic data was collected from various census bureau publications. Nearly one hundred and thirty volunteer fire departments responded to the questionnaire representing a response rate of nearly 30 percent. Bear in mind that since the entire population of volunteer fire agencies received a survey, this response rate represents 30% of the *population.* This point is meant to differentiate between sample response rates and population response rates. The official study size varied for individual descriptive statistics contained within this chapter as well as for the econometric regressions estimated in chapter five. This variation was due to missing observations and the inclusion of only RFDs, VFDs, VFCs, and FSAs in the estimated statistics. Appendix A contains a copy of the survey questionnaire sent to volunteer fire organizations in Montana.

This chapter will begin by describing the database. In addition, potential biases of the data set and their impact will be outlined and illustrated. A graphical presentation of descriptive statistics concerning volunteer firefighter

service as well as volunteer fire organization characteristics will be used to detail the magnitude and diversity of fire protection service in Montana.

4.1 SPECIFIC DATA SOURCES AND VARIABLES

The information base utilized in this study was generated from several sources:

① A comprehensive written survey questionnaire.[1]
② The Montana Public Employees Retirement Board, 1991, Annual Financial Report.
③ "Fire In Montana", 1986-1989, Annual Report, published by the Fire Marshal Bureau, Department Of Justice, compiled by Anita Varone, Program Specialist II.
④ Insurance Services Organization (ISO) list of departmental fire ratings for Montana.
⑤ 1990 Census of Population and Housing, U.S. Bureau of the Census.
⑥ City/County Data Book, 1988, U.S. Department of Commerce, Bureau of the Census.
⑦ Census of Governments, 1987.

Data was collected primarily from source #1. Observations on more than a hundred variables were assembled. Appendix B contains a comprehensive list and complete definition of all the variables gathered. A series of post-survey telephone calls were conducted to verify and augment elements of the collected survey data. In addition, several of the sources had overlapping information which made possible further cross-checking and verifying of the data set.

The survey of volunteer fire organizations focused on three major areas — Membership, Equipment, and Organization. The first group — Membership — provided details about active volunteer member firefighters such as their age breakdown, years of experience, special training, and time spent on fire related activities. Equipment information included number of fire apparatus, type, age,

[1] Survey conducted by Dr. Michael Kupilik and the Author.

and whether it was purchased new or used. The last category — Organization — elicited departmental data regarding type of agency, area and population served, source and amount of yearly budget, mutual aid agreement information, people and equipment *expected* on a "standard response", and ISO[2] number.

The Annual Financial Report as well as the Montana Public Employee's Retirement Division provided detailed information concerning actuarial retirement fund figures for 1981 through 1992 and specific benefit amounts awarded vested member volunteer firefighters.

The 1986-1989 summary report by the Fire Marshal Bureau of Montana was used primarily to cross-check certain data gathered from the returned surveys. Similarly, the ISO list was used to authenticate and verify a fire organization's assigned fire rating. For the most part, the ISO ratings claimed by individual fire departments were quite accurate.

The last three sources — 1990 Census of Population and Housing, City/County Data Book for 1988, and the Census of Governments — were employed in collecting the majority of the demographic data associated with the geographic location of a volunteer fire organization. Ideally, this data would be solely representative of the specific region, such as a city or town, in which the fire department was located. Unfortunately, data of this nature was either not available or the marginal costs of collection were too great. With this constraint in mind, data was collected primarily on the county or county subdivision in which the fire department was located. It is assumed that

[2] ISO stands for Insurance Services Organization. They rate the quality of fire protection that can be provided by a fire department. Their rating affects the amount of insurance that a fire department can carry as well as the insurance rates of households and other various buildings within a fire department's protection jurisdiction.

patterns realized on the county level are similar to those experienced at a more micro level such as a rural city or town within the county. In other words, the assumption is that there exists a direct association between the trends experienced countywide and those experienced by a specific town within the county subdivision. This assumption breaks down when a subdivisions' measures are influenced by a few large cities within it. In such a situation, the rural towns may have predominantly different patterns. Since volunteer fire organizations are found primarily in smaller rural communities, this assumption is an important one. Unfortunately, a reliable means of testing whether or not this assumption holds is unavailable.

4.2 Potential Biases and External Validity

Data analysis can be complicated by many biases. Basing results on biased data leads to unfounded and inconclusive evidence. An unbiased estimate is simply a case where the mean of successive random samples collapses on the population mean. In other words, the expected value of the estimate is the population parameter itself. Any nonrandom nature of the data can result in a biased outcome skewing the results in either a positive or negative direction.

Sources of potential bias are many. Survey responses can vary due to the type of people or organizations responding. Larger more established agencies may respond more than smaller ones. Better educated people or individuals having professional careers are more likely to return questionnaires.[3] If the

[3] Miller, Delbert C. 1991. *Handbook Of Research Design And Social Measurement.* Fifth Edition, Sage Publications, pg 153.

survey deals with subject matter that is of interest to those surveyed, then they are more likely to respond.[4] Respondents may even knowingly misrepresent information in their survey answers. Ideally, these sources of bias should be minimized.

A further consideration regarding data, is the extent or degree to which external validity holds. The issue of external validity refers to the extent to which the results from analyzing a sample data set can be generalized to its respective population; in other words, how well does the sample reflect or represent the population from which it was drawn. The desire for high generalizability is of much importance because it represents the primary goal or motivation of a research project. External validity is affected most by the sampling method employed. Fully randomized samples maintain the highest degree of generalizability. From such samples it is statistically possible or allowable to make generalizations regarding population parameters. By not employing a probability sampling technique, strong assumptions regarding the distribution of the data must be made and conclusions often suffer from being only suggestive at best.

Concerning the data generated for this study, it is not possible to definitively say that the surveys returned are statistically representative of the population.[5] Those departments responding to the survey questionnaire were not sequestered randomly and there is thus a weakened ability for the results to be generalized to the state of Montana as a whole. But, on the other hand, responding departments may have returned their questionnaires in a random

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[4] This concept is known more formally as "Saliency."
[5] The "population" being all the volunteer or volunteer/part-paid fire departments in Montana.

fashion thus providing a statistical foundation for maintaining external reliability. It is this unpredictable aspect of the data distribution that could bias the analysis and therefore the results of this study should be absorbed with some caution.

In argument against these potential weakness' of the data, there are some descriptives that are useful in providing limited evidence of generalizability. Figure one provides a comparative distribution of fire organizations in Montana. Notice that the percentage distributions by organization from the fire departments returning the survey questionnaire are similar to the distributions noted for the entire state. This response distribution provides evidence that does not dispute the notion that the returned surveys are representative of all fire departments in Montana and not just those organizations responding to the questionnaire. A critic might point to the greater number of VFDs and the lower number of VFCs responding to the survey with respect to their state distributions. These differences however, are not large and indicate a representative group of responses. In addition, Figure's two, three, four, and five detail histograms of the variables: POPSERV, denoting population served; ACTIVE, representing the number of active volunteer firefighters belonging to a certain fire department; YRBUDGET, describing the annual operating budget for the respondent fire department; and lastly, AVGMEMYRS, which measures the *average* years of experience of volunteer firefighters by fire department.

FIGURE 4.1 VOLUNTEER FIRE AGENCY STATEWIDE VS SAMPLE RESPONSE DISTRIBUTIONAL COMPARISON

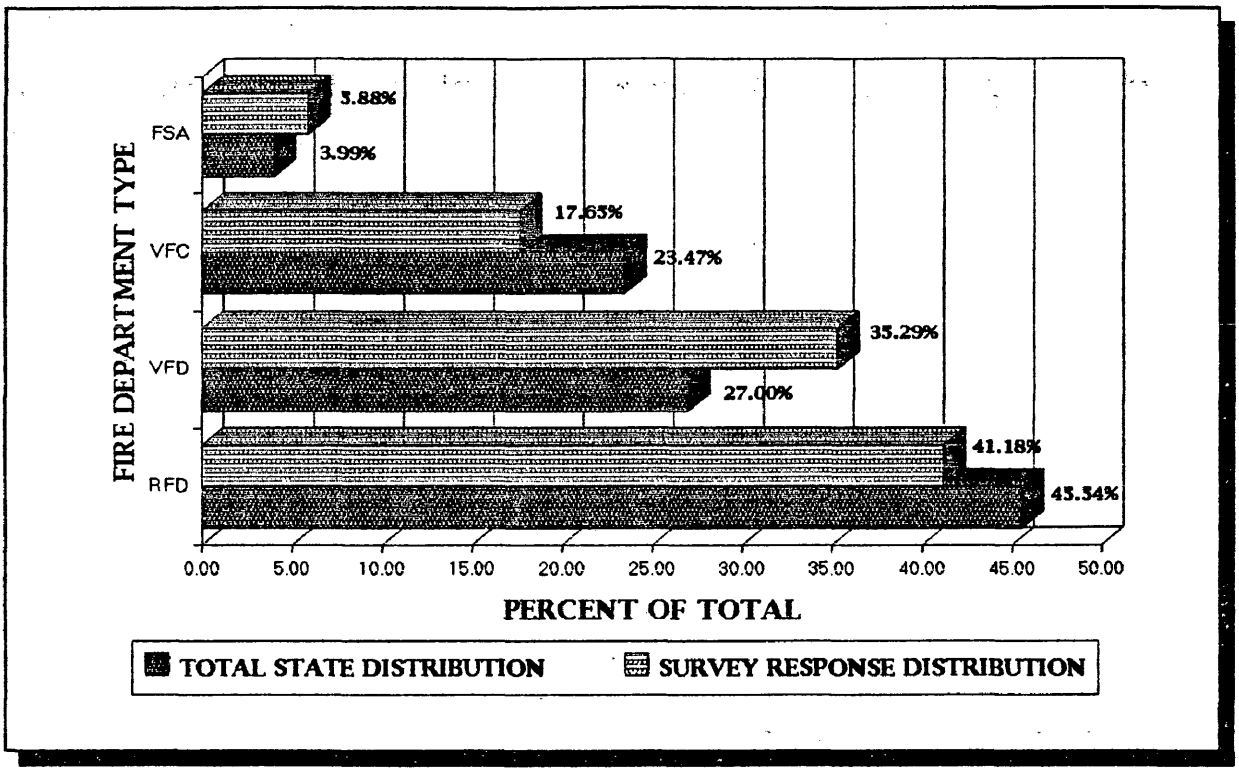


FIGURE 4.2 HISTOGRAM AND CUMULATIVE PERCENT FOR POPULATION SERVED DISTRIBUTIONS

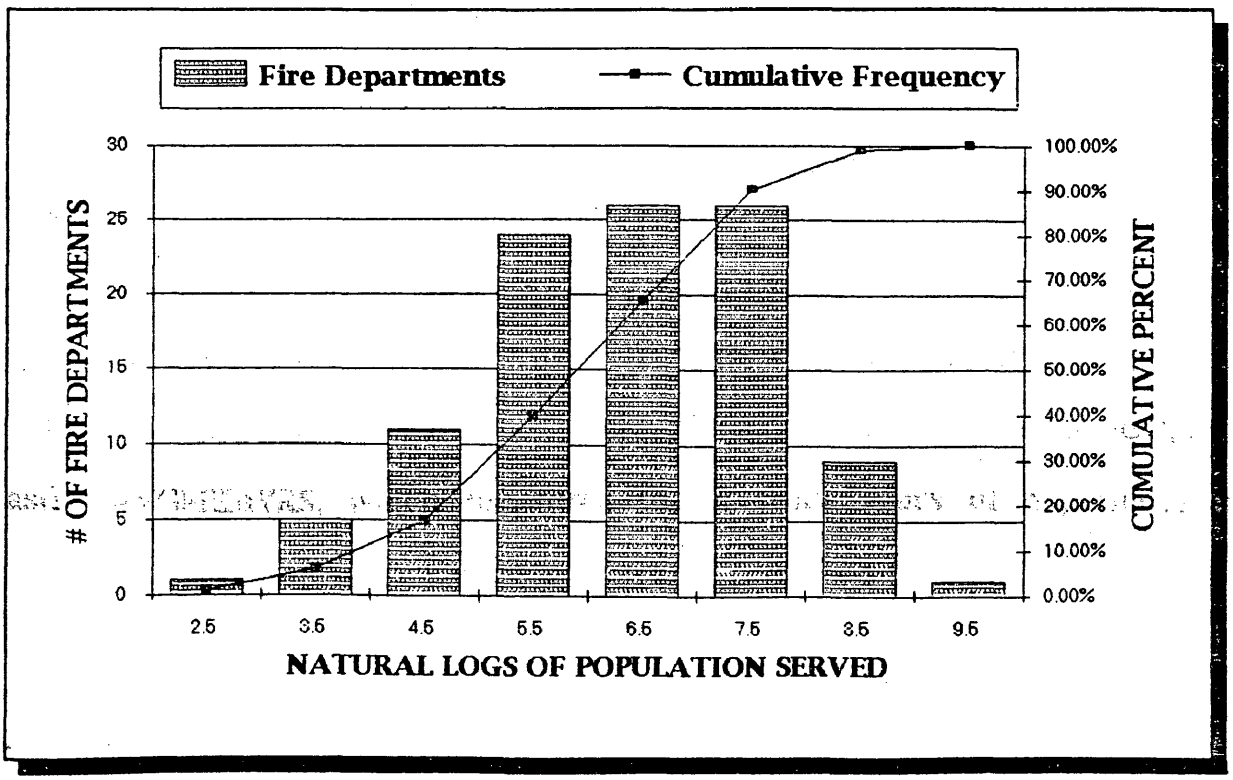


FIGURE 4.3 HISTOGRAM AND CUMULATIVE PERCENT FOR ACTIVE VOLUNTEER FIREFIGHTER DISTRIBUTIONS

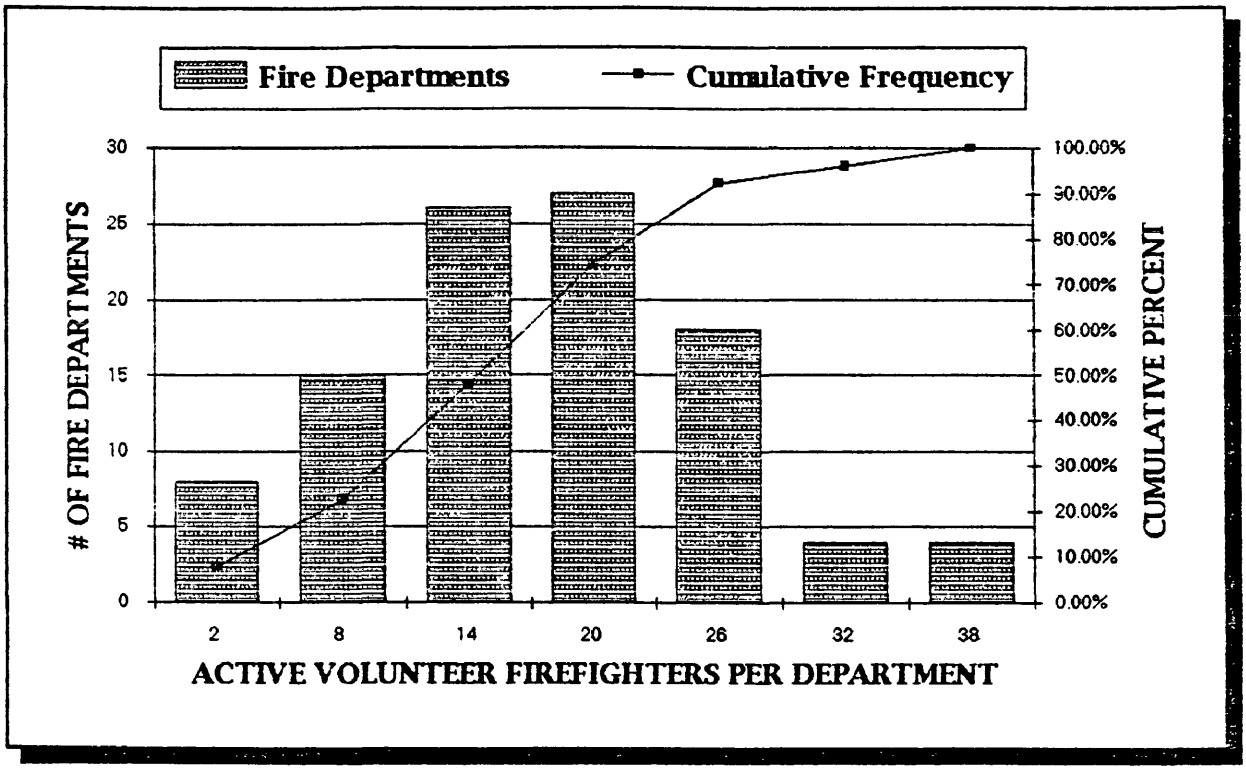


FIGURE 4.4 HISTOGRAM AND CUMULATIVE PERCENT FOR ANNUAL FIRE AGENCY OPERATING BUDGETS

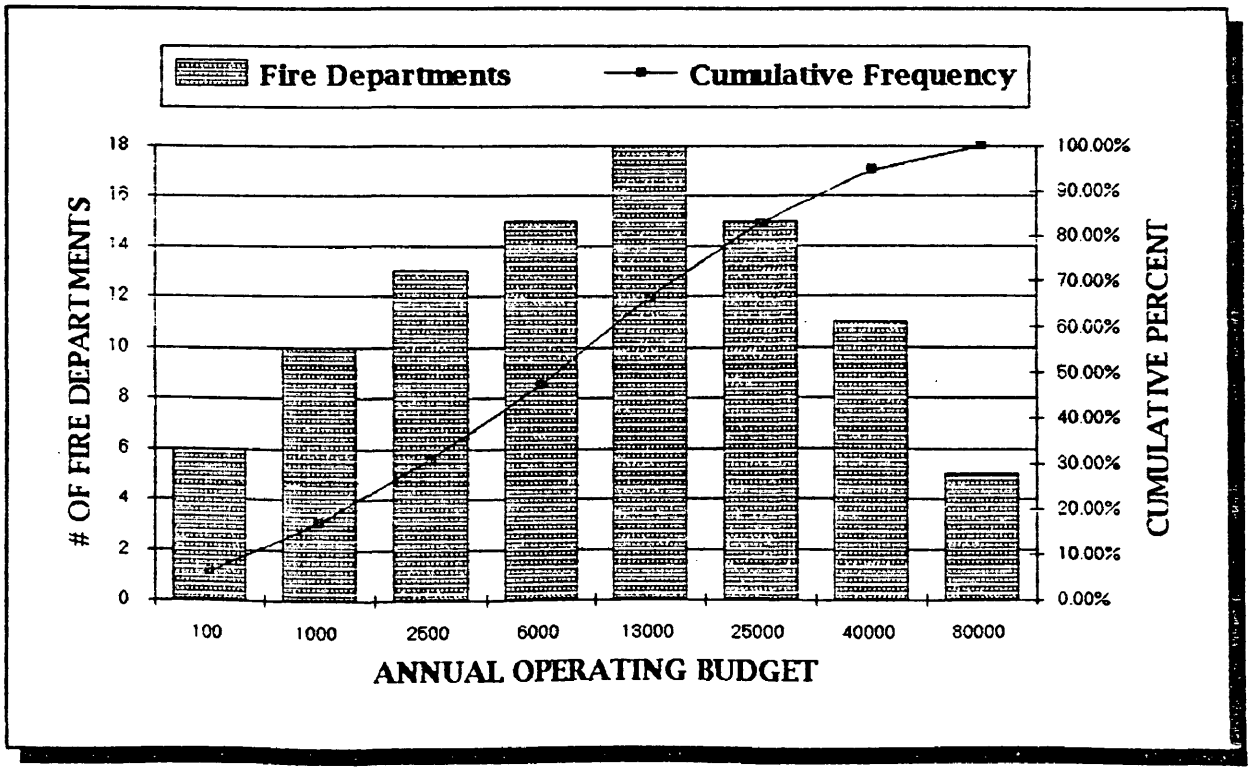
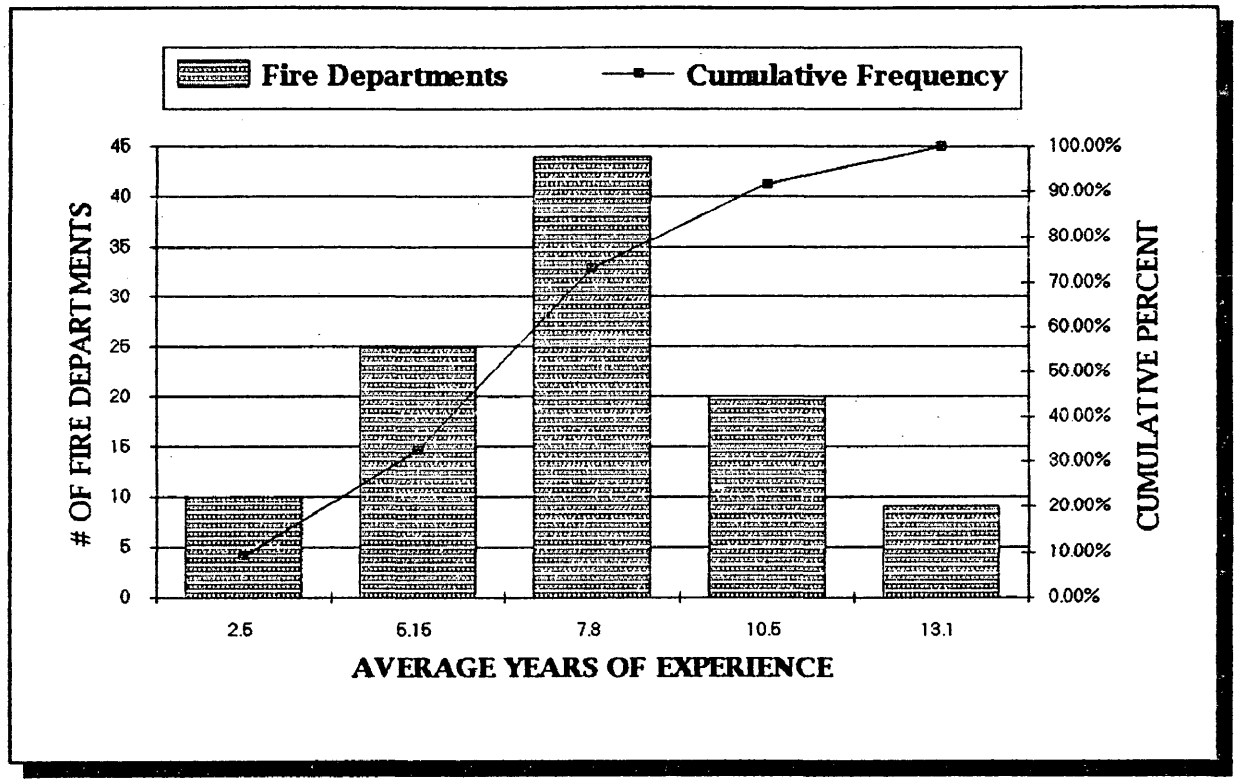
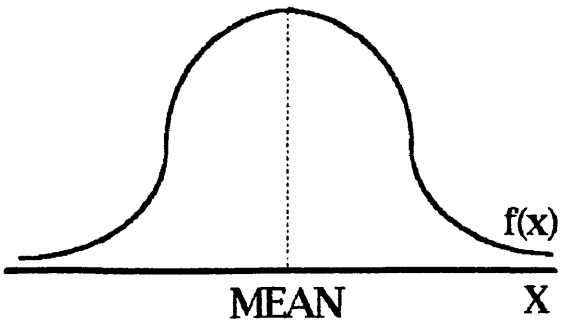


FIGURE 4.5 HISTOGRAM AND CUMULATIVE PERCENT FOR AVERAGE YEARS OF VOLUNTEER FIREFIGHTER EXPERIENCE PER DEPARTMENT



The four histograms provide an introspective view into the distribution patterns of the data set gathered for this study. These charts detail the relevant distribution range of a particular variable while also providing a quasi litmus test for the entire data set. The pattern inherent in a normal distribution is the traditional "Bell" shaped curve. The shape of a normally distributed histogram should resemble:



Observations fall predominantly around the mean and then taper off out toward the tails. It should be noted that almost no data set is perfectly symmetric. Therefore, it is reasonable to expect some digression away from this idealized shape. Skewness measures the degree of asymmetry of a distribution around its mean. If the data points are distributed with an asymmetric tail extending towards values greater than the mean, the overall distribution is referred to as positively skewed. It is negatively skewed if the asymmetric tail extends towards values less than the mean.

In addition to the distribution shape, the four charts provide a cumulative percent overlay. This line is helpful in further distinguishing the distribution characteristics of the data. For a perfectly symmetric distribution, this line would be straight running from corner to corner of the chart. The degree of skewness will be reflected in the deviation from linearity. Negative skew will tend to produce a more "S" shaped curve while a positive skew will result in a "ſ" shape, steeply climbing at first then leveling off.

Figure 4.2 resembles a normal distribution but could arguably indicate a negatively skewed distribution. Its cumulative percent line shows the most skewness out of all the four graphs. More supportive are figures 4.3 through 4.5 which provide evidence of a normalized distribution of survey responses. All three histograms represent the "Bell" curve quite notably. In addition, their cumulative percent lines maintain an even degree of linearity. Again, this evidence is not absolute in any sense of the term, but, is presented to help foster confidence in the population estimates to be detailed later in this study.

TABLE 4.1 COUNTY DEMOGRAPHIC VARIABLE DISTRIBUTIONS FOR DATA SAMPLE (N=104)

COUNTY VARIABLES	MEAN	STD ERROR	MED	VAR	KURT	SKEW	MIN	MAX
POPSUBDIV	6,877	1,079.31	2,927	1.16E+06	10.29	3.08	268	65,984
POP18UNDER	1,884	276.64	828.5	7.65E+04	9.34	2.95	7	16,170
PCT18UND	28%	4.59E-03	28%	2.11E-05	9.58	-1.16	0.02	0.43
POP65OVER	901	134.81	425	1.82E+04	7.46	2.75	28	7,264
PCT65OVR	14%	4.72E-03	14%	2.23E-05	-0.5	-0.07	0.03	0.25
MEDIANAGE	35.33	3.39E-01	35.2	1.15E-01	2.8	-0.79	21.8	45.7
FEMALE	3,480	551.74	1,445	3.04E+05	10.38	3.09	123	33,707
PCTFEMALE	50%	1.78E-03	50%	3.18E-06	2.28	-0.98	0.42	0.53
PERSONHH	2.59	2.59E-02	2.54	6.69E-04	15.55	2.98	2.22	4.27
MEAN#ROOMS	5.31	4.24E-02	5.3	1.80E-03	1.05	-0.87	4	6.2
TOTALHU	3,250	471.74	1,469	2.23E+05	7.92	2.72	172	27,727
TOTALOWNOCC	2,786	437.98	1,140	1.92E+05	9.25	2.9	107	26,369
OWNPCTTOTAL	79%	1.26	80%	1.59E+00	1.51	-1.26	38.93	95.55
AVGVALUE OF OWNOCCHU	49,378	1,450.6	46,950	2.10E+06	0.65	0.31	15,000	103,000
ESTABNUM	727	81.01	341	6.56E+03	1.52	1.5	34	3,981
ESTABEMP	5,724	752.5	2,464	5.66E+05	4.16	1.95	132	41,371
ESTABPYRLL	87,896	12,321.61	29,073	1.52E+08	5.62	2.17	1,534	710,207
RETAILESTAB	190	19.65	94	3.86E+02	0.82	1.37	11	911
RETAILEMP	1,638	217.38	684	4.73E+04	2.95	1.8	33	11,109
RETAILPYRLL	15,653	2,146.87	6,039	4.61E+06	3.29	1.86	217	111,414
RETAILSAL	8,825	116.24	9,142	1.35E+04	0.35	-0.89	5,816	10,749
FTEFIREEMP	11.47	1.99	1	3.97E+00	9.16	2.75	0	120
LOCALGVMT EMPLOYEES	825	72.05	522	5.19E+03	6.72	2.17	94	4,688
AVGMONTHLY GVMTSAL	1,682	19.12	1,689	3.66E+02	-0.11	-0.41	1,004	1,973
PERCAPPRPTY TAX	574	26.83	474	7.20E+02	3.55	1.67	259	1,806
PERCAPPERINC	9,824	110.12	9,686	1.21E+04	-0.62	0.34	7,656	12,576
UNRATE	8.36	2.29E-01	8.4	5.26E-02	0.36	0.54	3.1	15.4
GROSSASSESSED LOCAL	21,811	2,228.45	12,496	4.97E+06	6.5	2.16	2,096	141,348
TOTALSTT	49,036	3,881.6	31,358	1.51E+07	5.2	1.88	5,611	223,301
LOCALSTT	29,610	2,810.35	15,892	7.90E+06	6.24	2.15	3,032	177,514
EMPESTAB	6.47	1.80E-01	5.94	3.25E-02	1.03	0.79	2.97	13.54
PYRLLEST	94,609	4,216.93	87,772	1.78E+07	8.07	1.95	29,542	333,574
RTEMPEST	6.58	2.33E-01	5.87	5.41E-02	0.29	0.96	2.36	12.53
PYRLLRET	59,439	2,560.99	52,753	6.56E+06	0.36	0.91	15,500	128,458

Source: 1990 Census of Population and Housing, U.S. Bureau of the Census. City/County Data Book, 1988, U.S. Department of Commerce, Bureau of the Census. Census of Governments, 1987

In addition to the histograms, table 4.1 is provided to lend further support to the assumption of a normalized survey questionnaire response pattern. This table includes descriptive statistics on nearly all the variables collected outside of the survey responses. The statistics are meant to provide support to the contention that the assumption of external validity concerning the data set used for this thesis study is warranted. External validity refers to the degree of generalizability of a sample data set, i.e. whether results of a study can be generalized to other populations or to the population from which it was drawn. Of primary interest is the measure of *skew*. For the entire set of 34 variables in table 4.1 there appeared to be a slight positive skew to the distribution. Only 24% of the variables had negative or less than zero measures of skew. Approximately 35% had measures less than one while nearly 65% were less than two. Only 2 variables had skewed distributions of greater than three. Unfortunately there is no relevant scale upon which to base these figures. It isn't possible to say that a measure of "5" represents extreme skewness or whether "10" serves as a more appropriate delineation. Suffice to say, that a measure of three or less is not likely cause for alarm. It does however indicate proceeding with caution. With a majority of skewness measures below three it is possible to contend, with a degree of certainty, that the data distribution does reasonably maintain a normal shape.

Lastly, all previous claims aside, the *primary* assumption underlying this thesis study is that the data and population are multivariate normally distributed and that the response pattern to the survey questionnaire is random. This assumption allows the sample results to be generalized to the

population parameters. For this study, it specifically means that values obtained through careful analysis of the volunteer fire organization sample data can be used to derive usable estimates of statewide totals.

4.3 SAMPLE AND STATE DESCRIPTIVES

The survey of volunteer fire organizations in Montana revealed a host of fascinating descriptive statistics. This study provides an empirical view of how volunteer fire departments are organized and structured. This section will begin by comprehensively detailing the service and background characteristics of the primary input into the fire protection production process — volunteer firefighters. As will be shown through their service descriptives, volunteer firefighters maintain rigorous training and response schedules. In addition, they bring to a fire department significant experience as will be inferred from their age and experience breakdowns. Departmental characteristics will also be detailed revealing both a significant pool of capital equipment as well as a vast demand for fire protection services in the state of Montana. Of particular interest are the structural determinants of fire departments in Montana — i.e. size, shape, and quality. The descriptive charts and tables within this section describe RFDs, VFDs, VFCs, and FSAs. These four organizational types are the focus of this study. No attempt is made to generalize or describe those departments not adhering to Montana's current fire agency classification system. Paid fire department characteristics will be summarized where comparison needs arise. Data on paid fire departments was collected in an additional survey conducted by the author.

4.3.1 VOLUNTEER FIREFIGHTER SERVICE CHARACTERISTICS

Volunteer firefighters are the original constituent in the delivery of fire protection services to the rural areas of Montana. Their service levels are extensive as well as impressive. The total estimated[6] number of firefighters in the state of Montana is 9436. Decomposing this number, there are 591 fully paid career firefighters and 8845 volunteer firefighters. In percentage terms, career firefighters comprise a mere 6.3% while volunteer firefighters make up 93.7% of the state's fire fighting workforce.

Table 4.2 details volunteer firefighter characteristics broken down by agency type generated from the sample data. Terms used within the table are defined as follows:

Variables:

- *# VOL FF'S:* Number of Volunteer Firefighters.
- *AVG EXP:* The average level of experience in years by department.
- *AVG AGE:* The average age level of firefighters by department.
- *% EMT:* The percent of active firefighters per department certified as Emergency Medical Technician's.
- *% HAZMAT:* The percent of active firefighters per department trained in responding to a hazardous materials incident.
- *% MEM 30+:* The percent of active firefighters per department that had completed the state minimum of 30 or more hours of training in the last year.
- *TIME/INC:* The average length of time spent per incident by department.
- *HRS/MNTH:* The number of hours per month by department that the average member spends responding to incidents.

Statistical Terms:

- *COUNT:* Number of observations used in statistical calculations.
- *MEAN:* Arithmetic mean of the sample.
- *STD DEV:* Standard deviation of the sample.

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[6] These figures are "estimated" from the sample data.

- *MIN:* Minimum sample value.
- *MAX:* Maximum sample value.

Volunteer firefighters are, in general, quite experienced. Their average age by departmental type was in the upper thirties to the low forties. With age comes wisdom and experience such that most people within the range specified above have worked in the labor force for a significant number of years and have likely collected a variety of skills. It is these skills that Karn referred to as the "volunteer differential" and the often overlooked advantage of utilizing volunteer labor. In addition, the measure for average experience by department ranged from just over eight years of service for FSAs to just under ten years for VFCs. This amount is considerable and indicates that, at the time of the survey, Montana fire departments had a significant level of experienced volunteer firefighters.

Attesting to the quality of experience, % EMT indicates a well trained field of volunteer firefighters. For the relative percent of active volunteer firefighters certified as a EMT, measures ranged from 11.3% for FSAs to 8.1% for VFCs. These might seem like low percentages, but, given the amount of time required for certification as an EMT, not to mention the annual training necessary each year to maintain state certification, the percents per fire department are considerable and reflect a substantial personal investment by volunteer firefighters. The EMT class alone takes over a hundred hours to complete. For a volunteer to complete this course without the incentive of monetary recompensation is commendable, but more interestingly, it begs the

question of exactly what are the true motivations underlying a volunteer firefighter's decision to make such an investment.

Measures of the percent of active volunteers trained in responding to incidents involving hazardous materials (%HAZMAT) ranged from 6.9% for FSAs to 44.6% for RFDs. The range for this variable was lower than expected. Given the fact that the standard HAZMAT class is only four hours long and that it is a popular topic, it was predicted that these percentages would be much higher. Hazardous material incidents are receiving more attention under the specter of several recent major chemical spills from both tracter-trailer and railroad accidents in Montana.

A third measure of quality is % MEM 30+ listed in table 4.2. It is a legal stipulation that all volunteer firefighters complete at least thirty hours of training each year to be credited with a year of service. The average measures indicated a range of 47.4% for VFCs to 68.5% for RFDs. The lower figure for VFCs was expected. VFCs are located in smaller more rural areas and the distance and time constraints undoubtedly limit their ability to obtain formal fire training and thus meet the state standards. The other three agency types had averages of 60% or greater indicating that the majority of volunteer firefighters achieve the state minimum.

TABLE 4.2 VOLUNTEER FIREFIGHTER CHARACTERISTICS BY ORGANIZATION TYPE

AGENCY TYPE	# VOL FF'S	AVG EXP	AVG AGE	(%) EMT	(%) HAZMAT	(%) MEM 30+	HRS/ MNTH
RFD:							
Count	42	42	40	42	40	42	39
Mean	22	9.16	39.95	8.3%	44.6%	68.5%	5.15
Std Dev	8.99	2.95	4.75	11.3	31.9	33.3	4.61
Min	5	2.5	32.83	0%	0%	0%	0
Max	46	16.43	53.5	50%	100%	100%	18
VFD:							
Count	36	36	36	36	36	36	31
Mean	21	9.12	37.74	11.2%	29.6%	62.4%	5.12
Std Dev	7.46	2.47	2.89	13.7	33.1	34.7	5.2
Min	3	2.5	31.33	0%	0%	0%	0.17
Max	40	13.83	43.5	66.7%	100%	100%	20
VFC:							
Count	18	18	17	18	18	18	13
Mean	13.28	9.69	42.16	8.1%	15.2%	47.4%	2.21
Std Dev	7	5.21	6.77	14.9	18.7	39.4	3.45
Min	2	2.5	34.5	0%	0%	0%	0
Max	30	18.4	58.23	50%	50%	100%	12.5
FSA:							
Count	6	6	6	6	6	6	5
Mean	22.33	8.09	41.35	11.3%	6.9%	67.5%	5.03
Std Dev	11.08	2.19	3.01	12.4	7.8	31.3	3.52
Min	11	5.71	38.11	0%	0%	32.5%	1
Max	40	11.29	46.41	33.3%	16.7%	100%	10

Source: Sample data derived from the survey.

The measure — HRS/MNTH — contained in table 4.2 addresses the quantity of time donated or volunteered to rural fire protection efforts. Note

that this figure only captures incident response time. It makes no attempt at quantifying or capturing the amount of time volunteered to activities not specifically related to an emergency fire or medical call.[7] Many might argue that because of this exclusion, this figure grossly underrepresents the true extent to which volunteers donate their time and efforts to a community. This view is correct to a degree and implies that the hour estimates made from the sample data will likely underestimate the *total* time volunteered by just focusing specifically on the *incident* response times. But attaching a relevant economic value to hours beyond simple incident response times would complicate the valuation process to be detailed in chapter five. Constraining the time estimates to include only response hours is arguably more accurate because it captures the relevant volunteer time associated specifically with the production and delivery of fire protection services.

Average hours volunteered for all agency types except VFCs was slightly over 5 hours a month. Volunteers belonging to VFCs averaged 2.21 hours a month. This measure for VFCs is not surprising. In fact, the lower average was predicted due to the smaller size of VFCs as compared to RFDs, VFDs, and FSAs. This prediction is given further support by the comparatively lower incidents per month realized by an average Volunteer Fire Company (VFC). As will be detailed later, VFCs have an average of just under one incident per month while RFDs, VFDs, and FSAs all have between 4 to 5 incidents per month. Aggregating these figures to the state level results in 38061.88 hours volunteered specifically to emergency incident responses each month and a

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[7] Activities not included in these measures might include: participating in the yearly fund raising auction; painting the shop; leading training activities for the weekend; or performing maintenance on the fire apparatus.

staggering 456742.52 hours volunteered each year. Dividing this total annual figure by 2080, the number of hours corresponding to the full-time-equivalent (FTE) classification, results in nearly 220 full-time positions being represented by the emergency response hours volunteered to fire protection services in Montana.

Table 4.3 provides volunteer firefighter characteristics generated from the sample for all departments. Generalizing to a statewide level, the results indicate that there are an average of 20 volunteer firefighters per department with an average experience level and age of 9 and 39.5 years, respectively. Nearly 10 percent or approximately 2 firefighters per department are certified as EMTs. Almost 32 percent or 6 firefighters per department have had hazardous materials training (HAZMAT). Overall, 62.5 percent of the volunteer firefighters in an average fire department meet or exceed the state standard by investing in 30 or more training hours annually. The average volunteer firefighter spends 4.69 hours a month or just over 56 hours a year responding to emergency calls. Again, this figure does not include time volunteered to activities other than hours attributable to emergency responses.

The experience level of volunteer firefighters from the sample data are divided into 5 categories within figure 4.6. 65.23% of the sample volunteer firefighters had an experience level of 10 years or less while 83.81% had 15 years or less. Interestingly, nearly 35 percent of the volunteer firefighters had more than 10 years worth of experience in fire protection. This percentage is mentioned in relation to the vesting[8] date of the Volunteer Firefighter's

[8] Vesting refers to the date when a worker, in this case a volunteer firefighter, is legally entitled to collect benefits from a certain pension or retirement fund.

Compensation Act which occurs at 10 years of service. In actual numbers this means that, theoretically, 3075 volunteer firefighters are currently eligible to claim pension benefits. The size of this figure indicates the vast responsibility of actuarially funding and managing the volunteer firefighter's pension fund.

TABLE 4.3 VOLUNTEER FIREFIGHTER CHARACTERISTICS FOR ALL FIRE ORGANIZATION TYPES

RFD, VFD, VFC, FSA	# VOL FF'S	AVG EXP	AVG AGE	(%) EMT	(%) HAZMAT	(%) MEM 30+	HRS/ MNTH
Count	102	102	102	102	100	102	88
Mean	19.95	9	39.5	9.5%	31.6%	62.5%	4.69
Std Dev	8.73	3.18	4.79	12.8	31.8	35.1	4.68
Min	2	2.5	29.46	0%	0%	0%	0
Max	46	18.4	58.23	66.7%	100%	100%	20

Source: Sample data derived from the survey.

The breakdown of the percentage distribution regarding volunteer firefighters' age is illustrated in figure 4.7. The average age calculated from the sample data was 39.5 years. Combining these results further reveals that 68% percent of the firefighters fell between the age categories of 31 to 50 years. Only 19% were 30 years old or younger. At the opposite end of the spectrum, only 13% were aged greater than 50 years which means that 87% of the firefighters were younger than 51 years.

FIGURE 4.6 VOLUNTEER FIREFIGHTER PERCENTAGE DISTRIBUTIONS BY EXPERIENCE LEVEL

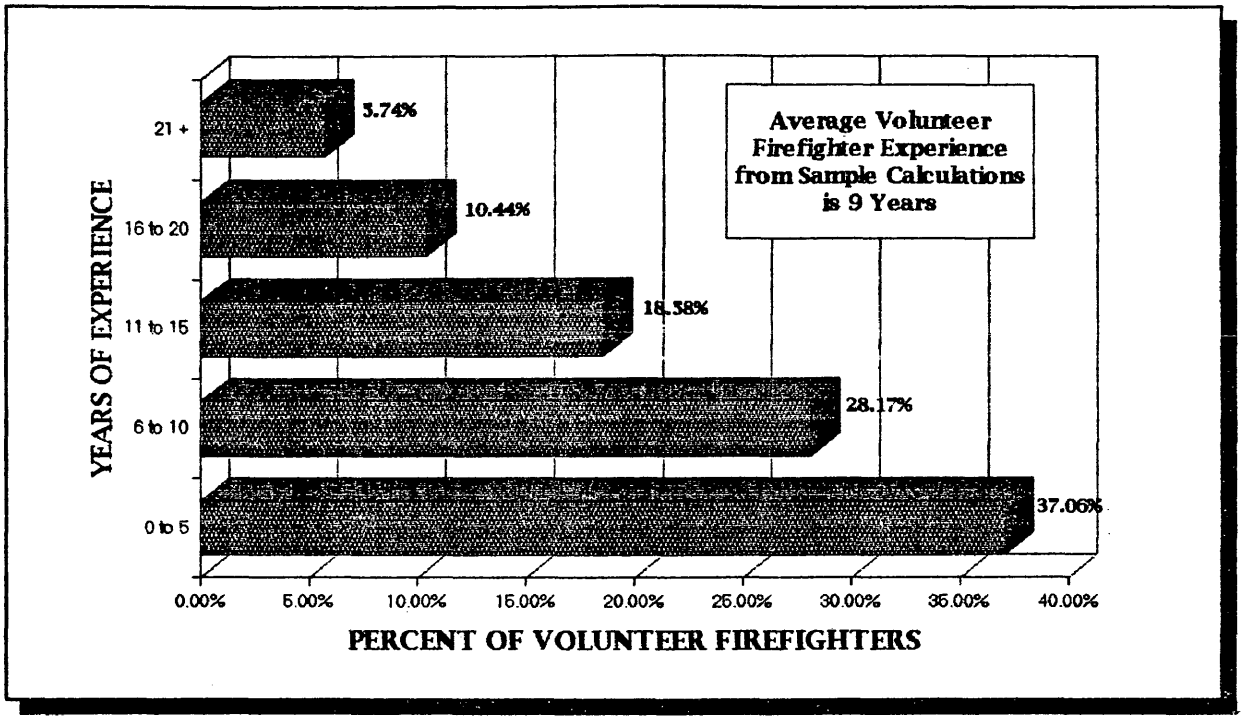
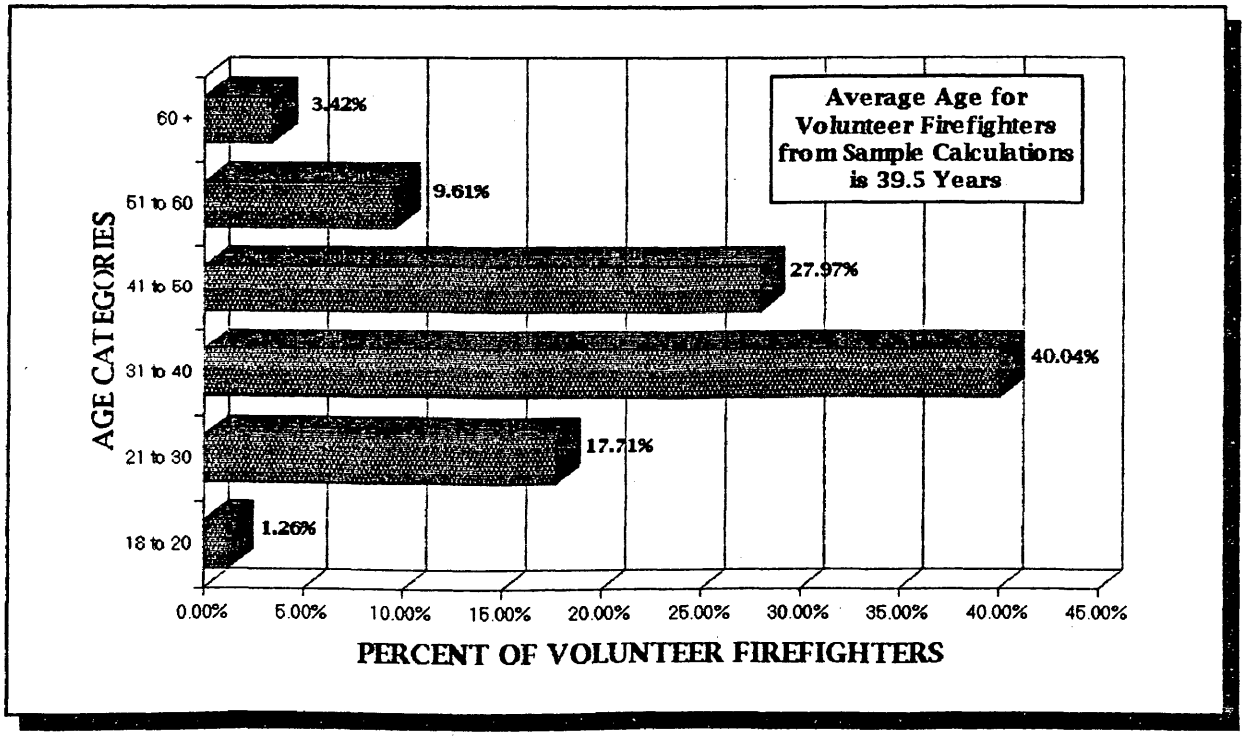


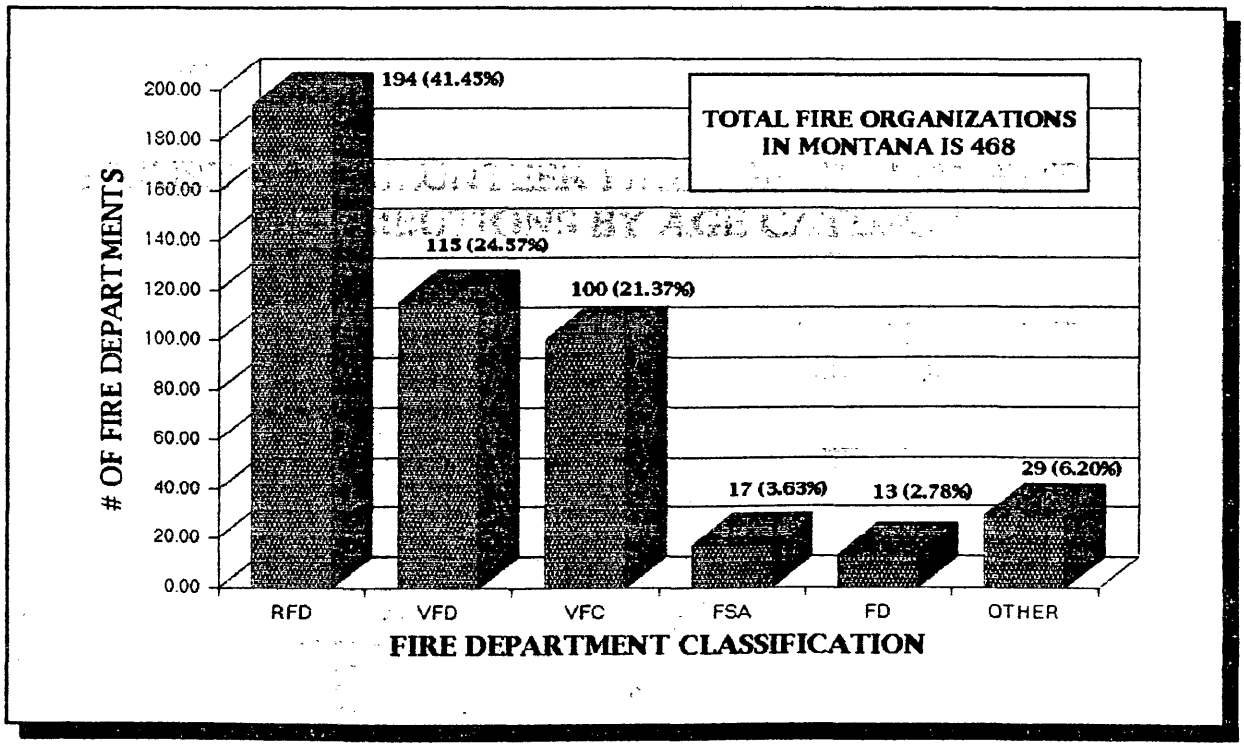
FIGURE 4.7 VOLUNTEER FIREFIGHTER PERCENTAGE DISTRIBUTIONS BY AGE CATEGORY



4.3.2 MONTANA VOLUNTEER FIRE ORGANIZATION DESCRIPTIVE CHARACTERISTICS

The total number of volunteer fire organizations in Montana is 468. Of these, 41.45% are Rural Fire Districts; 24.57% are Volunteer Fire Departments; 21.37% are Volunteer Fire Companies; and, 3.63% are Fire Service Areas. Figure 4.8 provides a graphical representation of these figures. This section will detail descriptive statistics on fire agency characteristics such as accumulated capital equipment, annual operating budgets, area and population served, and emergency incident response times.

FIGURE 4.8 MONTANA VOLUNTEER FIRE ORGANIZATIONS BY TYPE



To begin this discussion, table 4.4 provides descriptive statistics on several departmental measures. The measures are separated by fire

organization type. The variables used are defined thoroughly in Appendix B. Note that the definitions listed here are abbreviated and, also, that the terms listed in parentheses are the actual variable names as they appear in Appendix B. The variables used are:

- *FIRE RATING (FIRERTNG):* A fire department's ISO rating.
- *POP SERVED (POPSERV):* Population served or protected.
- *AREA SERVED (AREASERV):* Area in square miles served or protected.
- *TIME INC. (TIMEINC):* Average time spent per emergency incident.
- *INC. MONTH (INCMNTH):* Average number of incidents per month.
- *YEARLY BUDGET (YRBUDGET):* Annual operating budget.

In addition, table 4.5 provides the same measures but calculated for all fire departments. Table 4.6 details capital equipment segregated by organizational type. Dimensions concerning capital equipment for all fire departments are provided in table 4.7. Variables used within tables 4.6 and 4.7 are defined as follows:

- EQUIPMENT NUMBER (EQUIPNUM): Total number of fire apparatus, i.e. water tenders, ladder trucks, utility vans, etc.
- AVERAGE EQUIPMENT AGE (AVGEQAGE): Average age of fire apparatus in years.
- PERCENT PURCHASED NEW (PCTNEW): Percent of total fire apparatus that were purchased new.
- SCBA (SCBA): Number of self contained breathing apparatus.

First, regarding table 4.4, the population served measure proved to be quite extensive. RFDs and VFDs protect an average of 2507 and 2327 persons per department, respectively. FSAs serve an average of 1433 individuals while VFCs protect an average of 418 people per department. The lower figure for VFCs further evidences their reduced size and responsibility as was alluded to

earlier when discussing volunteer firefighter characteristics. RFDs and VFDs, considering a family household of 4 persons, protect an average of 627 and 582 households per department, respectively. Regarding paid[9] fire departments in Montana, they protect or serve approximately 33% of the population in Montana. This means that 77% of the population within Montana is served by volunteer fire organizations. This figure is considerable and expresses the demand, as well as, need for fire protection services by rural communities in Montana.

In addition, RFDs and VFDs have approximately 4.2 incidents per month when averaged over a year. VFCs have comparably less with an average of .91 or just under one incident per month. FSAs had the highest average incidents per month with 4.72. Again, the lower number for VFCs is consistent with their smaller size, more isolated location, and comparably less responsibility.

As a further indicator of departmental magnitude within different communities, RFDs, VFDs, and FSAs all had average annual operating budgets of $20000 or greater. RFDs had the highest budget with an average of $35698. Predictably VFCs were the lowest with an average annual operating budget of only $3935 which amounts to just 11% of the average RFD budget.

[9] Figures are derived from a sample of paid fire departments as well as direct observations conducted by the author.

TABLE 4.4 VOLUNTEER FIRE ORGANIZATION DESCRIPTIVES BY TYPE

AGENCY TYPE	FIRE RATING	POP SERVED	AREA SERVED	TIME INC	INC MONTH	YEARLY BUDGET
RFD:						
Count	38	42	42	42	42	39
Mean	8.24	2,507	405.24	2.01	4.19	$35698
Std Dev	1.2	2,954	881.68	0.94	4	46,474
Min	5	100	3	0	0	$2900
Max	10	13,500	5,300	4	20	$267000
VFD:						
Count	31	36	36	35	36	32
Mean	6.42	2,327	428.1	2.15	4.16	$21982
Std Dev	1.39	2,446.8	740.85	1.58	4.32	30,406
Min	4	60	1	0.3	0.25	$575
Max	10	10,000	2,400	8	20	$115000
VFC:						
Count	7	18	18	16	18	15
Mean	9.57	418	89.47	2.88	0.91	$3935
Std Dev	0.54	449.03	101.43	1.47	1.13	4,519
Min	9	20	5	0	0	$0
Max	10	1,320	400	6	4	$16000
FSA:						
Count	6	6	6	6	6	6
Mean	8	1,433	227.42	2.06	4.72	$21750
Std Dev	1.67	1,059.6	476.6	1.22	3.62	13,985
Min	6	300	20	1	0.17	$5000
Max	10	3,200	1,200	4	10	$40000

Source: Data derived from the sample.

Lastly, referring to table 4.5, the average ISO fire rating for the entire sample was 7.65. Breaking it down by organizational type resulted in the distributions listed within table 4.4. VFDs had the lowest overall rating with an

average of 6.42. RFDs and FSAs hovered around 8 while VFCs averaged near 10. Remember that the range for the ISO rating is from 10 to 1 with a 10 indicating very little firefighting capability and 1 being the best attainable rating. The low rating for VFCs is likely due to the lack of sufficient water carrying capacity. The ISO rating is sensitive to the water carrying capability of a volunteer fire organization. It is similarly likely that this is the reason the rating for VFDs is comparably better than the rest. VFDs are located in 2nd and 3rd class cities as well as smaller incorporated towns in Montana. These locations are often more densely populated and have greater opportunity for developing a system of fire hydrants. In addition, due to the greater number and closer proximity of housing and business establishments, VFDs have more of an incentive to purchase structure firefighting apparatus rather than combination brush/structure firefighting equipment. Apparatus designed to fight structure fires are generally capable of carrying a greater amount of water.

TABLE 4.5 DEPARTMENTAL DESCRIPTIVES FOR ALL VOLUNTEER FIRE ORGANIZATIONS

RFD, VFD, VFC, FSA	FIRE RATING	POP SERVED	AREA SERVED	TIME INC	INC MONTH	YEARLY BUDGET
Count	82	102	102	99	102	93
Mean	7.65	2,011.59	347.12	2.2	3.63	$25374
Std Dev	1.62	2,513.26	731.54	1.32	3.93	36,983
Min	4	20	1	0	0	$100
Max	10	13,500	5,300	8	20	$267000

Source: Data derived from the sample questionnaire.

Descriptive statistics regarding capital equipment are contained in tables 4.6 and 4.7. RFDs, VFDs, and FSAs had an average number of 4 to 5 fire apparatus[10] per department. VFCs had an average of slightly over 2 fire protection vehicles per department. The average equipment of a RFD, VFD, and FSA was approximately 20 years old while the average age for VFC fire protection vehicles was predictably higher at just over 29 years old.

Of the fire apparatus held by VFDs, a per department average slightly in excess of 54% was purchased new. VFDs are located in incorporated cities and towns which have the capability of selling general obligation bonds to finance the purchase of new fire apparatus which is the likely reason that the VFD *purchased new* rates were so much higher than the rest of the fire agency types. This capability was exclusive to VFDs until recent legislation allowed RFDs a similar capability. The figure for RFDs was lower with only 35.9% of their capital equipment having been purchased new. For VFCs, 1.5% of their firefighting vehicles were originally acquired new. This means that VFCs purchase *used* fire equipment almost entirely. This low figure is expected though, because VFCs lack the necessary fund raising or bond carrying capabilities of RFDs and VFDs. In addition, VFCs were consistently of a smaller scale regarding nearly every variable measured, therefore, it is plausible that their subjacent needs and requirements justify the purchase of a suitable *used* water tender rather than a new one. Lastly, the average FSA only purchased 7.3% of their fire equipment new.

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[10] Apparatus, in this discussion, refers only to mobile vehicles such as water tenders, ladder trucks, or utility vans, and not stationary equipment such as extending ladders or pick-axes.

TABLE 4.6 CAPITAL EQUIPMENT DESCRIPTIVES BY AGENCY

AGENCY TYPE	EQUIPMENT NUMBER	AVERAGE EQUIPMENT AGE	PERCENT PURCHASED NEW	SCBA
RFD:				
Count	42	39	38	41
Mean	4.76	20.22	35.93%	8.88
Std Dev	2.44	6.56	32.83	5.87
Min	1	7.99	0%	2
Max	13	34.33	100%	26
VFD:				
Count	34	29	28	34
Mean	4.35	21.64	54.1%	8.88
Std Dev	3.73	8.41	36.8	6.54
Min	1	7	0%	0
Max	18	40	100%	24
VFC:				
Count	18	15	17	14
Mean	2.39	29.14	1.5%	2.57
Std Dev	1.14	11.53	6.1	2.85
Min	1	12.5	0%	0
Max	4	54	25%	9
FSA:				
Count	6	5	5	6
Mean	5.33	19.61	7.3%	8
Std Dev	3.14	4.19	10.1	4.43
Min	2	14.8	0%	2
Max	11	24	20%	15

Source: Data derived from the sample questionnaire.

The variable *SCBA* was included as a quality proxy for fire protection service provided to a community. Self Contained Breathing Apparatus are worn when entering a burning building either for rescue attempts or to contain a

fire's spread more at the source. One must remember that the air within a burning structure can reach 1000 degrees Fahrenheit or more and that one breath would instantly and irreparably damage the lungs. The fact that a volunteer would even consider undertaking such risks without being compensated monetarily is commendable and fascinating in itself. The average RFD and VFD each had almost nine SCBAs. The average FSA had 8 while VFCs were the lowest having only 2.5 SCBAs per department.

TABLE 4.7 CAPITAL EQUIPMENT DESCRIPTIVES FOR ALL VOLUNTEER FIRE ORGANIZATIONS

RFD, VFD, VFC, FSA	EQUIPMENT NUMBER	AVERAGE EQUIPMENT AGE	PERCENT PURCHASED NEW	SCBA
Count	100	88	88	95
Mean	4.23	22.17	33.43%	7.89
Std Dev	2.94	8.62	35.62	6.07
Min	1	7	0%	0
Max	18	54	100%	26

Source: Data derived from the sample questionnaire.

Finally, table 4.7 provides capital equipment data on all volunteer fire departments. The average volunteer fire organization has approximately 4 pieces of fire apparatus with an average age of 22 years. Roughly 33% of the average firefighting equipment per department was originally purchased new. This proves to be a considerable amount especially when one is enlightened as to the costs of buying a new 1000 gallon water tender with all the trimmings.

Volunteer fire organizations in Montana have a multitude of fascinating characteristics that this chapter has just touched upon. The goal was to provide a rounded view of how volunteer fire agencies are structured, organized, and utilized. Descriptives on volunteer firefighters as well as on their respective fire departments were illustrated. Chapter five will use this information to develop a comprehensive measure of the economic value of volunteer firefighters and indirectly of volunteer fire organizations to the state of Montana.

Modeling Methods, Applications, And The Economic Value Of Volunteer Firefighters In Montana

"There are three kinds of liars in this world: liars, damn liars, and statisticians." — Benjamine Disraeli

Throughout this thesis, discussions and descriptive measures have all focused on detailing the structure and impact of volunteer firefighting organizations in Montana. This chapter attempts to derive the economic value for one element of the provision of fire protection — volunteer firefighters. It is arguably the most important component of a volunteer fire organization. A volunteer firefighters' skills, training, and willingness to respond to emergency situations at all hours of the day or night are indicators of the readiness and altruism of the volunteer.

Two methods will be used to estimate volunteer firefighter service value. The first method applies a rigorous volunteer firefighter wage imputation.[1] It accounts for departmental variations in overall training and response hours. Its goal is to accurately measure the marginal contribution by the average volunteer firefighter and then aggregate this figure on a statewide level to determine the economic value of volunteer services. The second method attempts to econometrically estimate a derived demand curve for volunteer firefighters. Theoretically, it has the potential to be the most accurate of the

[1] The wage used was derived from the FireFighter I classification of the Missoula Rural Fire District. They hold the statewide distinction of being a the largest fire district. They have a fully paid career staff as well as a large pool of well-trained volunteer firefighters. The Missoula RFD classification will be used in generating the *shadow wage* to be used in determining the economic value of volunteer firefighters.

two methods. By accounting for varying degrees of impact resulting from different independent effects on the demand for volunteers, the estimated relationship is more precise. Unfortunately, this econometric approach is also dependent on the strength of the underlying model. With such limited research having been done on the economic dimensions of volunteerism the results should not to be regarded as absolute in any means. Rather, this econometric method is forwarded to provide an alternative view into the empirical determination of the economic value of volunteer services.

5.1 Measuring Volunteer Firefighter Time Contributions

As was detailed in the last chapter, volunteer firefighters contribute a considerable amount of time to fire protection in Montana. Determining an economic value for volunteer time depends essentially on two factors — the total level of hours volunteered and the marginal value associated with each hour. To develop the first issue, the concept of time must be defined. Regarding volunteer firefighters, time contributions are divided into three general categories — Response time, Specialized training time, and Generalized training time.

5.1.1 Response Time

Response time is defined specifically as hours spent responding to a emergency fire or medical incident. This measure does not differentiate between the type of incident. For future research, attention should address the division of response time between medical and fire emergencies. It was

brought to my attention during the survey verification process that there has been a subtle yet direct shift of volunteer fire organizations to providing a substantial level of emergency medical services to rural communities. Within the last ten years paid fire departments in Montana have already become aware of this fact. They have seen their number of medical-related incidents increase steadily. In fact, for the average paid fire department in Montana medical responses now account for approximately 60% of their emergency calls.[2] Fire-related responses account for an average of 22%. The final 18% is attributable to miscellaneous calls (e.g. false alarms, etc.).

From the survey data there were two separate techniques used to calculate the monthly response time for a volunteer fire organization. The two measures serve to provide an internal check of the accuracy of the data. Technique #1 takes the hours spent volunteering in a given month by the average volunteer and multiplies by the number of active member volunteer firefighters within that particular fire organization. This measure provides an estimate of the average volunteer firefighter response time contributed per department on a monthly basis.

Technique #2 takes the average length of time spent per call, multiplied by the average incidents per month, and multiplied by the average number of volunteer firefighters expected to be present on an emergency call. This measure results in a similar estimate of the average response time contributed by volunteer firefighters per department on a monthly basis.

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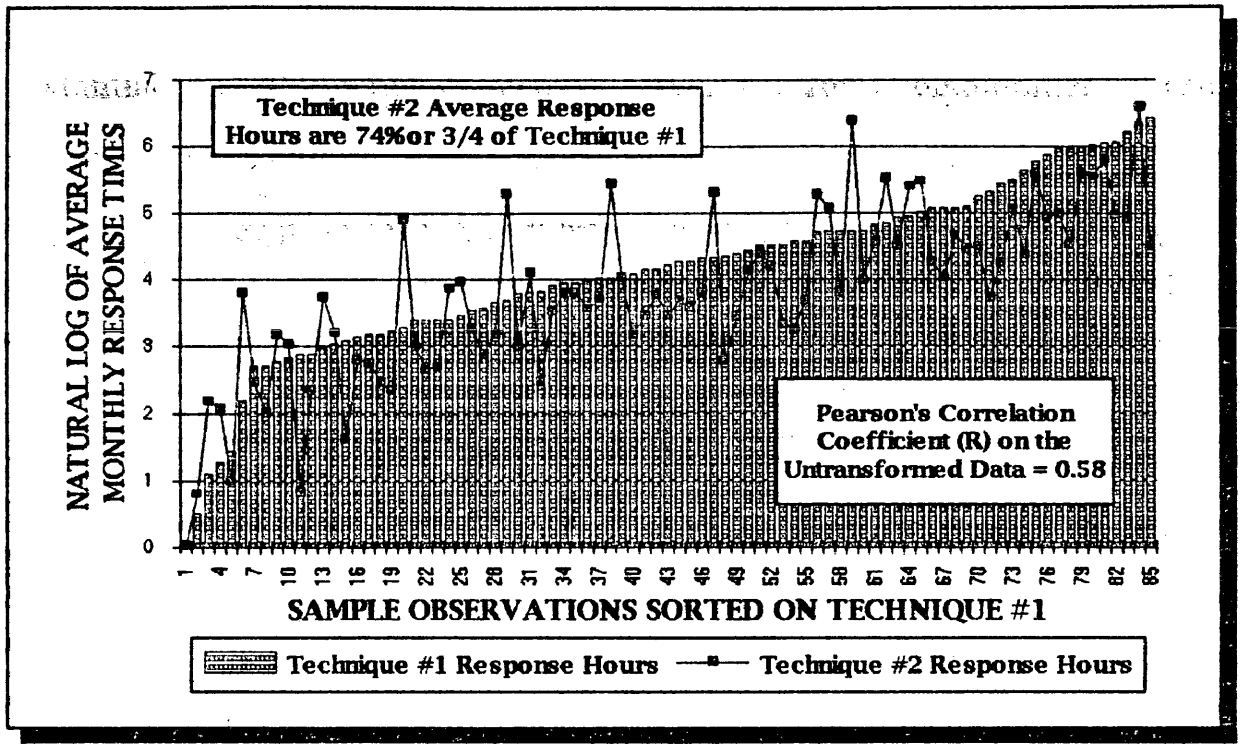
[2] These figures are derived from paid fire department data collected by the author.

FIGURE 5.1 COMPARISON OF TWO SEPARATE RESPONSE TIME CALCULATIONS



Both techniques of deriving the average response time resulted in measures that were fairly similar. Figure 5.1 provides a graphical comparison of both methods. Technique #2 was on average slightly less than technique #1. The simple correlation coefficient between both measures was 0.58. This coefficient was lower than desired but to be fair, it was hypothesized that the measurement from technique #2 might incorrectly reflect the actual number of volunteer firefighters that respond to a fire emergency and therefore misrepresent the actual hours volunteered per month by the average volunteer firefighter. The reason being that using the number of people *expected* on a standard response call can underestimate or overestimate the actual number of volunteer firefighters that actually respond to emergency incidents. The

expected figure may serve both as a minimum level or as a desired maximum number of volunteer firefighters. It is not known precisely how those fire departments responding to the survey questionnaire viewed this question. It was hypothesized before calculating each method that the correlation coefficient between the two measures would suffer. Figure 5.1 indicates that, on average, the responding fire departments viewed the *expected* number of firefighters more as a minimum level rather than a maximum. The two methods were similar enough to support the accuracy and consistency of the data.

The average monthly response time per department derived through technique #1 will be used for the economic value calculations. This measure was chosen over the other because it was felt to more accurately represent the actual hours contributed by volunteer firefighters.

TABLE 5.1 AVERAGE MONTHLY RESPONSE TIME IN HOURS PER DEPARTMENT BY FIRE ORGANIZATION TYPE

Organization Type	Mean	Std Dev	Minimum	Maximum	Aggregated State Totals
RFD (N=39)	130.00	141.29	0	612	25220.00
VFD (N=31)	119.77	131.80	3	500	13773.55
VFC (N=13)	28.82	37.96	0	125	2882.00
FSA (N=5)	118.51	95.89	38	240	2014.67
				Total ⇒	**43890.22**
ALL (N=88)	110.80	128.58	0	612	47200.80

Source: Survey Data.

TABLE 5.2 AVERAGE MONTHLY RESPONSE TIME CONFIDENCE INTERVALS BY FIRE ORGANIZATION TYPE

Type of Organization	Confidence Interval (Two-Tailed Significance Test) alpha=.05	alpha=.10
RFD (N=39)	(81.1,159.9)	(91.9,168.1)
VFD (N=31)	(64.9,149.3)	(79.6,159.9)
VFC (N=13)	(6.9,55.5)	(10.2,47.5)
FSA (N=5)	(8.3,228.8)	(32.1,204.9)
ALL (N=88)	(83.6,138.0)	(88.0,133.6)

Source: Table 5.1.

Included within table 5.1 are the average monthly response times separated by department type (e.g. RFD, VFD, VFC, and FSA). It also contains the response time aggregated to the state level. Note the difference between the state totals listed in rows 6 and 7; this is the result of a slight positive skew of the response time distribution. For calculations, the aggregate state total in row 6 will be used because it lessens the impact of any per department skewness to the aggregated state measure. Note also that these figures are monthly and that increasing the measures by a factor of 12 will result in yearly aggregate state estimates. Multiplying the total by 12 results in approximately 526684 hours of response time supplied by volunteer firefighters annually. Dividing this figure by the FTE (Full-Time-Equivalent) classification standard of 2080 hours corresponds to nearly 253 positions. In terms of percentage breakdown of the monthly total number of response hours: RFDs make up 57.5%; VFDs comprise 31.4%; VFCs constitute 6.6%; and FSAs include the

remaining 4.6%. In addition, table 5.2 provides the confidence intervals generated from the data for the average response times by department type.

5.1.2 Volunteer Firefighter Training Time

Volunteer firefighter training proved to be an interesting topic studied due to both the extent and variety of fire training available in Montana. The survey responses provided information about the level of EMT and HAZMAT training as well as the magnitude of volunteer firefighters completing the state mandated 30 hours training per year.

Fire training is separated into two distinct groups — Specific and General fire training. This division is meant to help differentiate between the variety of training available to volunteer firefighters. General training refers primarily to the 30 hour annual state standard. Training of this nature is most often concerned with equipment handling and general fire attack policies and procedures. It is usually repeated many times throughout the year and is available to all members. Specific training, on the other hand, applies primarily to special fire training classes often resulting in certificates of completion specifying a volunteer firefighter's ability to handle certain elements of fire or medical emergencies. A further differentiation between the two types of training is that general training represents a continuous annual amount of fire experience added to the total stock of fire training. In other words, the training is a repeated requirement every year for any active volunteer firefighter. In contrast, specific training can best be thought of as a one-shot addition to the total amount of fire training hours supplied to a volunteer fire agency. Specific

training, once completed, does not need to be repeated every year. Even though there are recertification hours necessary every year for such courses as EMT (Emergency Medical Technician) it is assumed for this study that the majority of the hours added are incurred during the initial certification stage and that the associated recertification hours are negligible and their omission will not significantly influence the final results. In economic terms, general training would be regarded as a *Flow* variable while specific training would represent a *Stock* variable.

General Fire Training

As stated above, the general training measurement collected from the survey consisted of those volunteer firefighters satisfying the 30 hour annual training state standard required before being credited with a year of service. As was mentioned in chapter four, the responses to this inquiry appeared quite genuine. It was hypothesized that there would be a response bias toward a high percentage (i.e. 80% to 90%) of volunteer firefighters per department completing the thirty hour minimum for the year prior to the survey. This hypothesis is due to the fraternal nature of volunteer organizations and their suspected tendency to record each member volunteer firefighter as having completed the required annual training when in fact they had been short. But this pattern did not bear out in the survey responses. It is likely that the anonymity of the survey contributed to the lower than expected answers. For this reason, the measure of the number of volunteer firefighters having

completed the state required yearly minimum 30 training hours is felt to have a considerable amount of accuracy.

Table 5.4 contains the general training as well as the specific fire training time distribution in hours by fire organization type. Essentially, measurement of general training time is computed by multiplying the proportion of a certain departments' volunteer firefighters having completed the annual training minimum by the figure of 30 hours. These figures are then aggregated to derive estimates by organizational type. From these estimates, the state population parameters can be computed. It should be noted that these calculations use only the minimum of 30 hours. It was not possible to measure the actual level or amount of general training time in excess of 30 annual hours even though it likely occurs to some degree. For this reason, the general training times used will be considered conservative estimates.

Specific Fire Training

Specific fire training is quite important when discussing the economic value of volunteer firefighters. It indicates the variety and level of individualized training completed by the volunteer labor force. In addition, it furthers the notion of the *volunteer differential* described by Karn (1982-83).

Specific training available to volunteer firefighters consists of many forms. Table 5.3 contains a listing of the primary classes characterized as specialized training. In addition, this list contains the number of hours associated with completion or necessary for receiving certification. Although

this list does not propose to be exhaustive in any sense, it does include the majority of available specific training.

Before getting into the survey measures, it is worthwhile to cite a few interesting points regarding the list given in table 5.3. Concerning the EMT class, the figure of 110 hours only accounts for the *in-class* time requirements and does nothing to account for the study hours spent *out of class.* In fact, it was related to the author that consideration of out of class study and practice time could potentially add 20 to 30 percent more hours to the total training time associated with obtaining the EMT certification. It is likely that this study time bias is inherent in most all the specific training but that it's effects are considerable for only those classes that require an extensive time commitment for completion. Often more short-term classes will include most of the study and practice time within the framework of the general class meetings.

Also, regarding EMT training, it is still somewhat rare to see very many volunteer firefighters with such a level of sophistication. This is changing and, as detailed in chapter four, the proportion of volunteer firefighters with EMT certification was considerable. Instead of EMT class, many volunteers enroll in the First-Responder course which is about half the time commitment of the EMT training but still quite rigorous. Unfortunately, the First Responder volunteer firefighter time element was not collected within the survey. This was due mainly from the author's lack of knowledge regarding the range of volunteer firefighter training as illustrated in table 5.3. For this reason the economic value estimates will be considered conservative.

TABLE 5.3 SPECIFIC TRAINING CLASS LIST AND ASSOCIATED COMPLETION TIMES

#	Type Of Specific Training	Hours Necessary For Completion
1	CPR (Cardiopulmonary Resuscitation)	8 Hours
2	Advanced First-Aid	40-45 Hours
3	First-Responder (medical)	60-70 Hours
4	EMT (Emergency Medical Technician)	110 Hours
5	EMT-D (D stands for Defibrillator)	16 Hours
6	Wildland Fire Training	
	- 2 Levels	
	i. Introduction	16 Hours
	ii. Intermediate	16 Hours
7	Hazardous Materials Training (HAZMAT)	
	- 3 Levels	
	i. Awareness	4 Hours
	ii. Operations	24 Hours
	iii. Technician	N.A.

Source: Kelly Close of The Department of State Lands in Missoula, Montana.
Note: N.A. means "not available."

Regarding the Wildfire training, it was brought to the author's attention that nearly all of the volunteer fire organizations in Montana currently participate in the State's Rural County-Coop Program.[3] This program is simply an agreement between the state and local fire departments to aid in fighting wildland fires threatening state owned land. In return for entering such an agreement, a volunteer fire organization becomes eligible for donations or low cost leasing of various state surplus fire equipment. One of the stipulations of the agreement is that the departments receive Wildland fire training. With the

[3] Information from discussions with Kelly Close of the Montana Department of State Lands. Kelly is a practicing volunteer firefighter with the Missoula Rural Fire District with a EMT certification and oversees all the County Co-op Agreements entered into with the Southwestern District of the Montana Department of State Lands.

majority of volunteer fire organizations engaged in some sort of County-Cooperative agreement with the state, most volunteer firefighters receive the *Introductory* course which takes 16 hours to complete. It should be noted that more and more volunteers are also receiving the *Intermediate* level of Wildland fire training which consists of an additional 16 hours.

Although the Wildland Fire training times were not collected with the volunteer fire organization survey their imputed impact will be included within a by-department and aggregate state time summation. This process will take the number of active member volunteer firefighters reported within the survey and multiply that figure by 16 hours. The impact of the Wildland Fire training hours will also be included within the volunteer firefighter economic value statistic for the state of Montana.

The survey questionnaire sent out to volunteer fire agencies collected data on two specific training times — EMT and HAZMAT training. To calculate the number of EMT hours per department, the proportion of volunteer firefighters with EMT training is multiplied by 110 hours or the time needed to formally complete the EMT course. Calculating total HAZMAT hours per department was a similar process such that the proportion of volunteer firefighters with hazardous materials training was multiplied by 4 hours or the time required to complete the HAZMAT *Awareness* class. The *Awareness* level was used rather than the *Operations* level because the majority of volunteer firefighters in Montana have taken the former course. As a side note, more and more volunteers are expressing interest in HAZMAT classes and are enrolling in the *Operations* course. Information on the average distribution of EMT and

HAZMAT hours as well as imputed measures for Wildland Fire training separated by organization type are included in table 5.4. Their respective confidence intervals are contained in table 5.5. It should be noted that the confidence intervals presented in table 5.2 and 5.5 are fairly large. This is due to the wide variance or spread of the measured response and training times.

The aggregated state totals are given in table 5.6. It is not surprising that RFDs, representing nearly 46 percent of the total volunteer fire agencies in Montana, include the majority of the supplied training hours. RFDs and VFDs, as a group, embody 84.8% of the general training hours, 85.2% of the EMT hours, 94.9% of the HAZMAT hours, and 79.7% of the Wildland Fire training hours supplied by volunteer firefighters. While these percentages are in line with the RFD and VFD proportion of total number of volunteer fire agencies in the state, they also indicate the pervasiveness and widespread use of either of these two fire organization structures in Montana.

5.2 The Value of Volunteer Firefighter Time

Estimating the value of volunteer firefighter services to the state of Montana requires calculation of a hourly volunteer firefighter wage respective of their marginal contribution to the delivery of fire protection and emergency assistance to rural communities. This is difficult for several reasons.

TABLE 5.4 AVERAGE GENERAL AND SPECIFIC TRAINING TIME DISTRIBUTIONS IN HOURS BY ORGANIZATION TYPE

TRAINING	RFD	VFD	VFC	FSA	ALL
General Training					
30 Hours:					
Count	42	36	18	6	102
Mean	471.4	412.5	175.0	435.0	396.2
Std Dev	287.9	301.3	174.1	263.4	291.4
Min	0.0	0.0	0.0	120.0	0.0
Max	1080.0	1080.0	480.0	870.0	1080.0
Specific Training					
EMT:					
Count	42	36	18	6	102
Mean	178.1	223.1	61.1	256.7	177.9
Std Dev	222.6	228.5	101.4	257.2	216.2
Min	0.0	0.0	0.0	0.0	0.0
Max	880.0	770.0	330.0	660.0	880.0
HAZMAT:					
Count	40	36	18	6	100
Mean	41.5	26.7	4.9	6.7	27.5
Std Dev	34.1	35.7	5.7	7.9	33.4
Min	0.0	0.0	0.0	0.0	0.0
Max	112.0	128.0	16.0	16.0	128.0
Imputed Wildland Fire Training:					
Count	42	36	18	6	102
Mean	352.0	336.0	212.4	357.3	322.0
Std Dev	143.1	119.4	112.0	177.2	139.9
Min	96.0	48.0	32.0	176.0	32.0
Max	736.0	640.0	480.0	640.0	736.0

Source: Survey Data.

TABLE 5.5 TRAINING DISTRIBUTION CONFIDENCE INTERVALS BY ORGANIZATION TYPE

Type of Training	Confidence Interval (Two-Tailed Significance Test) alpha=.05	alpha=.10
General Training		
30 Hours:		
RFD (N=42)	(381.6,561.2)	(396.6,546.2)
VFD (N=36)	(310.5,514.5)	(327.6,497.4)
VFC (N=18)	(88.8,261.2)	(103.8,246.2)
FSA (N=6)	(171.8,698.2)	(226.0,644.0)
ALL (N=102)	(338.9,453.4)	(348.3,444.1)
Specific Training		
EMT:		
RFD (N=42)	(108.7,247.5)	(120.3,235.9)
VFD (N=36)	(145.7,300.4)	(158.7,287.4)
VFC (N=18)	(10.9,111.3)	(19.7,102.6)
FSA (N=6)	(-0.26,513.6)	(52.7,460.7)
ALL (N=102)	(135.5,220.4)	(142.4,213.5)
HAZMAT:		
RFD (N=40)	(30.6,52.4)	(32.4,50.6)
VFD (N=36)	(14.6,38.8)	(16.6,36.7)
VFC (N=18)	(2.04,7.74)	(2.54,7.24)
FSA (N=6)	(-1.19,14.52)	(0.43,12.91)
ALL (N=100)	(20.8,34.1)	(21.9,33.0)
Imputed Wildland Fire Training:		
RFD (N=42)	(307.4,396.6)	(314.8,389.2)
VFD (N=36)	(295.6,376.4)	(302.4,369.6)
VFC (N=18)	(157.0,267.9)	(166.7,258.3)
FSA (N=6)	(180.3,534.4)	(216.8,497.9)
ALL (N=102)	(294.6,349.5)	(299.0,345.0)

Source: Table 5.4.

TABLE 5.6 GENERAL AND SPECIFIC AGGREGATE TRAINING HOURS FOR THE STATE OF MONTANA

TYPE OF TRAINING	RFD (N=194)	VFD (N=115)	VFC (N=100)	FSA (N=17)	AGGREGATE STATE TOTAL (N=426)
General Training					
30 Hours:					
Total Hours	91,451.6	47,437.5	17,500	7,395	163,784.1
Percent of Total	55.8%	29.0%	10.7%	4.5%	100%
Specific Training					
EMT:					
Total Hours	34,551.4	25,656.5	6,110	4,363.9	70,681.8
Percent of Total	48.9%	36.3%	8.6%	6.2%	100%
HAZMAT:					
Total Hours	8,051	3,070.5	490	113.9	11,725.4
Percent of Total	68.7%	26.2%	4.2%	1.0%	100%
Imputed Wildland Fire Training:					
Total Hours	68,288	38,640	21,240	6,074.1	134,242.1
Percent of Total	50.9%	28.8%	15.8%	4.5%	100%

Source: Table 5.4 general and specific training averages per department type.

First, regarding economic theoretical concerns, volunteers receive an implicit wage of zero because their time is not formally remunerated. Common sense tells us that in reality there is a positive value placed on volunteer firefighter services by the benefiting community. However, the associated wage measure is not explicit and must be imputed by some alternative method. In

other words, the marginal contribution by a volunteer firefighter cannot be determined by a market mechanism and subsequent efforts must be directed toward deriving a *shadow wage.* Secondly, derivation of such a shadow wage is confounded by the choice of what base to use, which method is employed, and what volunteer firefighter characteristics are accounted for in the determination process.

There are essentially three perspectives which facilitate the determination of the marginal time contribution value: Value to society; Fair return on human capital; and Economic value added.[4] These were described in chapter three and won't be redefined here. Economic value added is the primary perspective used within this study to monetarily ascribe a value to the marginal time contributions made by volunteer firefighters.

The process used in this thesis makes no attempt to account for the community's value of the public externalities created by an efficient rural firefighting volunteer force. *Peace of mind* is often a positive externality created by a local fire or police department. Attempting to attach an economic value measurement to this public externality is both costly and prone to error due to the difficulty in quantifying such an intangible concept.

Estimating the value of nonmarket volunteer firefighter time utilized the market cost design described in chapter three.[5] The market cost procedure estimates the cost or value of volunteer fire protection services on the basis

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[4] Greene, Robert J. 1989. Determinants of Occupational Worth: Understanding the Elements That Define Job Value. *Personnel Administrator*, (August), 78-82.

[5] Two articles detailing the Market cost and the Opportunity cost approaches to imputing measures for the marginal product of labor were:

Leuthold, Jane H. (1981). Taxation and The Value of Nonmarket Time. *Social Science Research*, September, 10, 267-281

Ferber, M.A. and B.G. Birnbaum. (1980). Housework: Priceless or Valueless. *Review of Income and Wealth*, December, 26, 387-400

that they must be procured through the process of hiring paid labor. Essentially this amounts to determining a relevant wage paid to career firefighters and applying it to volunteers.

5.2.1 Wage Imputation Design

Determining an appropriate shadow wage for volunteer firefighters was modeled after the "True Value Assessment Process" developed by Karn (1982-83). This method was presented in figure 3.2 and discussed in chapter three. Only it's application to this specific study will be detailed here. Karn's technique determines the value of the actual volunteer time rather than what the volunteer *could potentially* earn in the paid labor market. It's base is the market cost approach mentioned above. By maintaining this framework Karn minimizes the variation due to individual volunteer quality differentials and arrives at the *true value* of the volunteer work in question. Summarizing the advantage of his method, Karn notes:

> Implicit in this approach is the premise that the value of volunteer time is the actual worth of the contribution, not the volunteer's earning power. For volunteers performing the same task, calculations misguidedly based on earning power would serve to overvalue the contributions of some citizens who happen to enjoy a high rate of compensation in their work for pay such as engineers, physicians and attorneys, while undervaluing the contribution of other volunteers such as students, women who do not work outside of the home, and retired people. At the scene of a fire, each properly trained volunteer firefighter is essentially worth the same whether he or she is an eighteen year old student or a physician or an attorney. The only fair value is the worth of the volunteer work itself. [6]

The Missoula Rural Fire District's *"Firefighter I"* job classification and wage schedule characteristics will be used as a base for developing average

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[6] Karn (1982-83), page 4.

hourly wage measures for each individual volunteer fire agency responding to the survey. This classification was used because wage data was readily available and because the Missoula RFD holds the unique distinction of being a Rural Fire District maintaining a fully operational paid staff as well as arguably one of the largest and best trained supply of volunteer firefighters. The employment of Karn's technique is detailed in figure 5.2. Please note the following regarding figure 5.2:

1. The Longevity calculation used the average years of experience or service for active members of each department responding to the survey of Montana volunteer firefighting organizations. The example in figure 5.2 assumed an entry level firefighter with zero years experience.
2. There are no holiday hours listed under section VI because firefighters work their shift regardless of whether it falls on a holiday or not.
3. EMT-D was included within the salary calculations but used Hazardous Training records per department to determine whether the EMT-D dollar amount would be added to the base salary. This was done in an attempt to input some variation so that the imputed volunteer wage rate would better reflect the volunteer training differences among the fire organizations responding to the sample.
4. The EMT dollar amount was added to the base salary with respect to the proportion of volunteer firefighters within a department that were Certified EMT's.

FIGURE 5.2 TRUE VALUE ASSESSMENT CALCULATIONS FOR MONTANA VOLUNTEER FIRE ORGANIZATIONS

I. Equivalent Paid Classification	*Missoula RFD Firefighter I*
II. Annual Base Salary For Equivalent Paid Position	
Base Annual Salary	$20140.69
EMT (12 mo. @ $75)	$900.00
EMT-D (12 mo. @ $45)	$540.00
Longevity ($132 × # Years Experience)	$0.00
Holiday Pay (Average)	$925.00
Total (Gross) Annual Salary	$22505.69
III. Value Of Benefits Package	
FICA (1.45% of Gross Salary)	$326.33
Retirement (6% of Base Salary)	$1208.44
Health Insurance (Family Plan)	$3816.00
PERS (6.417% of Gross Salary)	$1444.19
Workers Comp. Ins. ($7.50 per $100 of Gross)	$1687.93
Unemployment Ins. (.15% of Gross Salary)	$33.76
Clothing Allowance	$250.00
Total Value of Benefits	$8516.65
IV. Value of Total Compensation Package	
Annual Salary	$22505.69
Benefits Package	$8516.65
Total Annual Compensation	$31022.34
Classical Hourly Wage Calculation (IV / V)	**$11.98**
V. Established Annual Work Hours	
(49.8 Hours × 52 Weeks)	2589.60
VI. Hours Paid But Not Worked Annually	
Annual Leave Hours	168.00
Sick Leave Hours	120.00
Total Pain Nonworked Hours	288.00
VII. Hours Actually Worked Annually	
(V Minus VI)	2301.60
VIII. Imputed Volunteer Firefighter Hourly Wage	
(IV Divided By VII)	**$13.48**

Source: Missoula Rural Fire District 1991-92 Wage and Benefit Schedule for *Firefighter I* job classification.

Notice that the Classical Hourly wage Calculation under section IV is less than the Imputed Volunteer Firefighter Hourly Wage. This is precisely what is supposed to occur. Karn (1982-83) argued that since volunteers receive no vacation or sick leave benefits, those respective hours should be subtracted from the total when determining the imputed wage. This action results in a higher imputed wage, but for good reason. The objective is to estimate the value of *actual* hours worked because volunteer time is often spent explicitly producing a particular good or service. In this study, the goal is to estimate the economic value for volunteer firefighter services. Note that the hours upon which the imputed wage will be multiplied by are either response or training hours. By their own definition they represent volunteer time spent explicitly performing work related to the duties and responsibilities as a volunteer firefighter.

The distribution of the imputed volunteer firefighter hourly wage rate is provided in table 5.7. If there is a criticism, it is that the variation among the estimated wages was quite small. A critic might argue that the imputed wage was essentially equivalent over all sample fire agencies. But this ignores the potential that there may naturally be little variation or difference in the value of a volunteer firefighter in one area or department as compared to another volunteer firefighter in another region. The limited variation in the final imputed wage figures likely resulted from the inability to accurately model the training and response time differences per volunteer firefighter. The constraint of having to derive average value estimates per department rather than per volunteer firefighter results in *aggregation* bias which undermines the accuracy

of the results by lowering the overall variation within the data distribution and hiding potential patterns or trends.

TABLE 5.7 IMPUTED VOLUNTEER FIREFIGHTER HOURLY WAGE DISTRIBUTIONS BY DEPARTMENT TYPE

Fire Organization Type	Mean	Std Dev	Minimum	Maximum	Confidence Interval (alpha=.05)
RFD (N=40)	$13.52	0.20	$13.17	$13.92	(13.46,13.58)
VFD (N=36)	13.49	0.20	13.02	14.14	(13.42,13.56)
VFC (N=18)	13.48	0.32	13.00	14.16	(13.32,13.64)
FSA (N=6)	13.38	0.14	13.20	13.53	(13.24,13.52)
ALL (N=100)	13.49	0.22	13.00	14.16	(13.45,13.53)

Source: Imputation method developed by Karn (1983) using survey data.

With a set of average wages calculated for every sample volunteer fire organization, it is now possible to estimate the value of volunteer firefighter services to those departments, separate the measures into average value calculations by department type (RFD, VFD, etc.), and then aggregate the results on a statewide basis.

5.2.2 Economic Value Method #1

This approach entails measuring the economic value of volunteer firefighters not just in terms of sheer firefighter numbers but incorporating factors such as training and response time into the calculations. By addressing training and response time differentials in fire protection services supplied to a

community, it is possible to value the total contribution made by volunteer firefighters in Montana.

Determining the economic value of volunteer firefighter service time contributions involves multiplying the average sample volunteer hours per department by their respective shadow wage developed in section 5.2.1. Generating the total economic value estimates for the entire spectrum of hours supplied by volunteer firefighters was conducted on a per department basis and then aggregated by department type (RFD, VFD, etc.) to the state level. The results are provided in table 5.8 and represent 1991 values calculated in 1991 dollars. In addition, the economic value calculations aggregated on a statewide level are contained within table 5.9.

The total economic value of the volunteer firefighter services contributed to the state of Montana was $12,404,729. Not surprising, RFDs and VFDs in relation to their size and influence comprised the bulk of the contributed volunteer service value. VFCs despite their total number in the state contributed an lower overall value of volunteer firefighter services. As was borne out in the figures, VFCs likely concentrate or focus on general training as well as Wildland Fire training since they are found in more rural areas with a higher geographic dispersion of population and building structures. The total value figures for FSAs were largely consistent with their proportion to the total number of volunteer fire organizations within the state. With so few number of FSAs in Montana it is difficult to confidently generalize to the aggregate level because the chance of one department skewing the averages rises significantly.

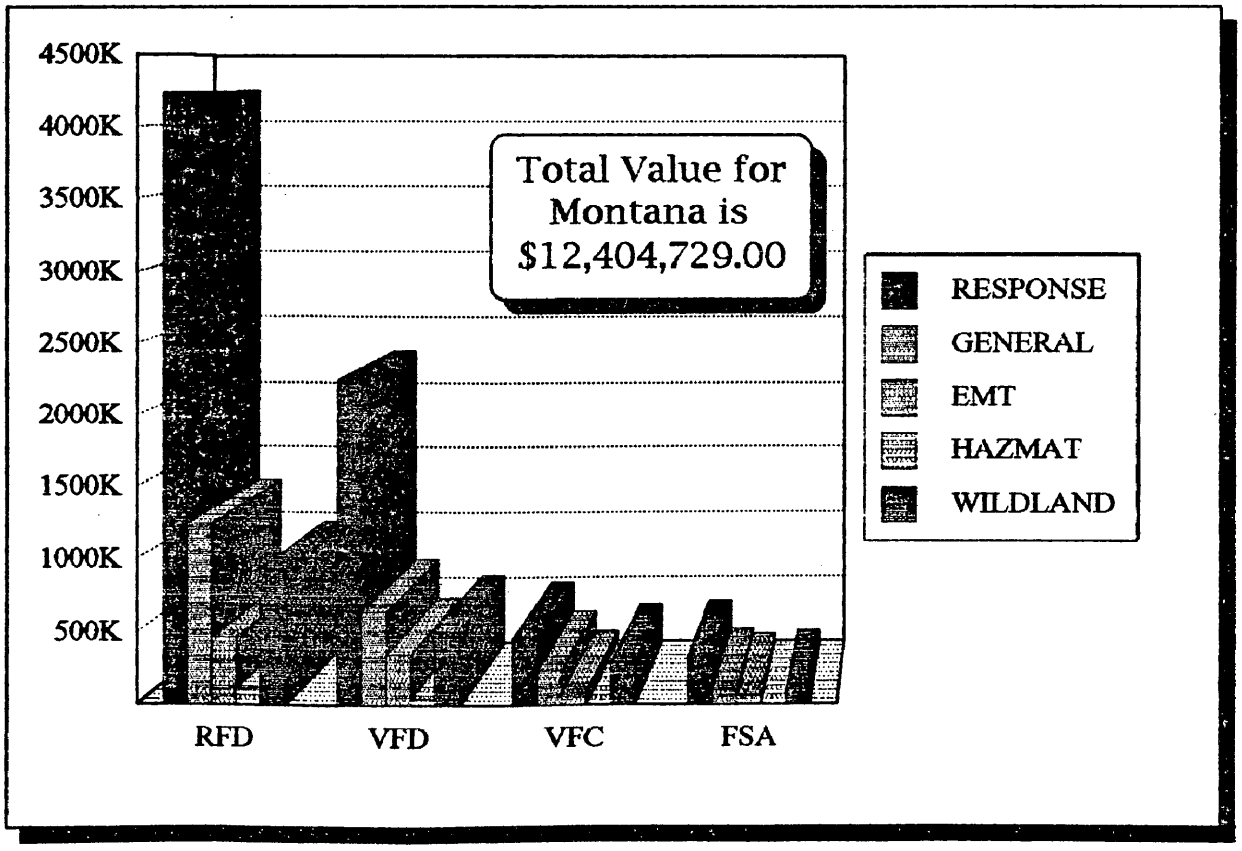
TABLE 5.8 VOLUNTEER FIREFIGHTER ECONOMIC VALUE ESTIMATES BY DEPT. TYPE AND BY TYPE OF SERVICE TIME

SERVICE TIME	RFD	VFD	VFC	FSA	ALL
Response Time/Month					
Count	37	31	13	5	86
Mean	$1818.80	$1623.30	$386.57	$1587.10	$1518.40
Std Dev	1,943.3	1,794.2	507.82	1,279.1	1,757.4
Min	0	42.42	0	508.2	0
Max	8,272.1	6,764.2	1,665.5	3,180.5	8,272.1
General Training/Year					
Count	40	36	18	6	100
Mean	$6402.60	$5576.20	$2325.5	$5821.2	$5336.3
Std Dev	3,970.2	4,093.1	2,295.4	3,559.2	3,977.4
Min	0	0	0	1,623.7	0
Max	14,566	14,566	6,320.1	11,774	14,566
Specific Training/Year					
EMT:					
Count	40	36	18	6	100
Mean	$2356.5	$3019.9	$827.15	$3435.6	$2384.8
Std Dev	3,087.9	3,090.4	1,368.2	3,438.4	2,950.6
Min	0	0	0	0	0
Max	11,894	10,286	4,345.1	8,789.6	11,894
HAZMAT:					
Count	40	36	18	6	100
Mean	$563.48	$362.98	$66.1	$89.34	$373.32
Std Dev	465.43	489.46	77.38	105.36	456.42
Min	0	0	0	0	0
Max	1,547.6	1,744.5	218.78	216.52	1,744.5
Wildland Fire Training:					
Count	40	36	18	6	100
Mean	$4819.3	$4534.4	$2854.6	$4780.1	$4360.7
Std Dev	1,955.4	1,626.2	1,496.4	2,365.9	1,904.6
Min	1,072.6	678.79	434.32	2,322.7	434.32
Max	9,968.8	8,631.5	6,258.1	8,523.3	9,968.8

Source: Survey Data of volunteer fire organizations in Montana.

Regarding table 5.9, volunteer firefighter emergency incident *response* hours generated the highest valued service element to the state of Montana. Figure 5.2 provides a graphical representation of the total economic value of individual volunteer firefighter service elements and their magnitude in relation to fire department type. General training registered second with Wildland Fire training generating the third highest value measures for the state of Montana. The more specialized courses of EMT and HAZMAT generated the lowest value figures.

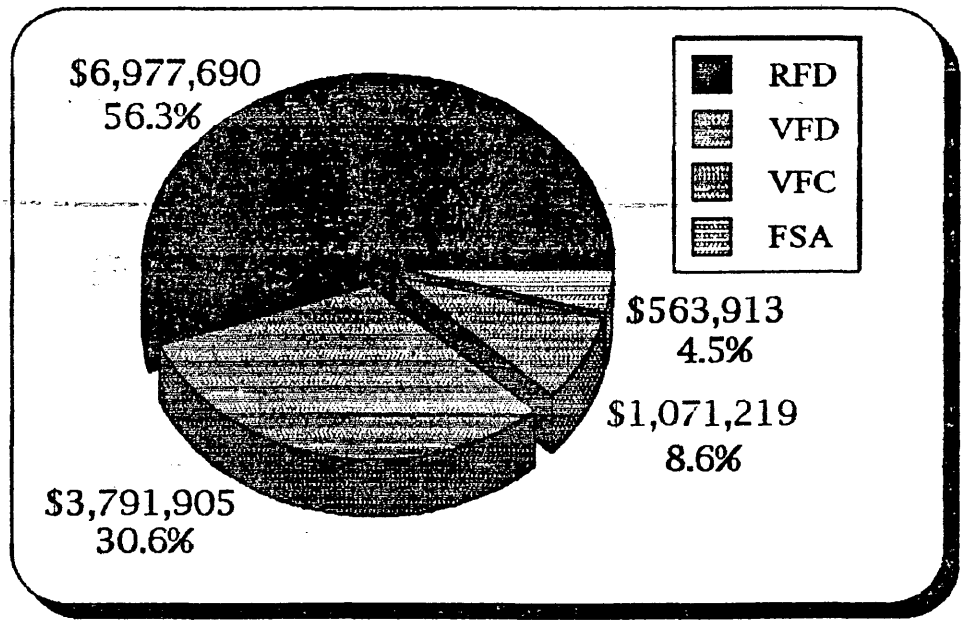
FIGURE 5.3 TOTAL ECONOMIC VALUE OF VOLUNTEER FIREFIGHTER SERVICES TO THE STATE OF MONTANA BY SERVICE TYPE AND ORGANIZATION



Source: Table 5.9.

Overall, the figures were generally reflective of a particular fire organization type's proportion to the total number of volunteer fire agencies in the state of Montana. Measurements for RFDs were on average higher than their overall proportion while VFC estimates were lower than their overall proportion. Figure 5.3 provides a graphical illustration of the aggregated value estimates and the proportional contributions to the total amount broken down by organizational type.

FIGURE 5.4 TOTAL ECONOMIC VALUE ESTIMATES FOR MONTANA BY ORGANIZATION



Source: Table 5.9.

5.2.3 Economic Value Method #2

The technique of determining the economic value of volunteer firefighter services to Montana under method #2 was to estimate an econometric model of the derived labor input or factor demand equation. This model can also be

referred to as a *producer* demand schedule such that it measures the level of volunteer firefighter labor demanded by an individual fire department. It is *derived* in the sense that a fire department's demand for volunteers comes or stems from the community's demand for fire protection services. The derived volunteer firefighter demand schedule estimated from the data attempted to explain changes in the level of volunteer firefighter numbers per department to changes in departmental characteristics, socioeconomic attributes, and demographic factors.

5.2.3.1 Labor Demand Theory, Model Specification, And Volunteer Firefighters

Applying the economic theory of labor demand to the voluntary sector prompts several concerns to be addressed. An important topic arising within this study is the discussion of endogeneity and it's resulting affects on econometric models of derived demand. Of equal weight is the attention to model specification and the relevance of certain economic theories, assumed to be operating within the private or paid public sectors, to elements of the volunteer labor market.

Endogeneity refers to the situation where two variables are jointly determined. For example, in the system of equations describing a simple demand and supply model:

Demand Function: $Q_t^d = \alpha_0 + \alpha_1 \cdot P_t + \varepsilon_{1t} \quad \alpha_1 < 0$

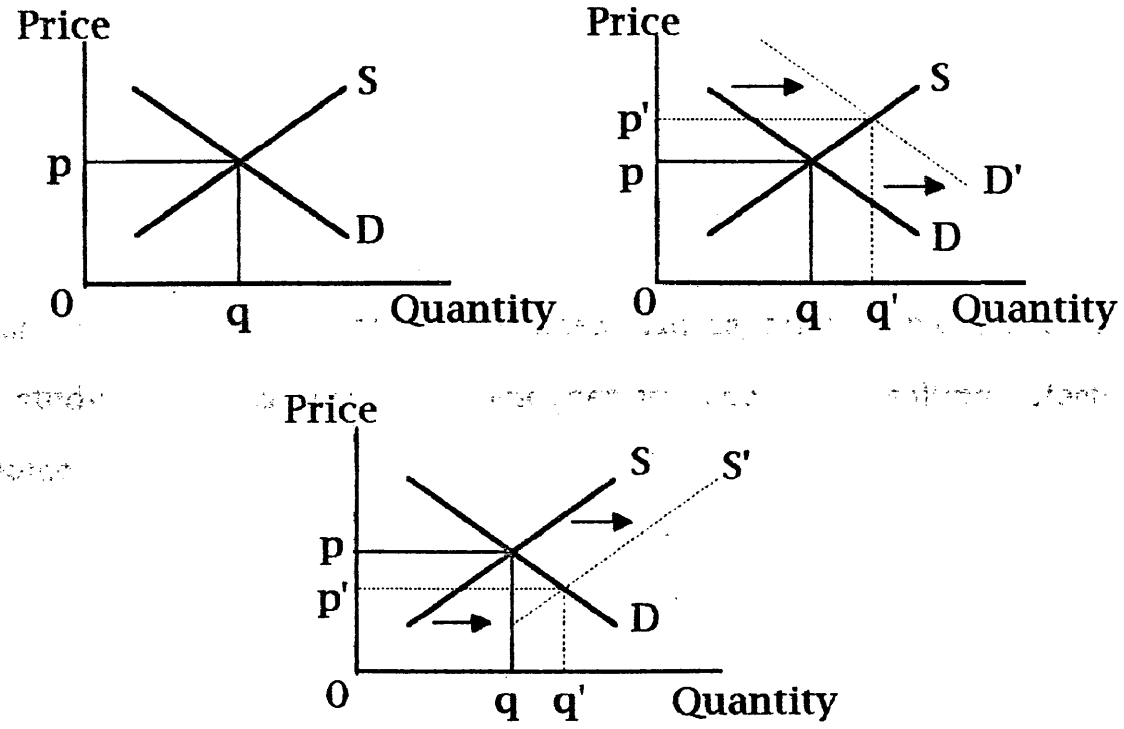
Supply Function: $Q_t^s = \beta_0 + \beta_1 \cdot P_t + \varepsilon_{2t} \quad \beta_1 > 0$

Equilibrium Condition: $Q_t^d = Q_t^s$

Where:
P = Price
Q^d = Quantity Demanded
Q^s = Quantity Supplied
t = Time

price (P) and quantity (Q) are jointly dependent variables such that price changes influence the level of quantity demanded and supplied but also that changes in overall Demand or Supply can perpetuate raising or lowering of the price level. Graphically this is presented in figure 5.4 below.

FIGURE 5.5 JOINT DETERMINATION OF PRICE AND QUANTITY



As seen in figure 5.4, Quantity shifts definitely result in price changes. As Demand increases due to a change in tastes or income, pressure is exerted on the price level to also increase to once again balance the overall demand with supply. But the line of causality runs the opposite direction also, since price increases can, *over the long run*, lead to a rise in Supply as new firms entering

the market increase total output. It is this situation or characteristic that best describes the condition of an endogenous relationship between two variables.

Endogeneity within an econometric model introduces a serious violation of the Classical Linear Regression assumption that the explanatory variables (X's) are not correlated with the disturbance term (ε). The consequence of endogeneity is that the estimate's from the Classical Linear Regression model will be inconsistent or not asymptotic such that as the sample size grows there is no guarantee that the estimated coefficients will converge to their true value. To address the potentially damaging influence of endogeneity several econometric applications can be used. Two Stage Least Squares (2SLS) regression is the primary method of choice due to it's low computational cost and the ease of running the procedure. 2SLS is often found on popular Econometrics computer software.

The structural derived labor demand model specified within this study of volunteer firefighters took the loglog form[7]:

$$LACTIVE = \alpha_0 + \alpha_1 \cdot LVOLWAGE + \alpha_{2i} \cdot X_{2i} + \alpha_{3i} \cdot X_{3i} + \alpha_{4i} \cdot X_{4i} + \varepsilon$$

Where:

LACTIVE = Natural log of the number of *active* member volunteer firefighters per department
LVOLWAGE = Natural log of the imputed volunteer firefighter hourly wage rate
X_{2i} = Vector of Demographic variables
X_{3i} = Vector of Socioeconomic variables
X_{4i} = Vector of Department-specific variables

[7] Modified from: Trejo (October, 1991) pg 173.

The question of endogeneity arose between LACTIVE and LVOLWAGE. Economic theory postulates that the wage rate and the level of employment are jointly determined. This hypothesis was tested and the results will be detailed later when discussing the estimation results. Suffice it to say that the level of endogeneity was insignificant and that estimation of the structural model was possible.

Regarding model specification, the decision of which variables to include or omit was a difficult process. With little research having been done concerning volunteer firefighters, or just plain volunteers for that matter, there was not a clear direction or path with which to guide the modeling decisions. In addition, the model utilized for this study was borrowed and modified from a paid firefighter labor market situation. Whether the variables used represent the major explanatory measures for volunteer firefighters as well as career paid firefighters is debatable. However, this thesis application treads new waters and the underlying theme of caution has already been raised. The final model estimated and detailed in the next section utilizes the majority of explanatory variables employed in similar estimated paid firefighter demand models.[8] Also, extensive work was done to discover explanatory measures within the data set collected for this study that would be specific to volunteer firefighters and volunteer fire organizations which would help explain the variance within the derived demand for volunteers.

[8] TreJo (1991), Southwick and Butler (1985), Ahlbrandt (1973), Vernez (1976), and Getz (1979).

5.2.3.2 Model Estimates and Results

Estimating the derived input demand schedule for volunteer firefighters specified in the last section was performed using Ordinary Least Squares (OLS). Both a loglog and linear form of the model were computed. Although most of the data descriptives have been detailed in chapter four, table 5.10 provides the means and standard deviations of the variables specifically used within the regression models. Variable definitions are contained within appendix B.

Endogeneity

Regarding the presence of endogeneity discussed in the previous section, two tests were run to determine whether it was indeed a problem. Remember that the volunteer hourly wage is an imputed figure and the empirical relevance of endogeneity is not clear. Therefore it was worthwhile to test for endogeneity before committing to using alternative procedures to fix what was not broken to begin with. The two tests were the Hausman Test and calculation of the Wald Statistic. The first test simply uses the reduced form predicted values and includes these in the estimated structural model. If the estimated coefficient of the instrumental (predicted values) variable is statistically significant then one can reject the hypothesis that there is not an endogenous relationship at work. The Wald Statistic provides another gauge of endogeneity and utilizes a system of 2SLS estimates to generate a chi-square statistic with degrees of freedom equal to the number of endogenous variables. Both tests were insignificant thereby allowing estimation of the structural derived demand schedule with OLS.

TABLE 5.10 DESCRIPTIVE STATISTICS FOR REGRESSION VARIABLES

Variable	Mean	Standard Deviation
Fire Department Specific Variables		
ACTIVE	19.82	8.55
VOLWAGE	13.49	0.23
POPSERV	2040.90	2559.90
MEM30PCT	0.63	0.35
INCMNTH	3.70	4.02
YRBUDGET	24720.00	38060.00
SCBA	7.77	6.13
EQUIPNUM	4.27	2.96
AVGAGE	39.60	4.83
CERTEMT	1.65	2.01
HZRDTRN	6.52	8.11
Demographic and Socioeconomic Variables		
PERSINC	9800.30	1140.10
ASSESSED	20814.00	22359.00
AVGVALUE	49269.00	14642.00
POP18PCT	0.28	0.05
FEMPCT	0.50	0.02
POP65PCT	0.14	0.05
Dichotomous Variables		
EAST	0.37	0.48
VFCDUM	0.18	0.39
SAMPLE SIZE	95	

Source: Survey data.

General Estimated Parameter Results

Estimating the volunteer firefighter derived demand model through econometric regression techniques proved to be both challenging and rewarding. The results detailed here indicate general support for using the econometric approach as a viable alternative to deriving the value of volunteers or simply to determine what explanatory variables predict or explain the demand for volunteer firefighters by rural communities.

The results of the econometric estimation are provided in table 5.11. Included are estimated parameters for both the loglog model as well as the linear model specification. Both models visually supported the data surprisingly well considering the apprehensive tone regarding the model's applicability to the voluntary sector.

In general, all the signs of the coefficients were correct or were plausible given certain assumptions. For instance, the coefficients for CERTEMT and HZRDTRN in the loglog and linear model were both positive. It was hypothesized a priori that these signs would be negative such that increasing the training level of the volunteer firefighter labor pool would lead to an overall increase in their productive capacity thereby causing fire departments to demand less volunteer firefighters to maintain a given level and quality of fire protection service.[9] But, these signs are not in conflict if we adjust our views regarding what it is that CERTEMT and HZRDTRN are measuring. Both represent specialized training. Specialized training affects labor demand differently than generalized training such that volunteers having the former

[9] Of this interpretation I am greatly indebted to Dr. Doug Dalenberg, Professor of Economics.

will be demanded more by agencies needing specific skills. It could be argued that volunteer fire agencies produce a public good that requires highly specialized skills and thus rewards specific training much higher than general training. It would not be surprising then to find that as the number of certified EMTs or personnel skilled in responding to emergencies involving hazardous materials increases, more demand of firefighters will result thereby supporting the positive sign realized in the estimated economic regression parameters.

The negative sign for the MEM30PCT coefficient supports the original hypothesis. As the overall general training level of the volunteer firefighter labor force increases, less firefighters are needed to maintain a certain level of output or quality of fire protection.

The expected sign for YRBUDGET was correct and significant in the loglog model but insignificant and the negative for the linear regression. Interestingly, POPSERV, which was thought to serve as a primary gauge of community demand, was not significant in either regression model. It is quite possible that community demand for fire protection is largely dictated by the number, size, density, and quality of building structures within an area. Unfortunately a reliable measurement of this community characteristic was not available. SCBA, which served as proxy measure for the quality of fire protection, was positive and significant in the loglog model. EQUIPNUM was an indicator both of departmental size as well as service quality. It's coefficient was positive and significant in the linear model but *not* significant in the loglog model. Only one of the demographic variables — AVGVALUE — was significant. The negative sign of the coefficient for AVGVALUE is plausible given that

owners of more expensive property may invest in a greater amount of substitutes for local fire protection like fire alarms and damage insurance thereby signaling fire departments to demand less volunteers.

Of primary support of the econometric application of a derived demand schedule to volunteer firefighters was that the sign of the VOLWAGE variable in both models was negative and significant thereby supporting the economic contention of a downward sloping demand curve. In addition, the R^2 measure was satisfactory at .683 and .647 for the loglog and linear models, respectively. Lastly, the F-statistic which measures the overall statistical significance of the regression was well above the critical value.

Potential Biases

Whenever econometric regression techniques are applied to the task of estimating model parameters, several of the assumptions underlying the Classical Linear Regression Model must be tested to determine the degree to which they are adhered to. If the estimated model deviates from any of the main assumptions significantly then bias can alter the parameters rendering any inferential characteristics more difficult or impossible. For this study, the primary concerns are with multicollinearity, heteroscedasticity, and model specification.

Multicollinearity (MC) characterizes or refers to an exact or relatively exact linear association among the explanatory variables (X's) within a regression model. The consequences of MC are to increase the standard errors of the parameter estimates thereby potentially rendering the regression coefficients statistically insignificant.

TABLE 5.11 OLS ESTIMATES: STRUCTURAL DERIVED LABOR DEMAND MODEL IN LOGLOG AND LINEAR FORMS

Variable	Model Estimated Parameters Loglog	Linear	Expected Sign
VOLWAGE	-12.560*** (2.549)	-10.776*** (3.422)	-
POPSERV	0.055 (0.048)	0.00051* (0.00038)	+
MEM30PCT	-0.272** (0.140)	0.997 (2.106)	-
INCMNTH	0.081* (0.054)	0.384** (0.1999)	+
YRBUDGET	0.087*** (0.032)	-0.16E-04 (0.20E-04)	+
SCBA	0.168** (0.077)	0.242* (0.168)	+
EQUIPNUM	0.061 (0.070)	1.103*** (0.269)	+
AVGAGE	0.680 (0.435)	0.173 (0.155)	(+,-)
CERTEMT	0.132*** (0.052)	0.731** (0.373)	-
HZRDTRN	0.142*** (0.041)	0.183* (0.119)	-
PERSINC	0.535* (0.349)	0.71E-03 (0.67E-03)	+
ASSESSED	-0.044 (0.045)	0.21E-04 (0.38E-04)	+
AVGVALUE	-0.350* (0.191)	-0.19E-04 (0.65E-04)	(+,-)
POP18PCT	-0.156 (0.797)	-8.931 (14.861)	(+,-)
FEMPCT	-0.163 (1.900)	-35.041 (40.611)	(+,-)
POP65PCT	0.681 (0.751)	13.293 (18.639)	(+,-)
EAST	-0.041 (0.083)	0.640 (1.668)	(+,-)
VFCDUM	0.125 (0.126)	-0.958 (1.751)	-
CONSTANT	30.628*** (7.054)	159.76*** (47.98)	+
R^2	0.683	0.647	
R^2_{Adj}	0.608	0.563	
F-statistic	9.08	7.72	
Sample Size	95	95	

Notes:

1. The dependent variable = ACTIVE.
2. Standard Errors are in parentheses.
3. * Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level.
4. The Significance tests are one-tailed if they had an a priori sign and two-tailed if an expected sign was unpredictable from theory.
5. In the Loglog model, all variables except the percentage and dichotomous measures are in natural log form.

The severity of MC was tested using the Condition Indexes and the ratio of significant t-scores against the strength of R^2. For the Condition Indexes, the rule of thumb is that if any are between 10 and 30 then there is moderate MC and if any exceed 30 then there is severe MC.[10] The Condition Indexes calculated for the explanatory variables included within the structural derived demand model indicated severe MC for the linear functional form. For the logged explanatory derived demand variables, the Condition Indexes were much lower but still indicated that MC was moderately severe. Looking at the t-scores for both functional forms of the model was not revealing. Both the loglog and linear forms had a fair number of significant coefficients compared to their respective measures of R^2.

Empirically, there is not much in the way of alleviating the effects of MC. One can drop a suspected collinear variable but at the risk of omitting a relevant explanatory measure from the model. Another alternative is to increase the sample size but that is sometimes not feasible and was not possible within this study due to collection costs. Suffice it to say that the estimated coefficients are still unbiased and consistent or of minimum variance. The practical problem of MC is that the larger standard errors cause the t-scores to go down. However if they are already significant then eliminating MC will not change the estimated coefficients but rather just increase their significance due to smaller standard errors.

Heteroscedasticity (HET) is the situation where the model disturbances or error term is not of equal variance. As an example, the error distribution

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[10] Gujarati (1988) pg 301.

could grow or shrink as an explanatory variable grows. In contrast, the situation of equal variance or homoscedasticity is represented symbolically by:

$$E(u_i^2) = \sigma_i^2 \quad i = 1,2,3,.....,N$$

Empirically, the consequences of HET are similar to MC. HET causes the estimated coefficients to no longer retain the properties of BLUE (Best Linear Unbiased Estimate). Serious heteroscedasticity affects the efficiency of the estimates such that they are no longer minimum variance and thus it is not known whether the standard errors of the estimated coefficients have increased or decreased.

To detect and measure the degree of HET within the volunteer firefighter derived demand model, several popular HET tests including the Glejser, Harvey, and Breusch-Pagan tests were calculated.[11] In addition, extensive plotting of the disturbance term against both the predicted values and several explanatory measures was also employed to detect HET within the model. For the linear form of the model, the HET tests were all insignificant. But, regarding the loglog form, the HET tests were significant indicating that heteroscedasticity was present. Also, the disturbance plots against the predicted values indicated a pattern such that as the number of predicted volunteer firefighters per department grew the error term decreased.

To address this problem, the loglog model was estimated using White's Heteroscedastic-Consistent Covariance Matrix Correction. This method corrects the standard errors of the estimated regression coefficients for an unknown form of heteroscedasticity. The overall effect of running White's

[11] These tests were run by stipulating the HET detection option while estimating regression models using the econometrics computer program SHAZAM®.

correction lowered the standard errors thus making the significance of the t-scores increase. For a few explanatory measures the standard errors increased but these variables were largely insignificant to begin with.

The last issue concerns Model Specification and is a difficult subject to deal with regarding the volunteer firefighter derived input demand schedule. There is little or no previous econometric work in estimating a derived demand for volunteers.

The initial process of deciding which independent variables to include was predicated on theoretical as well as empirical grounds. Variables consistently used in previous studies, especially in Trejo (1991), were included. In addition, variables showing significant correlation with the dependent variable were also included. This process facilitated two goals. The first was to adhere to the hypothesized relationships dictated by past research and theory regarding public service and labor economics. The second was to determine whether there were factors unused in previous studies that might help better explain derived *volunteer* firefighter demand. Insignificant variables without strong theoretical rational for inclusion were dropped from the analysis thereby allowing irrelevant factors to be weeded out and adherence to the *Principle of Parsimony.*

Indicators[12] of the quality of the volunteer firefighter derived demand model were the relatively high R^2 measures of both formulations of the estimated demand schedule. In addition, the similarity of the estimated parameter signs to their *expected* direction supports the notion of theoretical

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[12] Gujarati (1988) pg 399-400.

consistency. A regression with several of it's estimated coefficients having the wrong sign indicates an incorrectly specified model.

Testing for model specification error was accomplished primarily through use of Ramsey's RESET test which essentially introduces the predicted values in various forms into the regression analysis and calculates an F-statistic to test whether the increase in R^2 is significant or not. The disadvantage of using the RESET test is that an alternative model need not be specified. If the RESET statistic is significant then it only indicates that the model is specified incorrectly. It does not reveal a more appropriate model for consideration. For the linear formulation of the derived demand model, the RESET test was insignificant thereby allowing rejection of the hypothesized specification error. The loglog form had one F-statistic (out of three) that was significant at the 95% confidence level indicating that specification error might be present.

5.2.3.3 Econometric Value Generation

Generating the economic value of volunteer firefighters to Montana from the econometric derived demand model involves first computing the relevant area contained under the estimated demand schedule while holding all explanatory influences except VOLWAGE constant. Please note that only the loglog model results are presented.[13] Algebraically, the loglog volunteer firefighter derived demand schedule, untransformed for estimation purposes, takes the exponential form:

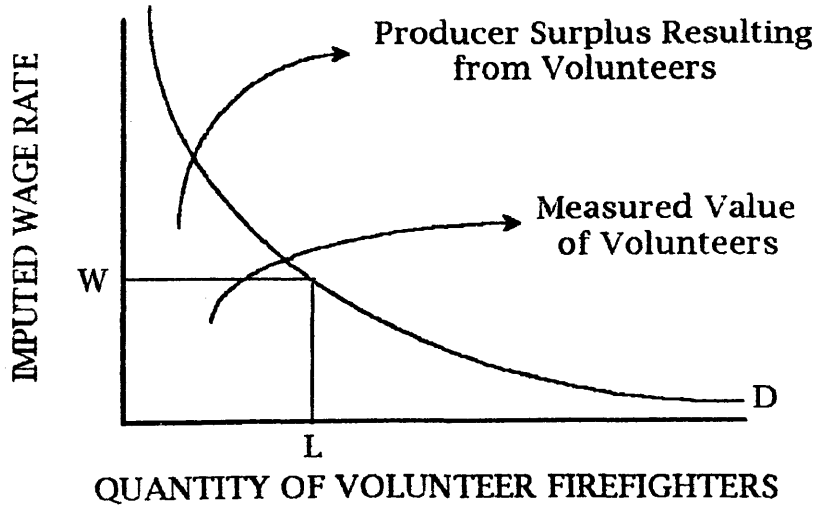
$$ACTIVE = (3.579 \cdot 10^{15}) \cdot VOLWAGE^{-12.56}$$

[13] The loglog specification was chosen because it was felt to have a greater degree of explanatory power. Both models were quite similar with the Total Economic Value estimate from the loglog model being only 8.1% larger than the estimate generated from the linear model.

Since the model was specified on a per department basis, the area measure represents the *total economic value* or total benefit derived from an hour of volunteer firefighter time contributed to the average volunteer fire organization.

Graphically this area is represented by the total region lying to the left of "L" under the demand curve within Figure 5.5. Notice that there are two sections of concern. The *total* economic value of 1 hour of volunteer firefighter time per department is comprised of the total area contained within both segments. The lower rectangle depicts the measured economic value of volunteers while the upper segment represents the surplus economic value accruing to the volunteer fire agency (i.e. the community) from their volunteer firefighters.

FIGURE 5.6 HYPOTHETICAL DERIVED DEMAND SCHEDULE AND THE MEASURE OF TOTAL BENEFIT



Calculations of the producer surplus and the measured economic value were performed by fire department type (i.e. RFD, VFD, etc.) such that the average imputed wage measure for each was used to calculate the number of volunteer firefighters demanded by the average volunteer fire organization. With these two figures it was then possible to define the delineated regions shown in figure 5.5. The "Measured Value" was calculated by multiplying the average wage attributable to a certain volunteer fire agency type by the average number of volunteer firefighters demanded by that agency type. Calculation of the "Producer Surplus" was slightly more difficult due to the exponential curvature of the derived demand schedule and necessitated the use of integral calculus. Specifically, the general function to be integrated took the form:

$$\int_{VOLWAGE_{Average}}^{\infty} (3.579 \cdot 10^{15}) \cdot VOLWAGE^{-12.56} dVOLWAGE$$

Table 5.12 provides a summary of the area calculations under the derived demand schedule. Producer surplus resulting from using volunteer firefighters constituted eight percent of the economic values listed in table 5.12.

TABLE 5.12 AREA MEASUREMENTS

	RFD	VFD	VFC	FSA
TOTAL ECONOMIC VALUE / PER VOLUNTEER HOUR AND FIRE DEPARTMENT TYPE				
Economic Value	$327.85	$336.38	$339.28	$369.78

Source: Table 5.11.

Table 5.13 details the aggregated economic valuation measures estimated from the regression model. The total economic values were calculated as follows:

Response Time Value: [Area Measure] x [HRSMNTH x 12] x [# Fire Dept's]
General Training Time Value: [Area Measure] x [(MEM30PCT) x 30 hours] x [# Fire Dept's]
EMT Time Value: [Area Measure] x [(EMTPCT) x 110 hours] x [# Fire Dept's]
HAZMAT Time Value: [Area Measure] x [(HAZMATPCT) x 4 hours] x [# Fire Dept's]
Wildland Training Time Value: [Area Measure] x [16 hours] x [# Fire Dept's]

Where:

MEM30PCT = % volunteers meeting the 30 hour yearly requirement.
EMTPCT = % volunteers certified as EMT.
HAZMATPCT = % volunteers completing the standard HazMat course.

The total value for the entire state of Montana was estimated to be slightly greater than $14 million dollars. The economic values for the emergency incident response hours comprised the largest portion (53.7%) of the total economic value generated by volunteer firefighters. Response and general training hours added each year accounted for approximately 72 percent of the total aggregated value. This figure is important because it indicates that the major portion of the total economic service value generated by volunteer firefighters is time donated on a continual basis year after year rather than specific training hours which essentially only accrue once. It should be noted though that since the trend is on volunteer firefighters acquiring more and more specialized training, then its likely that the associated economic service value will also continue to increase.

TABLE 5.13 AGGREGATE STATE ECONOMIC VALUES FOR VOLUNTEER FIREFIGHTER SERVICES

	RFD (N=194)	VFD (N=115)	VFC (N=100)	FSA (N=17)	STATE TOTAL (N=426)
Response Time Value/Year					
Total Value	$3930707	$2376712	$899768	$379435	$7586622
% of Total	51.8%	31.3%	11.9%	5.0%	100%
General Training Value/Year					
Total Value	$1307056	$724156	$482455	$127295	$2640962
% of Total	49.5%	27.4%	18.3%	4.8%	100%
Specific Training Value/Year					
EMT:					
Total Value	$580702	$476580	$302298	$78137	$1437717
% of Total	40.4%	33.2%	21.0%	5.4%	100%
HAZMAT:					
Total Value	$113469	$45801	$20628	$1735	$181633
% of Total	62.5%	25.2%	11.3%	1.0%	100%
Wildland Fire Training:					
Total Value	$1017659	$618936	$542846	$100579	$2280020
% of Total	44.6%	27.2%	23.8%	4.4%	100%
TOTAL ECONOMIC VALUE-ADDED					
	$6949593	$4242185	$2247995	$687181	$14126954

Source: Tables 4.2, 5.12.

Finally, RFDs accounted for just over 49% of the total economic value generated by volunteers which is consistent with their overall proportion to the total number of volunteer fire agencies in the state of Montana. Similar results apply to VFDs, VFCs, and FSAs. It is worthwhile to again point out that the estimated value results derived from the econometric approach are considered conservative for reasons outlined earlier and the reader should bear that in mind when digesting the magnitude the aggregate figures.

5.2.4 Modeling Comments and Methods Comparison

The reality of the results serve as an invaluable tool in assessing the validity of the models in question. For method #1, $12,404,729 was quite plausible. It made a significant attempt to capture only the value of the actual hours of fire protection service provided by volunteer firefighters to the rural communities of Montana. It is considered the most conservative out of the two methods forwared within this thesis primarily because it fails to capture the producer surplus derived from using volunteer firefighters.

$14,126,954 calculated by method #2 was higher than the first method and was also a credible estimate. This economic model's statistical validity and respectable explanatory power lend sufficient evidence to it's proposed usage as a legitimate, alternative econometric approach to valuing volunteer services. The total economic value generated from method #2 was 12.2% larger than the value estimate derived from method #1. This difference amount was comparable to the economic value associated with producer surplus which accounted for 8% of the aggregate figure calculated from method #2.

The advantage of method #2 over the first is it's ability to identify and account for a wider variety of effects present within the determination of derived demand. As mentioned earlier, capturing the producer surplus value, a feature not possible using method #1, is a significant advantage. In addition, there are several alternative uses of an econometrically estimated derived demand schedule such as calculation of labor and capital elasticities as well as modeling capabilities also not available from method #1.

The disadvantage of method #2 is when the estimated relationship becomes overly complicated by the statistical process. With the first method, determining the value of volunteer firefighter services was straightforward and intuitive. Method #2 involves a more complex approach imposing several statistical assumptions. Violation of just one of these assumptions could bias the results and lead to erroneous results. In addition, method #2 requires a greater degree of data collection and attention. Computational and collection costs are therefore higher.

Finally, the wage imputation technique is at the heart of the analysis and the ability to create a shadow wage that accounts for the entire variation in quality and quantity of fire protection services provided by various fire departments is imperative. The imputed wage utilized for this study was the essential key in deriving believable estimates. Future research should regard this aspect with primary importance because, in retrospect, it's relevance begets the very foundation upon which this modeling procedure is based.

Comments, Implications, and Future Research Potential

Volunteer fire organizations provide an immense service to the rural communities of Montana, but underlying this provision are the many volunteer firefighters who routinely accept significant sacrifices of personal time and even danger. Within this study, the empirically determined economic value of volunteer firefighters to Montana was modeled and calculated. Because Montana is such a geographically dispersed state it was expected that the majority of fire protection services are supplied by volunteer agencies. Consequently, it was not surprising that the value of volunteer service hours would be quite large. In addition to deriving an economic value of volunteer firefighter services, the structural and organizational dimensions of volunteer fire agencies were summarized using data compiled from a survey of fire departments in Montana.

COMMENTS

Two methods were used to model the economic value of volunteer labor. Method #1 took a direct approach by assessing the total time in hours contributed to local fire protection efforts by volunteers, imputing an hourly wage rate, and then multiplying that figure by the aggregate volunteer firefighter time. Method #2 took a more statistical approach by attempting to

first estimate an econometric derived demand function for volunteer firefighters. With significant regression results, it was possible to calculate the area underneath the estimated demand schedule thereby providing a second measure of the economic value of volunteer services.

In general, both estimation methods resulted in fairly similar results. Method #1 estimated a total economic value of $12.4 million while method #2, using an econometric model of derived demand, resulted in a slightly higher figure of $14.1 million. A priori it was expected that the econometric value estimation would be larger than the figure associated with method #1. The rationale being that method #2 includes the producer surplus value related to the use of volunteer labor which method #1 fails to measure. The economic value estimate derived from method #2 is 12.2% larger than method #1. Producer surplus accounts for an estimated 8% of the economic value figure generated from method #2. The fact that the difference amount (12.2%) between both estimated economic value calculations is similar to the producer surplus (8%) measured from method #2 lends support to the accuracy and advantage of the econometric approach over method #1.

It should be pointed out that both estimates of the total economic value of volunteer firefighter services are considered conservative. One reason is that several training time measures were excluded from the analysis. Specifically, the First Responder course with a completion time of approximately 50 to 60 hours was not collected. This volunteer time element is fairly significant and it is hypothesized that it's inclusion could increase the state aggregate value estimates by 10 to 20 percent. Furthermore, fire training

courses involving substantial time commitments such as First Responder or Emergency Medical Technician can also require a considerable amount of out-of-class study or preparation time which is not accounted for by the official completion schedule.

In addition, this analysis only counted volunteer firefighter hours specifically spent either responding to emergencies or engaged in fire training. The estimates neglected legitimate volunteer time spent doing community work such as department fundraising, business and residential property inspections, and public appearances. In addition, they also excluded time volunteered to the annual maintenance of fire apparatus and the fire house. These omissions were justified earlier in this thesis with the reasoning being that their inclusion complicates the economic valuation process. But one could easily argue that these volunteer hours are significantly large and their exclusion certainly results in an underestimation of the total benefit accruing to a community from the efforts of their local volunteer firefighters.

IMPLICATIONS

The economic values and departmental descriptive statistics calculated in this thesis affect several areas of interest involving local and county governments. Not only do they provide support for the investment in fire protection services supplied by volunteers but they also indicate the magnitude and diversity of these services within rural Montana.

Many volunteer fire departments were surprisingly well off. Their level of training, capital equipment stock, and annual operating budgets were often

quite considerable. For example, regarding all volunteer fire agencies in Montana, it was estimated that almost 10% of the active member firefighters are certified EMTs. This is substantial considering the 110 to 120 hour course completion time. The average number of years of experience as a volunteer firefighter was 9. The average volunteer firefighter spends almost 5 hours a month responding to emergency incidents. The average volunteer fire organization in Montana served approximately 2000 people, responded to roughly 40 incidents per year, and operated on an annual budget appropriation of $25,374. In addition, the average department owned (or leased) approximately 4 fire engines having a mean age of 22 years. Of these just over 33% were purchased new.

Local townships and county agencies can use such descriptive measures to better inform the public regarding the benefits derived from volunteer fire organizations and relate this information to issues of how and where tax dollars are being invested in regional fire protection. With increasing constraints being imposed on public budgets, this capability will surely serve as an advantage in alleviating the fiscal stress currently faced by local governments.

FUTURE RESEARCH

Although this thesis only addressed firefighter demand, there are the potential issues of volunteer firefighter supply estimation, volunteer fire department cost analysis and economies of scale, impacts of volunteer retirement and disability benefits, and trends in volunteer firefighter utilization

rates. In addition, further study of the demographic and socioeconomic patterns characterizing volunteer firefighters would also provide excellent insight into who is volunteering and why.

Modeling recommendations for future research on volunteer firefighters essentially deals with two themes. First, the specification of the imputed volunteer wage rate must be done with the utmost concern for capturing the range of quality variation among *individual* volunteer firefighters. Every effort should be made to account for the entire range of training and response time differentials. The "individual" firefighter should be specified rather than a by-department average. Within this thesis, an average shadow wage was determined for each volunteer fire agency. This measure runs a greater risk of suffering from aggregation bias and therefore may fail to capture the true human capital differentials between volunteer firefighters and volunteer fire organizations for that matter.

Secondly, econometric model specification represents a formidable task because of limited research on the voluntary sector. Studying the voluntary sector represents a new challenge to economics and therefore the modeling process remains in the trial and error phase. The econometric model used for this study explained the data well and thus supplies initial support for it's further exploratory application to labor demand analysis in the voluntary sector.

CONCLUSION

This study attempted to estimate the economic value of volunteer firefighter services to the state of Montana. The figure of approximately $12.4 million determined through method #1 seems reasonable and valid, albeit conservative, as does the estimated $14.1 million derived through method #2. These economic service value estimates reflect a considerable contribution by volunteer firefighters worthy of respect and admiration and indicate the significant positive return realized from a community's investment in local fire protection. Undoubtedly, volunteer provision of fire protection to rural Montanan's is well respected and valued. This study serves as an empirical measure supporting what most rural communities in Montana already know first hand.

APPENDIX A

THE MONTANA VOLUNTEER FIREFIGHTING ORGANIZATION SURVEY QUESTIONNAIRE

SURVEY

MONTANA VOLUNTEER FIREFIGHTING ORGANIZATIONS

ORGANIZATION:
DEPARTMENT >
ADDRESS >

If the department name and/or address is incorrect, please provide the correct information in the box.

Check here if you wish to receive a research summary._____

I. Organization

1. Is your organization a Rural Fire District formed under MCA 7-33-2101? _____Yes _____No

2. If you are a RFD, do you have Volunteer Fire Companies as subunits? _____Yes _____No

   a. If yes, please list.

Please use back of this page if more room is needed.

3. If your organization is a Volunteer Fire Company are you associated with a Rural Fire District? _____Yes _____No

If yes, name of District?

_____

4. If your organization is not a Fire District or a Volunteer Fire Company, would you please describe your organization.

5. What is the approximate population served by your organization?

_____

6. What is the approximate area served by your organization?

_____

II. Membership

7. What is the active membership of your organization?

_____

8. How many active members do you have in the following age groups?

a. 18-20 _____
b. 21-30 _____
c. 31-40 _____
d. 41-50 _____
e. 51-60 _____
f. 61 + _____

9. How many active members do you have with the following years of experience?

a. 0-5 _____
b. 6-10 _____
c. 11-15 _____
d. 16-20 _____
e. 20 + _____

10. How many of your active members are currently certified emergency medical technicians?

_____

11. How many of your active members have had training in responding to incidents involving hazardous materials?

_____

12. Last year, how many of your active members exceeded the required 30 hours of training?

_____

13. On average, how many incidents does your organization respond to each month.

_____

14. What is the average length of time spent per incident?

_____

15. How many hours per month does the average member spend responding to incidents?

_____

16. Does your organization have difficulty maintaining a full roster of qualified firefighters? _____Yes _____No

17. If the answer to question 17 is yes, do you think increased retirement benefits would help solve the problem?

_____

18. Are there any other characteristics of your memberships which would be of use to this survey?

III. EQUIPMENT

The following questions are asked with reference to the National Fire Protection Association 1901 - "Minimum Standards for Fire Apparatus" 1985 ed.

19. Do you have the following equipment?

CLASS	APPARATUS TYPE	HOW MANY	AGE	PURCHASED NEW YES	PURCHASED NEW NO
E1	Structural Engine I				
E2	Structural Engine II				
E3	Structural Engine III				
WE4	Wildland Engine IV				
WE5	Wildland Engine V				
WE6	Wildland Engine VI				
WE7	Wildland Engine VII				
WE8	Patrol				
TS1	Truck Structural I				
TS2	Truck Structural II				
WTS1	Water Tender Structural I				
WTS2	Water Tender Structural II				
WTS3	Water Tender Structural III				
WTW1	Water Tender Wildland I				
WTW2	Water Tender Wildland II				
WTW3	Water Tender Wildland III				
WYW4	Water Tender Wildland IV				

20. How many self contained breathing apparatus (SCBA) do you have?

_____

21. For a "standard response" how many people and what type of equipment are expected to be present?

People _____

Equipment _____

IV. OTHER

22. What is your yearly budget? _____

Source of Funds:	SOURCE	PERCENT OF BUDGET
	Property Tax (Mill Levy)	_____
	County Funds (County provides funds directly. For example, through Sheriff's Office.)	_____
	Subscription	_____
	Donations	_____
	Federal Funds	_____
	Other	_____

23. Is your organization under contract to fight fires on State land?
_____Yes _____No

If no, does the State occasionally contract with your organization to fight fires on State land?

_____Yes _____No

24. Is your organization under contract to fight fires on Federal land?
_____Yes _____No

If no, does the Federal government occasionally contract with your organization to fight fires on Federal land?
_____Yes _____No

25. Is this fire organization insured? _____Yes _____No

If yes, what is the organization's fire rating with the insurance company?
_____

APPENDIX B

VARIABLE DEFINITIONS

Please be aware that not all the variables listed below were included within this thesis. Many were collected for use in a prior study dealing with volunteer firefighters and the Montana Volunteer Firefighter's Compensation Act. An "*" has been placed before the variable name if it was included within this study.

NOTE:

99 = No Response
999 = Not Applicable
9999 = No Response

GENERAL VARIABLES:

1. IDNUM: Identification number for each record.

2. ORGNAME: Name of fire department.

3. ORGTYPE: Type of organization.
   Valid entries:
   - FD = Paid Fire Department
   - FSA = Fire Service Area
   - RFD = Rural Fire District
   - VFC = Volunteer Fire Company
   - VFD = Volunteer Fire Department
   - XXX = Other

4. *TYPENUM: Number relating to organization type.
   Valid entries:
   - 1 = RFD
   - 2 = VFD
   - 3 = VFC
   - 4 = FSA
   - 5 = XXX
   - 6 = FD

5. COUNTY: County where fire dept. is located.

6. COUNTYNUM: Number indicating county where fire dept. is located (license number: i.e. 4=Missoula and 3=Yellowstone. etc.).

7. COSUBDIV: County subdivision; this comes from the variables collected from the 1990 Census of Population and Housing.

SECTION I: SURVEY VARIABLES

8. RFDSTRCT: Dummy variable indicating whether the fire dept is an RFD formed under MCA 7-33-2101.
   Valid entries:
   a. 1 = yes
   b. 0 = no
9. RFDWVFC: Dummy variable indicating whether an RFD has any VFC's as subunits.
   Valid entries:
   a. 1 = yes
   b. 0 = no

10. VFCNUM: Number of VFC subunits for an RFD.

11. VFCWRFD: Dummy variable indicating whether a VFC is associated with an RFD or not.
   Valid entries:
   a. 1 = yes
   b. 0 = no

12. DISTRICT: The RFD that a VFC is associated with (provided the answer to VFCWRFD is "yes").

13. *POPSERV: Population served by the fire dept. (this number is from the survey responses).

14. *AREASERV: Area in square miles served or protected by the fire dept.

15. MEMTYPE: Number indicating what type of members the fire dept retains.
   Valid entries:
   a. 1 = Volunteer
   b. 2 = Paid
   c. 3 = Both Paid and Volunteer

16. *ACTIVEMEM: Number of active members claimed by a fire dept.

17. *AGE18TO20: Active members in age group 18-20.

18. *AGE21TO30: Active members in age group 21-30.

19. *AGE31TO40: Active members in age group 31-40.

20. *AGE41TO50: Active members in age group 41-50.

21. *AGE51TO60: Active members in age group 51-60.

22. *AGE61PLUS: Active members aged 61 and older.

23. *MEM0TO5: Active members with 0-5 years experience.

24. *MEM6TO10: Active members with 6-10 years experience.

25. *MEM11TO15: Active members with 11-15 years experience.

26. *MEM16TO20: Active members with 16-20 years experience.

27. *MEM21PLUS: Active members with 21 or more years experience.

28. *CERTEMT: Number of active members EMT certified.

29. *HAZRDTRN: Number of active members with training in responding to incidents involving hazardous materials.

30. *MEM30HRS: Number of active members that exceeded the required 30 hours of training in the previous year.

31. *INCMNTH: Average number of incidents that the fire dept. responds to on a monthly basis.

32. *TIMEINC: Average length of time spent per incident.

33. *HRSMNTH: Number of hours per month that the average member spends responding to incidents.

34. FULLROST: Dummy variable indicating whether or not the fire dept has difficulty maintaining a full roster of qualified volunteer firefighters.
    Valid entries:
    a. 1 = yes
    b. 0 = no

35. RETIRE: Dummy variable indicating whether increased retirement benefits would help fire departments retain a full roster (provided the question to FULLROST is "yes").

36. E#: Number of Structural Engines.

37. AVGEAGE: Average age for all the Structural Engines.

38. E#PURCHNEW: Number of Structural Engines purchased new.

39. E#PURCHOLD: Number of Structural Engines purchased used.

40. WE#: Number of Wildland Engines.

41. AVGWEAGE: Average age for all the Wildland Engines.

42. WE#PURCHNEW: Number of Wildland Engines purchased new.

43. WE#PURCHOLD: Number of Wildland Engines purchased used.

44. TS#: Number of Truck Structural (ladder trucks).

45. AVGTSAGE: Average age for all the Truck Structural.

46. TS#PURCHNEW: Number of Truck Structural purchased new.

47. TS#PURCHOLD: Number of Truck Structural purchased used.

48. WTS#: Number of Water Tender Structural.

49. AVGWTSAGE: Average age for all the Water Tender Structural.

50. WTS#PURCHNEW: Number of Water Tender Structural purchased new.

51. WTS#PURCHOLD: Number of Water Tender Structural purchased used.

52. WTW#: Number of Water Tender Wildland.

53. AVGWTWAGE: Average age for all the Water Tender Wildland.

54. WTW#PURCHNEW: Number of Water Tender Wildland purchased new.

55. WTW#PURCHOLD: Number of Water Tender Wildland purchased used.

56. MISC: Number of Miscellaneous vehicles.

57. AVGMISCAGE: Average age for all the Miscellaneous vehicles.

58. MISC#PURCHNEW: Number of Miscellaneous vehicles purchased new.

59. MISC#PURCHOLD: Number of Miscellaneous vehicles purchased used.

60. *SCBA#: Number of Self Contained Breathing Apparatus.

61. *STDRESPP#: People expected to be present on a standard response call.

62. *STDRESEQ#: Equipment apparatus (i.e. pumpers. etc.) expected to be present to a standard response call.

63. *YRBUDGET: The fire Department's yearly budget (90 or 91 preferably).

64. PROPTAX: Dummy variable indicating whether property tax is a source of budgetary funds.
    Valid entries:
        a. 1 = yes
        b. 0 = no

65. CNTYFUNDS: Dummy variable indicating whether county funds are a source of budgetary funds.
    Valid entries:
        a. 1 = yes
        b. 0 = no

66. SUBSCRIP: Dummy variable indicating whether subscription or contract fees are a source of budgetary funds.
    Valid entries:
        a. 1 = yes
        b. 0 = no

67. DONATE: Dummy variable indicating whether donations are a source of budgetary funds.
    Valid entries:
        a. 1 = yes
        b. 0 = no

68. FEDFUNDS: Dummy variable indicating whether federal funds are a source of budgetary funds.
    Valid entries:
        a. 1 = yes
        b. 0 = no

69. OTHER: Dummy variable indicating the use of an unlisted source of budgetary funds.
    Valid entries:
        a. 1 = yes
        b. 0 = no

70. PROPTAX%: Percent of budget coming from property tax.

71. CoFUND%: Percent of budget coming from county funds.

72. SUBSCR%: Percent of budget coming from subscription or contract fees.

73. DONATE%: Percent of budget coming from donations.

74. FEDFUND%: Percent of budget coming from federal funds.

75. OTHER%: Percent of budget coming from alternative or unlisted sources.

76. STCONTRCT: Dummy variable indicating whether or not the fire department is under contract or in mutual agreement to fight fires on state land.
    Valid entries:
    a. 1 = yes
    b. 0 = no

77. OCCSTCON: Dummy variable indicating whether or not the state occasionally contracts with the fire dept.
    Valid entries:
    a. 1 = yes
    b. 0 = no

78. FEDCONTRCT: Dummy variable indicating whether or not the fire department is under contract or in mutual agreement to fight fires on federal land.
    Valid entries:
    a. 1 = yes
    b. 0 = no

79. OCCFEDCON: Dummy variable indicating whether or not the federal government occasionally contracts with the fire dept.
    Valid entries:
    a. 1 = yes
    b. 0 = no

80. INSURED: Dummy variable indicating whether or not the fire department is insured.

81. *FIRERTNG: The fire department's ISO (Insurance Services Organization) number indicating their fire fighting capability range for valid entries: 3 (very good) <-------> 10 (very limited).

SECTION II: ADDITIONAL DEMOGRAPHIC VARIABLES

82. *COSUBPOP: Population of the county subdivision.

83. *POP18PCT: Proportion of population aged 18 and under.

84. *POP65PCT: Proportion of population aged 65 and older.

85. *MEDAGE: Median age of the county subdivision population.

86. *FEMPCT: Proportion of females out of the county subdivision population.

87. *PERSONHH: Persons per household within the county subdivision.

88. *MEANROOM: Mean number of rooms per housing unit in the county subdivision.

89. *TOTALHU: Total housing units within the county subdivision (includes owner occupied and vacant).

90. *OWNOCCHU: Total owner occupied housing units within the county subdivision.

91. *OWNPCT: Technically this is [(#90/#89)*100]; it measures the owner occupied housing unit's percent of the total housing units within the county subdivision.

92. *AVGVALUE: The median value of a owner occupied housing unit within the county subdivision.

93. *ESTABNUM: Total number of establishments within the county.
Note 1: Definition of Establishment
"A single physical location at which business is conducted or where services or industrial operations are performed."
Note 2: Definition of Total (as it pertains to all types of business within a county)
Total = Sum of Agricultural service; Forestry; Fishing; Mining; Construction; Manufacturing; Transportation and Public Utilities; Wholesale trade; Retail trade; Finance,Real Estate. and Insurance; and finally unclassified establishments.

94. *ESTABEMP: Total number of employees for all establishments within the county.

95. *ESTPYRLL: Total annual payroll (in thousands of dollars) for all establishments within the county.

96. *RETESTAB: Total retail trade establishments within the county.

97. *RETEMP: Numer of employees working for the retail trade industry within the county.

98. *RETPYRLL: Total retail trade payroll (in thousands of dollars) within the county.

99. *RETSAL: Technically this is [(#98*100)/#97]; this provides a measure of the yearly salary earned by the average retail worker within the county.

100. *FIREEMP: Number representing the quantity of full time paid firefighters employed within the county (note: this is from the Census of Governments data and may not be accurate).

101. *GVMTEMP: Total FTE local government employment for the month of October within the county.

102. *GVMTSAL: Average October FTE earnings for all government employees within the county.

103. *POLICECO: The county's expenditures (in dollars) on police protection.

104. *PRPTYTAX: Per capita property tax (in dollars) for the county.

105. *PERSINC: Per capita personal income (in dollars) for the county.

106. *UNRATE: County unemployment rate.

107. *ASSESSED: Gross value (before partial exemptions) of locally assessed property within the county.

108. *TOTALSTT: Total assessed value. by county. subject to tax after deduction of partial exemptions.

109. *LOCALSTT: The value of locally assessed property. by county subject to tax after deduction of partial exemptions.

110. *EMPESTAB: Average # of employees per establishment.

111. *PYRLLEST: Average payroll per establishment (in dollars).

112. *RTEMPEST: Average retail employment per retail establishment.

113. *PYRLLRET: Average retail payroll per retail establishment (in dollars).

114. MNTHSAL: Average monthly firefighter salary (note: this is zero for volunteers).

SECTION III: CALCULATED VARIABLES

115. *AVGAGE: Average age of the active members of a particular fire department.

116. *AVGEXP: Average experience of the active members of a particular fire department.

117. *EQUIPNUM: Total number of pieces of fire apparatus.

118. *AVGEQAGE: Average age of fire apparatus.

119. *NEWNUM: Total number of fire apparatus that were purchased new.

120. *PCTNEW: Percent of total fire apparatus that were purchased new.

121. *DUMEMT: Dummy variable indicating whether a fire department has active members that are trained as EMT's (Emergency Medical Technician); this variable is equal to 1 if a fire department has certified EMT's and 0 otherwise.

122. *YRSALARY: Imputed yearly salary, including benefits, for an active member volunteer firefighter.

123. *ANNSAL: Imputed yearly salary. excluding benefits. for an active member.

124. *MONTHSAL: Imputed monthly salary or compensation measure; this measure is simply ANNSAL divided by 12; (Note: this is adjusted for the differential in hours volunteered by members of a department. whether their particular department had EMT and hazardous materials trained personnel. and for the average experience level of the volunteer fire fighters within a department).

125. *REALWAGE: Imputed hourly wage rate for hypothetical paid personnel of a particular fire department.

126. *VOLWAGE: Imputed volunteer hourly wage rate. Calculated using Karn's "True Value" Assessment Model and detailed in chapter five.

127. *VOLVALUE: Calculated value of volunteer service donated by members to the Fire Department.

128. *EAST: Dummy variable: 1 if the fire department is on the east (flatter) part of Montana and 0 if on the west (mountainous) side. Note: the geographic separation was arbitrary and is intended to distinguish between the mountainous regions of Montana and the more flat areas. Also. it might capture part of a communities density such that communities on the east part of the state may be less compact than those in the more mountainous regions of the west.

129. *VOLDUM: Dummy variable with a value of 1 if a respondent volunteer fire organization was a Volunteer Fire Company (VFC) and 0 otherwise. This variable is meant to capture the differences between VFC's and the other fire department types such as size, operating budgets, etc..

APPENDIX C

1992 MONTANA FIREFIGHTING ORGANIZATIONS ARRANGED BY TYPE AND COUNTY OF ORIGIN

For the reader interested in contacting any of these departments, further information (e.g. Fire Chief, phone numbers, etc.) is available by contacting:

(1) Frenchtown Rural Fire District
Frenchtown, Montana
Phone: (406)-626-4335

(2) Coordination Center
Department of State Lands, Forestry Division
Missoula, Montana
Phone: (406)-542-4300

1992 MONTANA FIRE SERVICE ORGANIZATIONS ARRANGED BY TYPE AND COUNTY OF ORIGIN

TYPE	#	ORGANIZATION	COUNTY	CITY
PAID FIRE DEPARTMENT (FD)				
FD	1	Great Falls Fire Dept.	Cascade	Great Falls
FD	2	Miles City Fire Dept.	Custer	Miles City
FD	3	Glendive Fire Dept.	Dawson	Glendive
FD	4	Anaconda Fire Department	Deer Lodge	Anaconda
FD	5	Lewistown Fire Department	Fergus	Lewistown
FD	6	Kalispell Fire Dept.	Flathead	Kalispell
FD	7	Bozeman Fire Department	Gallatin	Bozeman
FD	8	Havre Fire Dept.	Hill	Havre
FD	9	Helena Fire Department	Lewis & Clark	Helena
FD	10	Missoula Fire Dept.	Missoula	Missoula
FD	11	Livingston Fire Dept.	Park	Livingston
FD	12	Butte Fire Department	Silver Bow	Butte
FD	13	Billings Fire Department	Yellowstone	Billings

TOTAL # FD'S ==► 13

TYPE	#	ORGANIZATION	COUNTY	CITY

FIRE SERVICE FEE AREA (FSA)

FSA	14	Vaughn Fire Service Area	Cascade	Vaughn
FSA	15	Gore Hill Fire Service Area	Cascade	Great Falls
FSA	16	Sun River Fire Service Area	Cascade	Sun River
FSA	17	Whitefish Fire Service Area	Flathead	Whitefish
FSA	18	Reese Creek Fire Service Area	Gallatin	Belgrade
FSA	19	Fort Ellis Fire Service Area	Gallatin	Bozeman
FSA	20	Rae Fire Service Area	Gallatin	Bozeman
FSA	21	Lakeside Fire Service Area	Lewis & Clark	East Helena
FSA	22	Canyon Ferry Fire Service Area	Lewis & Clark	
FSA	23	Fisher River Fire Service Area	Lincoln	Libby
FSA	24	Trego-Fortine-Stryker Fire Ser. Area	Lincoln	Fortine
FSA	25	Eureka Fire Service Area	Lincoln	Eureka
FSA	26	Martinsdale Fire Service Area	Meagher	Martinsdale
FSA	27	Shepherd Fire Service Area	Yellowstone	Shepherd
FSA	28	Blue Creek Fire Service Area	Yellowstone	Billings
FSA	29	South Blue Creek Fire Service Area	Yellowstone	
FSA	30	Laural Urban Fire Service Area	Yellowstone	Laurel

TOTAL # FSA'S ==► 17

RURAL FIRE DISTRICT (RFD)

RFD	31	Dillon Rural Fire Dist.	Beaverhead	Dillon
RFD	32	Lima Rural Fire Dist.	Beaverhead	Lima
RFD	33	Wisdom Rural Fire Dist.	Beaverhead	Wisdom
RFD	34	Jackson Rural Fire Dist.	Beaverhead	Jackson
RFD	35	Busby Rural Fire Dist.	Big Horn	Busby
RFD	36	Townsend Rural Fire Dist.	Broadwater	Townsend
RFD	37	Broadwater Co. Rural Fire Dist.	Broadwater	Townsend
RFD	38	Radersburg Rural Fire Dist.	Broadwater	Toston
RFD	39	Belfry Rural Fire Dist.	Carbon	Belfry
RFD	40	Clark Fork RFD	Carbon	Bridger
RFD	41	Joliet Rural Fire Dist.	Carbon	Boyd

TYPE	#	ORGANIZATION	COUNTY	CITY
RFD	42	Fromberg Rural Fire Dist.	Carbon	Fromberg
RFD	43	Red Lodge Rural Fire Dist.	Carbon	Red Lodge
RFD	44	Roberts Rural Fire Dist. #6	Carbon	Roberts
RFD	45	Edgar Rural Fire Dist.	Carbon	Edgar
RFD	46	Clark Fork Rural Fire Dist.	Carbon	Bridger
RFD	47	Belt Rural Fire District	Cascade	Belt
RFD	48	Black Eagle Rural Fire Dist.	Cascade	Black Eagle
RFD	49	Highwood Rural Fire Dist.	Chouteau	Highwood
RFD	50	Geraldine Rural Fire Dist.	Chouteau	Geraldine
RFD	51	Elim Rural Fire Dist.	Chouteau	Fort Benton
RFD	52	Ismay Rural Fire Dist.	Custer	Ismay
RFD	53	Peerless Rural Fire Dist.	Daniels	Peerless
RFD	54	West Glendive Rural Fire Dist.	Dawson	Gelndive
RFD	55	Race Track Valley Rural Fire Dist.	Deer Lodge	Deer Lodge
RFD	56	Opportunity Rural Fire Dist.	Deer Lodge	Opportunity
RFD	57	Lost Cr./Antelope Rural Fire Dist.	Deer Lodge	Anaconda
RFD	58	West Valley Rural Fire Dist.	Deer Lodge	Anaconda
RFD	59	Plevna Rural Fire Dist.	Fallon	Plevna
RFD	60	Baker Rural Fire Dist.	Fallon	Baker
RFD	61	Grass Range Rural Fire Dist.	Fergus	Grass Range
RFD	62	Hilger Rural Fire Dist.	Fergus	Hilger
RFD	63	Lewistown Rural Fire Dist.	Fergus	Lewistown
RFD	64	Roy Rural Fire Dist.	Fergus	Roy
RFD	65	Coffee Creek Rural Fire District	Fergus	Coffee Creek
RFD	66	Heath Rural Fire District	Fergus	Lewistown
RFD	67	Olney Rural Fire Dist.	Flathead	Olney
RFD	68	Hungry Horse Rural Fire Dist.	Flathead	Hungry Horse
RFD	69	Columbia Falls Rural Fire Dist.	Flathead	Columbia Falls
RFD	70	Bigfork Rural Fire Dist.	Flathead	Bigfork
RFD	71	Coram-West Glacier Rural Fire Dist.	Flathead	Coram
RFD	72	Bad Rock Rural Fire Dist.	Flathead	Columbia Falls
RFD	73	Creston Rural Fire Dist.	Flathead	Kalispell
RFD	74	Blankenship Rural Fire District	Flathead	Columbia Falls
RFD	75	Martin City Rural Fire Dist.	Flathead	Martin City
RFD	76	Somers Rural Fire Dist.	Flathead	Somers
RFD	77	Marion Rural Fire Dist.	Flathead	Marion
RFD	78	Big Mountain Rural Fire Dist.	Flathead	Whitefish

TYPE	#	ORGANIZATION	COUNTY	CITY
RFD	79	South Kalispell Rural Fire Dist.	Flathead	Kalispell
RFD	80	West Valley Rural Fire Dist.	Flathead	Kalispell
RFD	81	Smith Valley Rural Fire Dist.	Flathead	Kalispell
RFD	82	Ferndale Rural Fire Dist.	Flathead	Bigfork
RFD	83	Evergreen Rural Fire Dist.	Flathead	Kalispell
RFD	84	Manhattan Rural Fire Dist.	Gallatin	Manhattan
RFD	85	Gallatin Gateway RFD	Gallatin	Bozeman
RFD	86	Sourdough Rural Fire Dist.	Gallatin	Bozeman
RFD	87	Big Sky Rural Fire Dist.	Gallatin	Big Sky
RFD	88	Willow Creek Rural Fire Dist.	Gallatin	Willow Creek
RFD	89	Springhill Rural Fire Dist.	Gallatin	Belgrade
RFD	90	Sedan Rural Fire Dist.	Gallatin	Wilsall
RFD	91	Belgrade Rural Fire Dist.	Gallatin	Belgrade
RFD	92	Bridger Canyon Rural Fire Dist.	Gallatin	Bozeman
RFD	93	East Glacier Rural Fire Dist.	Glacier	East Glacier Park
RFD	94	Browning Rural Fire Dist.	Glacier	Browning
RFD	95	Cut Bank Rural Fire Dist.	Glacier	Cut Bank
RFD	96	Golden Valley Co. Rural Fire Dist.	Golden Valley	Ryegate
RFD	97	Drummond (Valley RF Dist.)	Granite	Drummond
RFD	98	Gilford Rural Fire Dist.	Hill	Gilford
RFD	99	Kremlin Rural Fire Dist.	Hill	Kremlin
RFD	100	Rural Fire District #7	Hill	Havre
RFD	101	Rudyard Rural Fire Dist.	Hill	Rudyard
RFD	102	Box Elder Rural Fire Dist.	Hill	Box Elder
RFD	103	Wildhorse Rural Fire Dist.	Hill	Havre
RFD	104	St. Joe Rural Fire Dist.	Hill	Havre
RFD	105	Inverness Rural Fire Dist.	Hill	Inverness
RFD	106	Elk Park Rural Fire Dist.	Jefferson	Butte
RFD	107	Montana City Rural Fire Dist.	Jefferson	Clancy
RFD	108	Basin Rural Fire District	Jefferson	Basin
RFD	109	Boulder Rural Fire Dist.	Jefferson	Boulder
RFD	110	Clancy Rural Fire Dist.	Jefferson	Clancy
RFD	111	Jefferson Valley Rural Fire Dist.	Jefferson	Whitehall
RFD	112	Judith Basin Rural Fire Dist.	Judith Basin	Stanford
RFD	113	Hobson Rural Fire Dist.	Judith Basin	Hobson
RFD	114	Rollins Rural Fire Dist.	Lake	Rollins

TYPE	#	ORGANIZATION	COUNTY	CITY
RFD	115	Ronan Rural Fire District	Lake	Ronan
RFD	116	Polson Rural Fire Dist.	Lake	Polson
RFD	117	Charlo Rural Fire Dist.	Lake	Charlo
RFD	118	Arlee Rural Fire District	Lake	Arlee
RFD	119	Montecahto Rural Fire Dist.	Lake	Polson
RFD	120	Swan Lake Rural Fire Dist.	Lake	Swan Lake
RFD	121	Moiese Rural Fire Dist.	Lake	Moiese
RFD	122	Canyon Creek Rural Fire Dist.	Lewis & Clark	Helena
RFD	123	East Gate Rural Fire Dist.	Lewis & Clark	East Helena
RFD	124	East Valley Rural Fire District	Lewis & Clark	Helena
RFD	125	W. Helena Valley Rural Fire Dist.	Lewis & Clark	Helena
RFD	126	Lincoln Rural Fire Dist.	Lewis & Clark	Lincoln
RFD	127	Birdseye Rural Fire Dist.	Lewis & Clark	Helena
RFD	128	Augusta Rural Fire Dist.	Lewis & Clark	Augusta
RFD	129	Baxendale Rural Fire Dist.	Lewis & Clark	Helena
RFD	130	Craig Rural Fire District	Lewis & Clark	Wolf Creek
RFD	131	Joplin Rural Fire Dist.	Liberty	Joplin
RFD	132	McCormick Rural Fire Dist.	Lincoln	Troy
RFD	133	Bull Lake Rural Fire Dist.	Lincoln	Troy
RFD	134	Troy Rural Fire Dist.	Lincoln	Troy
RFD	135	Libby Rural Fire District	Lincoln	Libby
RFD	136	Madison Valley Rural Fire Dist.	Madison	Ennis
RFD	137	Harrison-Norris-Pony RF Dist.	Madison	Harrison
RFD	138	Sheridan Rural Fire Dist.	Madison	Sheridan
RFD	139	Alder Rural Fire District	Madison	Alder
RFD	140	Twin Bridges Rural Fire Dist.	Madison	Twin Bridges
RFD	141	St. Regis Rural Fire Dist.	Mineral	St. Regis
RFD	142	East End Rural Fire Dist.	Mineral	Alberton
RFD	143	Saltese Rural Fire Dist.	Mineral	Saltese
RFD	144	Superior Rural Fire Dist.	Mineral	Superior
RFD	145	West End Rural Fire Dist.	Mineral	Haugan
RFD	146	Missoula Rural Fire Dist.	Missoula	Missoula
RFD	147	Frenchtown Rural Fire Dist.	Missoula	Frenchtown
RFD	148	Mouth of Petty Cr. R.F. Dist.	Missoula	Alberton
RFD	149	Seeley Lake Rural Fire Dist.	Missoula	Seeley Lake
RFD	150	Clinton Rural Fire Dist.	Missoula	Clinton
RFD	151	East Missoula Rural Fire Dist.	Missoula	East Missoula

TYPE	#	ORGANIZATION	COUNTY	CITY
RFD	152	Bull Mountain Rural Fire Dist.	Musselshell	Roundup
RFD	153	Emigrant Rural Fire Dist.	Park	Emigrant
RFD	154	Park Co. Rural Fire Dist. #1	Park	Livingston
RFD	155	Cooke City Rural Fire Dist.	Park	Cooke City
RFD	156	Gardiner Rural Fire Dist.	Park	Gardiner
RFD	157	Clyde Park Rural Fire Dist.	Park	Clyde Park
RFD	158	Wilsall Rural Fire Dist..	Park	Wilsall
RFD	159	Phillips Co. Rural Fire Dist.	Phillips	Malta
RFD	160	Conrad Rural Fire Dist.	Pondera	Conrad
RFD	161	Brady Rural Fire Dist.	Pondera	Brady
RFD	162	Valier Rural Fire Dist.	Pondera	Valier
RFD	163	Belle Creek Rural Fire Dist.	Powder River	Belle Creek
RFD	164	Helmville Rural Fire Dist.	Powell	Helmville
RFD	165	Garrison Rural Fire Dist.	Powell	Garrison
RFD	166	Deer Lodge Rural Fire Dist.	Powell	Deer Lodge
RFD	167	Valley Rural Fire Dist.	Powell	Gold Creek
RFD	168	Ovando Rural Fire Dist.	Powell	Ovando
RFD	169	Race Track Valley Rural Fire Dist.	Powell	Deer Lodge
RFD	170	Fallon Rural Fire Dist.	Prairie	Fallon
RFD	171	Cabin Creek Rural Fire Dist.	Prairie	Fallon
RFD	172	Three Mile Rural Fire Dist.	Ravalli	Stevensville
RFD	173	Florence Rural Fire Dist.	Ravalli	Florence
RFD	174	Darby Rural Fire Dist.	Ravalli	Darby
RFD	175	Sula Rural Fire District	Ravalli	Sula
RFD	176	Stevensville Rural Fire Dist.	Ravalli	Stevensville
RFD	177	Victor Rural Fire Dist.	Ravalli	Victor
RFD	178	Corvallis Rural Fire Dist.	Ravalli	Corvallis
RFD	179	West Fork Rural Fire Dist.	Ravalli	Darby
RFD	180	Sidney Rural Fire Dist.	Richland	Sidney
RFD	181	Lambert Rural Fire Dist.	Richland	Lambert
RFD	182	Bainville Rural Fire District	Roosevelt	Bainville
RFD	183	West Rosebud Rural Fire Dist.	Rosebud	Sumatra
RFD	184	Ashland Rural Fire Dist.	Rosebud	Ashland
RFD	185	Colstrip Rural Fire Dist.	Rosebud	Colstrip
RFD	186	Thompson Falls Rural Fire Dist.	Sanders	Thompson Falls
RFD	187	Paradise Rural Fire Dist.	Sanders	Paradise
RFD	188	Noxon Rural Fire Dist.	Sanders	Noxon

TYPE	#	ORGANIZATION	COUNTY	CITY
RFD	189	Plains Rural Fire Dist.	Sanders	Plains
RFD	190	Hot Springs Rural Fire Dist.	Sanders	Hot Springs
RFD	191	Heron Rural Fire Dist.	Sanders	Heron
RFD	192	Trout Creek Rural Fire Dist.	Sanders	Trout Creek
RFD	193	Dixon Rural Fire District	Sanders	Dixon
RFD	194	Plentywood Rural Fire District	Sheridan	Plentywood
RFD	195	Medicine Lake Rural Fire Dist.	Sheridan	Medicine Lake
RFD	196	Westby Rural Fire Dist.	Sheridan	Westby
RFD	197	Redstone Rural Fire Dist.	Sheridan	Redstone
RFD	198	Outlook Rural Fire Dist.	Sheridan	Outlook
RFD	199	Big Butte Rural Fire Dist.	Silver Bow	Butte
RFD	200	Boulevard Rural Fire Dist.	Silver Bow	Butte
RFD	201	Centerville Rural Fire District	Silver Bow	Butte
RFD	202	Race Track Rural Fire Dist.	Silver Bow	Butte
RFD	203	Home Atherton Rural Fire Dist.	Silver Bow	Butte
RFD	204	Melrose Rural Fire Dist.	Silver Bow	Melrose
RFD	205	Terra Verde Rural Fire Dist.	Silver Bow	Butte
RFD	206	Rocker Rural Fire Dist.	Silver Bow	Butte
RFD	207	Columbus Rural Fire Dist.	Stillwater	Columbus
RFD	208	Absarokee Rural Fire Dist.	Stillwater	Absarokee
RFD	209	Park City Rural Fire Dist.	Stillwater	Park City
RFD	210	Sweet Grass Co. Rural Fire Dept.	Sweet Grass	Big Timber
RFD	211	Big Timber Rural Fire Dist.	Sweet Grass	Big Timber
RFD	212	Chouteau Rural Fire Dist.	Teton	Chouteau
RFD	213	Dutton Rural Fire Dist.	Teton	Dutton
RFD	214	Fairfield Rural Fire Dist.	Teton	Fairfield
RFD	215	Richland Rural Fire Dist.	Valley	Richland
RFD	216	Hinsdale Rural Fire Dist.	Valley	Hinsdale
RFD	217	Wheatland Co. Rural Fire Dept.	Wheatland	Harlowton
RFD	218	Wibaux Rural Fire Dist.	Wibaux	Wibaux
RFD	219	Wibaux Co. Rural Fire Dist.	Wibaux	Wibaux
RFD	220	Laurel Rural Fire Dist. #7	Yellowstone	Laurel
RFD	221	Laurel Rural Fire Dist. #5	Yellowstone	Laurel
RFD	222	Broadview Rural Fire Dist.	Yellowstone	Broadview
RFD	223	Lockwood Rural Fire Dist.	Yellowstone	Billing
RFD	224	Worden Rural Fire District	Yellowstone	Worden

TOTAL # RFD'S ==> 194

TYPE	#	ORGANIZATION	COUNTY	CITY

VOLUNTEER FIRE COMPANY (VFC)

VFC	225	Grant Vol. Fire Company	Beaverhead	Dillon
VFC	226	Wise River Vol. Fire Co.	Beaverhead	Wise River
VFC	227	Crow Agency Vol. Fire Company	Big Horn	Crow Agency
VFC	228	Yellowtail Project Vol. Fire Co.	Big Horn	Hardin
VFC	229	Big Horn County Vol. Fire Co.	Big Horn	Hardin
VFC	230	Turner Vol. Fire Company	Blaine	Turner
VFC	231	Lohman Vol. Fire Company	Blaine	Lohman
VFC	232	Lone Tree Vol. Fire Company	Blaine	Chinook
VFC	233	Lloyd Vol. Fire Company	Blaine	Lloyd
VFC	234	Fort Belknap Vol. Fire Co.	Blaine	Fort Belknap
VFC	235	North Chinook Vol. Fire Co.	Blaine	Chinook
VFC	236	Hogeland Vol. Fire Company	Blaine	Hogeland
VFC	237	Clearcreek Vol. Fire Co.	Blaine	Chinook
VFC	238	Badlands Vol. Fire Company	Blaine	Harlem
VFC	239	Gordon Cattle Vol. Fire Co.	Blaine	Chinook
VFC	240	Winston Vol. Fire Co.	Broadwater	Winston
VFC	241	Alzada Vol. Fire Company	Carter	Alzada
VFC	242	Mill Iron Vol. Fire Co.	Carter	Mill Iron
VFC	243	Stockett Vol. Fire Company	Cascade	Stockett
VFC	244	Monarch Vol. Fire Company	Cascade	Monarch
VFC	245	Cascade Rancher Vol. Fire Co.	Cascade	Cascade
VFC	246	Ulm Vol. Fire Co.	Cascade	Ulm
VFC	247	Sand Coulee Vol. Fire Co.	Cascade	Sand Coulee
VFC	248	Simms Vol. Fire Co.	Cascade	Simms
VFC	249	Dearborn Vol. Fire Company	Cascade	Cascade
VFC	250	Fort Shaw Vol. Fire Co.	Cascade	Fort Shaw
VFC	251	Shonkin Vol. Fire Co.	Chouteau	Shonkin
VFC	252	Loma Vol. Fire Co.	Chouteau	Loma
VFC	253	Knees Vol. Fire Co.	Chouteau	Brady
VFC	254	Carter Vol. Fire Company	Chouteau	Carter
VFC	255	Fishtail Vol. Fire Co.	Daniels	Nye
VFC	256	Whitetail Vol. Fire Co.	Daniels	Whitetail
VFC	257	Georgetown Lake Vol. Fire Co.	Deer Lodge	Anaconda
VFC	258	Warm Springs Vol. Fire Co.	Deer Lodge	Warm Springs

TYPE	#	ORGANIZATION	COUNTY	CITY
VFC	259	Cheadle Vol. Fire Company	Fergus	Lewistown
VFC	260	Maudlow Vol. Fire Company	Gallatin	Maudlow
VFC	261	Pass Creek Vol. Fire Co.	Gallatin	Belgrade
VFC	262	Amsterdam Vol. Fire Company	Gallatin	Manhattan
VFC	263	Three "F" Corp. Vol. Fire Co.	Gallatin	Bozeman
VFC	264	Gallatin Gateway Vol. Fire Co.	Gallatin	Gallatin Gateway
VFC	265	Babb Vol. Fire Company	Glacier	Babb
VFC	266	East Glacier Park Vol. Fire Co.	Glacier	East Glacier Park
VFC	267	Blackfoot Agency Vol. Fire Co.	Glacier	Browning
VFC	268	St. Mary's Vol. Fire Company	Glacier	St. Mary's
VFC	269	Del Bonita Vol. Fire Co.	Glacier	Cut Bank
VFC	270	Glacier Nat'l Park Vol. Fire Co.	Glacier	West Glacier
VFC	271	Texcom Vol. Fire Co.	Hill	Havre
VFC	272	Bearpaw Vol. Fire Co.	Hill	Havre
VFC	273	North Havre Vol. Fire Co.	Hill	Havre
VFC	274	Havre AFB Vol. Fire Company	Hill	Havre
VFC	275	Jefferson City Vol. Fire Co.	Jefferson	Jefferson City
VFC	276	Raynesford Vol. Fire Co.	Judith Basin	Raynesford
VFC	277	Geyser Vol. Fire Co.	Judith Basin	Geyser
VFC	278	Windham Vol. Fire Company	Judith Basin	Stanford
VFC	279	Stanford Vol. Fire Co.	Judith Basin	Raynesford
VFC	280	Pablo Vol. Fire Co.	Lake	Pablo
VFC	281	Kicking Horse Vol. Fire Co.	Lake	Ronan
VFC	282	Dixon Vol. Fire Co.	Lake	Dixon
VFC	283	Chief Cliff Vol. Fire Company	Lake	Proctor
VFC	284	Big Arm Vol. Fire Co.	Lake	Big Arm
VFC	285	Canyon Ferry Vol. Fire Co.	Lewis & Clark	East Helena
VFC	286	York Vol. Fire Company	Lewis & Clark	Helena
VFC	287	Wolf Creek Vol. Fire Company	Lewis & Clark	Wolf Creek
VFC	288	Champion Fire Brigade	Lincoln	Libby
VFC	289	Ranchers Vol. Fire Co.	Lincoln	Libby
VFC	290	Vida Vol. Fire Co.	McCone	Wolf Point
VFC	291	Brockway Vol. Fire Company	McCone	Brockway
VFC	292	Checkerboard Vol. Fire Co.	Meagher	White Sulphur Springs

TYPE	#	ORGANIZATION	COUNTY	CITY
VFC	293	Superior Vol. Fire Co.	Mineral	Superior
VFC	294	Swan Valley Vol. Fire Co.	Missoula	Condon
VFC	295	Greenough-Potomac Vol. Fire Co.	Missoula	Greenough
VFC	296	Hawk Creek Vol. Fire Company	Musselshell	Musselshell
VFC	297	Springdale Vol. Fire Co.	Park	Springdale
VFC	298	Royal Teton Vol. Fire Company	Park	Corwin Springs
VFC	299	Dupuyer Vol. Fire Company	Pondera	Dupuyer
VFC	300	Avon Vol. Fire Company	Powell	Avon
VFC	301	Elliston Vol. Fire Co.	Powell	Elliston
VFC	302	Galen Vol. Fire Co.	Powell	Deer Lodge
VFC	303	Savage Vol. Fire Company	Richland	Savage
VFC	304	Smoke Creek Vol. Fire Co.	Roosevelt	Froid
VFC	305	Enterprise Vol. Fire Company	Roosevelt	Froid
VFC	306	Charlie Creek Vol. Fire Co.	Roosevelt	Brockton
VFC	307	North 13 Vol. Fire Company	Roosevelt	Wolf Point
VFC	308	Volt Vol. Fire Company	Roosevelt	Wolf Point
VFC	309	Lame Deer Vol. Fire Co.	Rosebud	Lame Deer
VFC	310	St. Labre Vol. Fire Co.	Rosebud	Ashland
VFC	311	Antelope Vol. Fire Company	Sheridan	Antelope
VFC	312	Tri-County Vol. Fire Company	Sheridan	Reserve
VFC	313	Little Basin Cr. Vol. Fire Co.	Silver Bow	Butte
VFC	314	Floral Park Vol. Fire Co.	Silver Bow	Butte
VFC	315	Reed Point Vol. Fire Co.	Stillwater	Reed Point
VFC	316	Rapelje Vol. Fire Company	Stillwater	Rapelje
VFC	317	Nye Vol. Fire Company	Stillwater	Nye
VFC	318	Molt Vol. Fire Co.	Stillwater	Molt
VFC	319	Power Vol. Fire Company	Teton	Power
VFC	320	Sweet Grass Vol. Fire Co.	Toole	Sweet Grass
VFC	321	Frazer Vol. Fire Co.	Valley	Frazier
VFC	322	Homewood Park Vol. Fire Co.	Yellowstone	Billings
VFC	323	Huntley Vol. Fire Co.	Yellowstone	Huntley
VFC	324	Custer Vol. Fire Company	Yellowstone	Custer

TOTAL # VFC'S ==> 100

TYPE	#	ORGANIZATION	COUNTY	CITY
VOLUNTEER FIRE DEPARTMENT (VFD)				
VFD	325	Lima Vol. Fire Dept.	Beaverhead	Lima
VFD	326	Dillon Vol. Fire Dept.	Beaverhead	Dillon
VFD	327	Lodge Grass Vol. Fire Dept.	Big Horn	Lodge Grass
VFD	328	Hardin Vol. Fire Dept.	Big Horn	Hardin
VFD	329	Chinook Vol. Fire Dept.	Blaine	Chinook
VFD	330	Harlem Vol. Fire Dept.	Blaine	Harlem
VFD	331	Gallatin Canyon Vol. Fire Dept.	Bozeman	Big Sky
VFD	332	Townsend Vol. Fire Dept.	Broadwater	Townsend
VFD	333	Fromberg Vol. Fire Dept.	Carbon	Fromberg
VFD	334	Joliet Vol. Fire Dept.	Carbon	Joliet
VFD	335	Bridger Vol. Fire Dept.	Carbon	Bridger
VFD	336	Red Lodge Vol. Fire Dept.	Carbon	Red Lodge
VFD	337	Ekalaka Vol. Fire Dept.	Carter	Ekalaka
VFD	338	Cascade Vol. Fire Dept.	Cascade	Cascade
VFD	339	Neihart Vol. Fire Dept.	Cascade	Neihart
VFD	340	Belt Vol. Fire Dept.	Cascade	Belt
VFD	341	Big Sandy Vol. Fire Dept.	Chouteau	Big Sandy
VFD	342	Geraldine Vol. Fire Dept.	Chouteau	Geraldine
VFD	343	Fort Benton Vol. Fire Dept.	Chouteau	Fort Benton
VFD	344	Ismay Vol. Fire Dept.	Custer	Ismay
VFD	345	Scobey Vol. Fire Dept.	Daniels	Scobey
VFD	346	Flaxville Vol. Fire Dept.	Daniels	Flaxville
VFD	347	Richey Vol. Fire Dept.	Dawson	Richey
VFD	348	Baker Vol. Fire Dept.	Fallon	Baker
VFD	349	Moore Vol. Fire Dept.	Fergus	Moore
VFD	350	Denton Vol. Fire Dept.	Fergus	Denton
VFD	351	Winifred Vol. Fire Dept.	Fergus	Winifred
VFD	352	Grass Range Vol. Fire Dept.	Fergus	Grass Range
VFD	353	Whitefish Vol. Fire Dept.	Flathead	Whitefish
VFD	354	Manhattan Vol. Fire Dept.	Gallatin	Manhattan
VFD	355	West Yellowstone Vol. Fire Dept.	Gallatin	West Yellowstone
VFD	356	Belgrade Vol. Fire Dept.	Gallatin	Belgrade
VFD	357	Three Forks Vol. Fire Dept.	Gallatin	Three Forks
VFD	358	Jordan Vol. Fire Dept.	Garfield	Jordan

TYPE	#	ORGANIZATION	COUNTY	CITY
VFD	359	Cut Bank Vol. Fire Dept.	Glacier	Cut Bank
VFD	360	Browning Vol. Fire Dept.	Glacier	Browning
VFD	361	Ryegate Vol. Fire Dept.	Golden Valley	Ryegate
VFD	362	Lavina Vol. Fire Dept.	Golden Valley	Lavina
VFD	363	Philipsburg Vol. Fire Dept.	Granite	Philipsburg
VFD	364	Drummond VFD	Granite	Drummond
VFD	365	Hingham Vol. Fire Dept.	Hill	Hingham
VFD	366	Boulder Vol. Fire Dept.	Jefferson	Boulder
VFD	367	Whitehall Vol. Fire Dept.	Jefferson	Whitehall
VFD	368	Hobson Vol. Fire Dept.	Judith Basin	Hobson
VFD	369	Stanford Vol. Fire Dept.	Judith Basin	Stanford
VFD	370	St. Ignatius Vol. Fire Dept.	Lake	St. Ignatius
VFD	371	Ronan Vol. Fire Dept.	Lake	Ronan
VFD	372	Polson Vol. Fire Dept.	Lake	Polson
VFD	373	East Helena Vol. Fire Dept.	Lewis & Clark	East Helena
VFD	374	Marysville Vol. Fire Dept.	Lewis & Clark	Marysville
VFD	375	Chester Vol. Fire Dept.	Liberty	Chester
VFD	376	Troy Vol. Fire Dept.	Lincoln	Troy
VFD	377	Rexford Vol. Fire Dept.	Lincoln	Rexford
VFD	378	Libby Vol. Fire Dept.	Lincoln	Libby
VFD	379	Ennis Vol. Fire Dept.	Madison	Ennis
VFD	380	Virginia City Vol. Fire Dept.	Madison	Virginia City
VFD	381	Twin Bridges Vol. Fire Dept.	Madison	Twin Bridges
VFD	382	Sheridan Vol. Fire Dept.	Madison	Sheridan
VFD	383	Circle Vol. Fire Dept.	McCone	Circle
VFD	384	White Sulphur Springs Vol. Fire Dept.	Meagher	White Sulphur Springs
VFD	385	Superior Vol. Fire Dept.	Mineral	Superior
VFD	386	Alberton Vol. Fire Dept.	Mineral	Alberton
VFD	387	Melstone Vol. Fire Dept.	Musselshell	Melstone
VFD	388	Roundup Vol. Fire Dept.	Musselshell	Roundup
VFD	389	Clyde Park Vol. Fire Dept.	Park	Clyde Park
VFD	390	Winnett Vol. Fire Dept.	Petroleum	Winnett
VFD	391	Saco Vol. Fire Dept.	Phillips	Saco
VFD	392	Malta Vol. Fire Dept.	Phillips	Malta
VFD	393	Dodson Vol. Fire Dept.	Phillips	Dodson
VFD	394	Conrad Vol. Fire Dept.	Pondera	Conrad

TYPE	#	ORGANIZATION	COUNTY	CITY
VFD	395	Valier Vol. Fire Dept.	Pondera	Valier
VFD	396	Broadus Vol. Fire Dept.	Powder River	Broadus
VFD	397	Deer Lodge Vol. Fire Dept.	Powell	Deer Lodge
VFD	398	Terry Vol. Fire Dept.	Prairie	Terry
VFD	399	Stevensville Vol. Fire Dept.	Ravalli	Stevensville
VFD	400	Pinesdale Vol. Fire Dept.	Ravalli	Pinesdale
VFD	401	Hamilton Vol. Fire Dept.	Ravalli	Hamilton
VFD	402	Sidney Vol. Fire Dept.	Richland	Sidney
VFD	403	Fairview Vol. Fire Dept.	Richland	Fairview
VFD	404	Brockton Vol. Fire Dept.	Roosevelt	Brockton
VFD	405	Poplar Vol. Fire Dept.	Roosevelt	Poplar
VFD	406	Culbertson Vol. Fire Dept.	Roosevelt	Culberson
VFD	407	Bainville Vol. Fire Department	Roosevelt	Bainville
VFD	408	Wolf Point Vol. Fire Dept.	Roosevelt	Wolf Point
VFD	409	Froid Vol. Fire Dept.	Roosevelt	Froid
VFD	410	Forsyth Vol. Fire Dept.	Rosebud	Forsyth
VFD	411	Hot Springs Vol. Fire Dept.	Sanders	Hot Springs
VFD	412	Plains Vol. Fire Dept.	Sanders	Plains
VFD	413	Thompson Falls Vol. Fire Dept.	Sanders	Thompson Falls
VFD	414	Outlook Vol. Fire Dept.	Sheridan	Outlook
VFD	415	Medicine Lake Vol. Fire Dept.	Sheridan	Medicine Lake
VFD	416	Plentywood Vol. Fire Dept.	Sheridan	Plentywood
VFD	417	Walkerville Vol. Fire Dept.	Silver Bow	Walkerville
VFD	418	Broadview Vol. Fire Dept.	Stillwater	Broadview
VFD	419	Columbus Vol. Fire Dept.	Stillwater	Columbus
VFD	420	Big Timber Vol. Fire Department	Sweet Grass	Big Timber
VFD	421	Fairfield Vol. Fire Dept.	Teton	Fairfield
VFD	422	Dutton Vol. Fire Dept.	Teton	Dutton
VFD	423	Pendroy Vol. Fire Dept.	Teton	Pendroy
VFD	424	Chouteau Vol. Fire Dept.	Teton	Chouteau
VFD	425	North Toole Co. Vol. Fire Dept.	Toole	Sunburst
VFD	426	Shelby Vol. Fire Dept.	Toole	Shelby
VFD	427	Kevin Vol. Fire Dept.	Toole	Kevin
VFD	428	Sunburst Vol. Fire Dept.	Toole	Sunburst
VFD	429	Hysham Vol. Fire Dept.	Treasure	Hysham
VFD	430	Nashua Vol. Fire Dept.	Valley	Nashua
VFD	431	Fort Peck Vol. Fire Dept.	Valley	Fort Peck

TYPE	#	ORGANIZATION	COUNTY	CITY
VFD	432	Opheim Vol. Fire Dept.	Valley	Opheim
VFD	433	Glasgow Vol. Fire Dept.	Valley	Glasgow
VFD	434	Judith Gap Vol. Fire Dept.	Wheatland	Judith Gap
VFD	435	Harlowton Vol. Fire Dept.	Wheatland	Harlowton
VFD	436	Wibaux Vol. Fire Dept.	Wibaux	Wibaux
VFD	437	Laurel Vol. Fire Dept.	Yellowstone	Laurel
VFD	438	Custer Vol. Fire Dept.	Yellowstone	Custer
VFD	439	Shepherd Vol. Fire Dept.	Yellowstone	Shepherd

TOTAL # VFD'S ⟹ 115

NONCLASSIFIED FIRE ORGANIZATIONS (XXX)

XXX	440	Blaine County Fire Council	Blaine	Chinook
XXX	441	Carter County Fire Dept.	Carter	Ekalaka
XXX	442	Malstrom AFB Fire Dept.	Cascade	Great Falls
XXX	443	MT. Air Nat'l Guard Fire Dept.	Cascade	Great Falls
XXX	444	Chouteau County Fire Council	Chouteau	Loma
XXX	445	Custer County Fire Dept.	Custer	Miles City
XXX	446	Miles City Rural Fire Assoc.	Custer	Miles City
XXX	447	Daniels County Rural Fire Dept.	Daniels	Scobey
XXX	448	Dawson Co. Rural Fire Dept.	Dawson	Glendive
XXX	449	Rocky Boy Reservation Fire Org.	Hill	Box Elder
XXX	450	Hill Co. Fire Council	Hill	Havre
XXX	451	MT Air Nat'l Guard FD	Jefferson	Clancy
XXX	452	B.I.A. Forestry	Lake	Pablo
XXX	453	Fort Harrison Fire Organization	Lewis & Clark	Fort Harrison
XXX	454	Lewis & Clark Co. Rural Fire Dept.	Lewis & Clark	Helena
XXX	455	Helena Airport Fire Dept.	Lewis & Clark	Helena
XXX	456	Meagher Co. Rural Fire Dept.	Meagher	White Sulphur Springs
XXX	457	Missoula Co. Airport Authority	Missoula	Missoula
XXX	458	Musselshell Co. Rural Fire Dept.	Musselshell	Roundup
XXX	459	Powder River Co. Rural Fire Dept.	Powder River	Broadus
XXX	460	Montana State Prison Fire Dept.	Powell	Deer Lodge

TYPE	#	ORGANIZATION	COUNTY	CITY
XXX	461	Prairie Co. Rural Fire Dept.	Prairie	Terry
XXX	462	Roosevelt Co. Rural Fire Dept.	Roosevelt	Wolf Point
XXX	463	Rosebud Co. Rural Fire Dept.	Rosebud	Forsyth
XXX	464	Silver Bow Fire Training Ct.	Silver Bow	Butte
XXX	465	Silver Bow Co.	Silver Bow	Butte
XXX	466	Bert Mooney Airport Fire Dept.	Silver Bow	Butte
XXX	467	Valley County Rural Fire Dept.	Valley	Glasgow
XXX	468	Yellowstone B&G Ranch	Yellowstone	Billings

TOTAL # XXX'S ==> 29

XXX	444	Chouteau County Fire Council	Chouteau	Loma

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