IS BIGGER BETTER? AN ANALYSIS OF ECONOMIES OF SCALE AND MARKET POWER IN IDAHO POLICE DEPARTMENTS

by

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DEDICATION

This thesis is dedicated to D. Allen Dalton, whose generosity helped make it possible.

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ABSTRACT

Whether the nature of policing services allows for economies of scale to be realized is an important question for police departments for reasons of both cost and efficiency. This study replicates the methodology used by Southwick (2005) to estimate police production and demand in order to determine whether there are economies of scale among police departments in Idaho. Southwick's (2005) method is unique in that it incorporates measures of market power to predict police efficiency. The present study is unique in that it involves data from a low density, low population western state. Southwick's results for New York State are markedly different from the results found for Idaho, thus the external validity of Southwick's model as applied to a relatively low population state is questionable. The findings also indicate that, controlling for relevant variables, crime in Idaho is highly correlated with population, suggesting that Idaho police departments would not achieve efficiency gains through consolidation.

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LIST OF ABBREVIATIONS

A	Assets
C4	Measure of the 4 FBI Index Violent Crimes
C7	Measure of all 7 FBI Index Crimes
COP	Community-Oriented Policing
D	Density
HH	Herfindahl-Hirschman Index
LEMAS	Law Enforcement Management and Administrative Statistics
NIBRS	National Incident Based Reporting System
POLPOP	Number of Police per 1,000 Population
POP	Population
POP1	Inverse of Population
WPOL	Total Expenditures on Police Divided by Number of Police

CHAPTER ONE: INTRODUCTION

Issues of cost and efficiency are important for local governments. Despite their ability to tax, there is a limit to how much revenue they can collect and allocate to certain uses. Policing is a service that many municipalities provide, though some choose to contract it out to private companies or neighboring governments, citing economies of scale as a cost savings justification. This is an efficient approach for services such as garbage collection, which many cities contract out instead of providing 'in-house', but does it work for policing?

The purpose of this study is to shed further light on the question, to what extent are there economies (or diseconomies) of scale in policing? This is an important question as public safety is one of the most crucial services that cities provide. Since all cities have a limited supply of funds, producing services in the most efficient way possible will allow them to maintain more or better quality services. In terms of policing, some smaller municipalities contract their policing services to county sheriffs' offices, justifying such a measure based on cost savings, assuming that larger county sheriffs' offices enjoy economies of scale over smaller municipal police departments (Finney, 1997). While there are intuitive reasons to expect that larger police departments enjoy cost savings in some areas, such as through the elimination of duplicate layers of management (Southwick, 2005), there are ways in which they may be less efficient in providing public safety. One example is that larger departments devote a smaller percentage of personnel to street patrol (Lithopoulos, 2015). Knowing at which point economies of scale are

maximized, or having an idea of when mergers incur diminishing (or even negative) returns to public safety, can help ensure that municipal governments have more optimal levels of policing subject to their budgetary constraints.

Another reason this research question is important is that, just like any other resource, public services are scarce and must be allocated to their most highly valued uses in order to achieve the efficient level of public safety. Police departments face an economic knowledge problem that most other industries deal with to a lesser extent. Although police departments are able to calculate the costs of providing their services, they do not receive revenue based on the type or number of services they provide, and, therefore, lack market feedback on which services are most highly valued by citizens in terms of what they are willing to pay. In other words, police departments do not have the benefit of the information profits and losses provide in making decisions on organizational size (Mises, 1998). They do not have the informational benefits provided by competition and market prices; rather, the scale of police departments is a bureaucratic decision made without the benefit of this information. Thus, due to the institutional framework in which they operate, police departments face greater hurdles than private industry in achieving the most efficient size.[1] This research intends to address, but not necessarily serve as a substitute for, this lack of knowledge.

[1]Due to the nature of policing and the local differences in expectations of police, the ideal scale for policing may be different depending on the location. Indeed, the International Association of the Chiefs of Police (2007) discourages using figures such as officers per thousand population to make staffing decisions.

CHAPTER TWO: LITERATURE REVIEW

The Purpose of American Policing and Measuring Police Output

In order to test whether there are economies of scale in policing, it is necessary to define the purpose of modern American policing. This section contains an extended discussion of how the role of the police has changed over time and, thus, how measures of their performance have (or have not) changed as well. This discussion is included in order to explain the complexities of the policing role and the corresponding difficulty of finding an accurate measure of police output for the purpose of measuring economies of scale.

Though scholars differ in the specifics of what police *should* do, there is widespread agreement on defining *who* the police are. Bittner (1979) describes the modern Western police force as arising during an era (in the late 19th century) in which "the quest for peace by peaceful means is one of the cultur[al] traits" (p. 36) of civilization. Instead of the police simply being the means by which kings or other heads of state enforce their will upon the governed, the police are to serve the function of maintaining the peace in a neutral manner so as to minimize the amount of violence in society. However, Bittner also describes the police in less lofty terms: "...police are nothing else than a mechanism for the distribution of situationally justified force in society" (1979, p. 39). In other words, police still serve as the arm of the state that fulfills its claim as a "monopoly on the legitimate use of physical force within a given territory" (Weber, Mills, & Gerth, 1965, p. 1).

Although this definition appears limited, the hope is that the police will play a wider public service role rather than strictly a law enforcement one. Indeed, Bayley (1979) argues that the scope of the police function is more than guarding life and property and enforcing laws. Despite attempts to neatly categorize all police functions, Bayley (1979) denies that these descriptions capture the full range of what police actually do, especially when considering the far greater number of administrative functions undertaken by police in continental Europe compared to the United States. In his "nearly exhaustive list of police functions, specifying at least one country where each is performed," Bailey (1979, p.111) includes "advising about crime prevention (Canada)...conducting prosecutions (Britain)...gathering information about political and social life (France)...[and] counseling juveniles (Netherlands)" (p.111-112) among a host of other activities. In order to accommodate all of these diverse responsibilities, Bayley confers upon police a rather elastic definition: "Police are a group authorized in the name of territorial communities to utilize force within the community *to handle whatever needs doing*" (1979, p. 113, emphasis added). This is consistent with Dunham and Alpert (2001), who note that the complexity of the role of the modern police officer has expanded, but the justification for the police remains largely the same: to ensure a civilized society, provide domestic safety, and to make sure people contribute to paying for public goods (though it is no longer the local police who enforce tax laws).

Eck and Rosenbaum (1994) describe four main traditional functions of police. The first function is crime control, even though most police activities are not directly related to crime control. The second is to provide emergency services to people in need. The third function, which most other scholars do not mention, is to serve justice; that is,

to enforce the law even in situations where it is unclear that enforcement will serve a crime control function. Even if the efficacy of arrest in terms of serving the crime control function is questionable, it demonstrates that there are consequences for those who break the law, thus also serving a legitimizing function for the institution of the police. The fourth function is a catch-all: providing non-emergency services. In community-oriented policing[2] (discussed below), all four of these traditional functions remain important, though with greater priority placed on the non-emergency service function. Some examples of these non-emergency service functions, according to Goldstein (1977), include ensuring individual constitutional protections such as the freedom of speech, facilitating flows of traffic, assisting individuals who cannot care for themselves (such as the intoxicated and the mentally ill), providing conflict resolution (between individuals as well as between individuals and the government), and identifying and solving problems that have the potential to grow into more serious issues.

As will be discussed below, the role of the police is intimately connected with both how police performance is measured and how a police organization is structured and managed. Many American police departments claim to have made the transition between the professional era of policing (with its emphasis on crime control, rapid response, and random patrol) to community-oriented policing (COP). Under COP, police are expected to do more than simply engage in preventive patrols, investigate crimes, and respond to calls for service. They are to take a more active, problem-solving approach, preventing the conditions in communities that can lead to more serious crime (Wilson & Kelling, 1982; Goldstein, 1979). But is this actually a change in the role of the police or merely a

[2] Community-oriented policing (COP) is used here as a broad term to describe a number of distinct, yet similar, approaches to policing, including the Community Partnership Model (see Correia, 2000) and Problem-Oriented Policing (Goldstein, 1990).

different and (hopefully) more effective method for the traditional goal of reducing crime? Bittner (1979) notes that the role of the police always has been primarily associated with law enforcement such that when they engage in other activities, they have had to justify it by connecting it to serving the law enforcement function. Moore (1994, p. 292-293) describes community policing as establishing new goals, such as reducing fear of crime, 'enhancing security,' building police-community partnerships, and helping to provide communities with knowledge and resources in order for them to be involved in providing for their own safety. However, he says it is unclear from the community policing philosophy whether these are independent goals or whether they are primarily for the purpose of reducing crime (Moore, 1994).

Indeed, despite the claim that COP became the dominant strategy in American policing in the 1990s, and the fact that the 100,000 police officers hired as a result of the 1994 Crime Bill are legally required to be engaged in community policing, its lack of a precise definition has complicated measuring to what extent police departments have implemented community-oriented policing, as well as evaluation of its effectiveness (Cordner, 2015). While many police departments have utilized an assortment of innovations that they have labeled as community-oriented policing, it is unclear that the philosophical orientation of police departments has been radically altered, or that their assessments of performance have changed from the traditional measures of crime rates and arrests (Cordner, 2015).

It is clear that most policing scholars see a greater role for police than simply controlling crime, as do most citizens. Indeed, most calls to police are for non-crime related matters (Dunham & Alpert, 2015). Police are expected to maintain order, provide

a very wide range of services, and engage in actions that reduce fear of crime in neighborhoods. Regardless, crime control remains a primary function of the police.

The Police Department as an Organization

Whether economies of scale exist can depend on technology and the organizational structure of a production unit. For example, organizations that are excessively bureaucratic or hierarchical can suffer from diseconomies of scale due to too many layers placed between upper-level management and front-line workers (Cowen and Tabarrok, 2015). Therefore, the issue of police organization is relevant to the question of economies of scale and will be considered in this section.

The traditional organizational model of policing in the professional era was characterized by a hierarchical structure used in an attempt to control and coordinate police efforts and standardize police procedure (Wilson & McLaren, 1963). Though this approach may seem outdated today, it was developed in response to the patronage era of policing, when police personnel were far more subject to the whims of elected officials. Thus, insulating police decision-making and policy from short-term political influence was at least partially responsible for police departments adopting a closed model of organization (Cordner, 1978). The closed model (also called bureaucratic, formal, rational and mechanistic) has some of the following characteristics:

> Routine tasks occurring in stable conditions, task specialization, means (or the proper way to do a job) are emphasized, conflict within the organization is adjudicated from the top...one's primary sense of responsibility and loyalty are to the bureaucratic subunit to which one is assigned, knowledge is inclusive only at the top of the hierarchy. (Cordner, 1978, p. 23)

According to Cordner (1978), all of these aspects of the closed organizational model describe the typical police department, except for “routine tasks occurring in stable

conditions" (p. 23), and this exception is quite important. Most police labor is allocated to the patrol function, which often requires officers to face non-routine situations in unstable conditions (Cordner, 1978). Furthermore, police officers in these situations often do not have the benefit of managerial oversight and no procedural manual could possibly be developed to guide officers based on the contingencies of the variety of situations they encounter. Thus, if the closed organizational model is to be maintained or useful, the police function has to be narrow enough so that it is amenable to bureaucratic management. However, as previously discussed, such a narrow mission (crime control and order maintenance), a mission which in practice is often not narrow, falls short of what people expect from the police.

This leads Cordner (1978) to consider whether the open model of organizations would be more appropriate to the modern police function. The characteristics of the open model are:

> Nonroutine tasks occurring in unstable conditions, specialized knowledge contributing to common tasks, ends (or getting the job done) are emphasized, conflict within the organization is adjusted by interaction with peers, one's sense of responsibility and loyalty are to the organization as a whole... (p. 29)

Police departments have embraced certain facets of the open model, such as utilizing knowledge at all levels of their organization, problem solving and conflict resolution as much as possible without direction from higher ranks (and thus encouraging horizontal interaction and not relying upon vertical interaction), and allowing for more discretion among the lower ranks (Cordner, 1978). Also, the open model's compatibility with non-routine tasks taking place in unstable conditions is consistent with what police officers experience: a wide variety of situations that requires them to use their discretion in resolving a situation. However, there are certain aspects of policing that stand in the way

of a full embrace of the open model. One of these is the legalistic emphasis on means, such as procedural due process. Although the goal of crime control may be hindered by adherence to procedural due process, these means are considered to serve more important ends (such as civil liberty) [Cordner, 1978]. There are dilemmas in what is expected of the police that leave full embrace of either model untenable. We cannot create a handbook of standardized responses to every situation the police encounter, though we desire high standards and equity. And although police are considered the primary party for controlling crime, there are limits placed on their power to do so. Despite this, Cordner (1978) concludes that there are management approaches associated with the open model (job enrichment, participatory management, and Theory Y)[3] that are applicable to police management, particularly strategies like team policing. The nature of policing does not necessarily require a closed model.

Langworthy (1992) argues that the organizational structures in American policing arose in such a way to serve the ends that local governments had for the police. Early American policing organizations were much more decentralized than in the professional era,

> reflecting their close ties to political machines and ward politics. The agenda for these police organizations was to do a minimum amount of law enforcement, keep the neighborhood relatively quiet, and serve the needs of entrenched political interests. (1992, p. 89)

This style of policing existed in an era before the widespread use of civil service protection laws and police department positions were patronage jobs to be distributed by

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3Theory Y style of management was developed by Douglas McGregor (1957). In contrast to Theory X, which assumes employees dislike work and will try to avoid it and therefore must be managed in an authoritarian style, Theory Y sees employees as self-motivated and generally enjoying work that allows them to be creative.

the successfully elected. Thus, the role of the police was to do whatever (up to and including election rigging) to ensure that the incumbent maintained power. Furthermore, due to the cultural diversity of American cities where municipal police departments first arose, as well as the constraints of communication technology, a decentralized organizational structure was more appropriate for serving the police role at the time (Langworthy, 1992).

However, part of Progressive Era reform was to attack this intimate connection between politicians and the police (Langworthy, 1992). It was thought that a more bureaucratic orientation would sever this inappropriate tie between politicians and police officers, and that a narrower focus on law enforcement would better regulate police activities. These reforms led to the 'professional era' of policing, during which American police departments embraced the closed model of policing described above (Dunham & Alpert, 2015).

This model of police organization that characterizes the professional era, however, has since been found to be inadequate in serving all of the functions that are expected of police, including crime control (Thurman, Zhao, & Giacomazzi, 2001). The paramilitary structure and closed nature of the professional model are not ideal for fostering collaboration with communities to solve problems (Thurman, Zhao, & Giacomazzi, 2001). Due to the limitations of the closed, bureaucratic model, a number of policing scholars (Cordner, 1978; Langworthy, 1992; Brogden & Nijher, 2013) argue that police organizations would be better able to achieve their goals and solve unique problems by having a more flexible and less mechanistic organizational structure.

However, despite the promises of having a more open organizational structure, there is a lack of empirical evidence that such changes will improve policing services (Cordner, 2015). As well, it is unclear how successful police organizations have been in reforming themselves. In a study assessing whether changes in policing have reduced violent crime, Eck and Maguire (1999) state that,

> Although some police organizations have undoubtedly changed their structures, cultures, and management styles, evidence suggests that overall, such shifts are occurring glacially. Changes in structure are just now starting to occur nationally. Evidence suggests that changes in culture, if they are occurring at all, are probably not widespread. (p. 220-221)

And despite many police departments' claims to have implemented COP (which often goes no further than initiating a single community-oriented tactic), police performance is still heavily evaluated upon what can easily be measured: crime rates, clearance rates, tickets issued, and arrests (Dunham & Alpert, 2015).

The following section discusses how police performance has traditionally been measured, the shortcomings of these measures, and the data currently available.

Determination of the Effectiveness of Policing

In this section, we arrive at the point of our extended discussion about the role of policing and police organizations: producing a measure of police performance (or output) in order to assess whether economies of scale exist. As discussed above, the role of American police goes beyond crime control and law enforcement. Regardless, police are still expected to reduce crime. Chaiken (1976) writes that the control of crime, both to the public and police administrators, is a dominant goal of the police. Despite the fact that officers spend most of their time dealing with issues that are not crime-related, police would have difficulty in defending their budgets in terms of benefits not related to crime

reduction (Chaiken, 1976). Police departments themselves are not free from blame for this perception. In budget negotiations, police unions have used arrest numbers and crime rates in order to argue for higher budgets (Benson, Rasmussen, & Sollars, 1995). And even if crime rates were a conceptually accurate measure of police performance, they have serious validity issues:

> Some crimes occur but are not reported to the police, while other crimes are reported to the police but are ignored or reclassified as to time, location, or crime type. When the police officers know that the crime counts will or may be used to evaluate the effectiveness of a particular activity, the incentives for discretionary alteration of the crime counts may be great. (Chaiken, 1976, p. 5)

Perversely, reported crime rates may increase if police are more effective; that is, if victims perceive that alerting the police could have a positive effect, they will be more likely to report than if they expected that police involvement would have a neutral or negative result (Kelling, 1999).

Arrest rates also present difficulties in terms of measuring police performance. Kelling (1999) offers an empirical example of this, comparing two types of responses to graffiti issues in the New York City subways. One strategy involved greater amounts of patrol during certain hours of the day and more arrests for those engaged in graffiti. The other strategy conducted by the Transportation Authority involved quickly painting over graffiti after it was discovered. Despite the latter strategy leading to fewer arrests, it was more effective in lowering the instances of unwanted graffiti (Kelling, 1999). Likewise, situations where an officer can intervene and resolve a conflict before a crime occurs will not show up in arrest statistics. Thus, traditional measures of police performance (crime rates, arrest rates, clearance rates) leave much to be desired.

Issues such as these have led researchers to propose radically different methods of measuring police performance. In their report for the National Institute of Justice, Whitaker, Mastrofski, Ostrom, Parks, and Percy (1982) describe many of the issues with proposed alternative measurements of police performance and offer their own recommendations. Problems that must be avoided are: collecting certain kinds of data simply because they are easier to collect, conflating service quality with quantity, failure to scrutinize the data collection process, and trying to develop one measure of output (or indexes of variables) despite the wide-ranging mandates of police departments that cannot be measured in a single output. Instead, Whitaker et al. (1982) suggest that performance measurement should be a learning process where problems are identified, programs are developed, and theories are formulated. Although this may not provide us with an objective, cardinal measure of police performance, it may be more realistic and helpful in informing police departments about how they can improve. Whitaker et al. (1982) comment,

> Some observers, like Lipsky, believe that all attempts to measure police performance are misleading. We do not share this pessimism. We may not be able to say that one agency is twice as good at reducing burglary than another, and a single performance measure may be too little a basis for policy decision, but carefully constructed measures which are based on explicit, tested theories can provide useful knowledge about service quality as well as service quantity. To abandon measurement of police services, despite the many obstacles, would be to abandon a very essential component to the necessary and never-ending debate about what constitutes good police service. (p. 22)

Unfortunately, most departments have not radically changed the way they measure and evaluate their performance. According to the most recent Law Enforcement Management and Administrative Statistics (LEMAS) survey, less than a third of law enforcement agencies even bother to assess the community's opinion of the police

department's efforts (Davis et al., 2015).[4] Consider, for example, how important of a role 'fear of crime' plays as a component of quality of life outcomes the police are expected to improve under COP (Cordner, 2015). The fact that a sizable majority of police agencies do not attempt to collect even this relatively simple type of data strongly suggests that obtaining other alternative measures of performance is not a priority. Therefore, those attempting to measure police efficiency and economies of scale have to rely on data that is collected, such as crime rates, arrest rates, and clearance rates.

Economies of Scale in Municipal Services

Economies of scale describe a situation in which an enterprise has increasing returns to scale; that is, an increase in inputs leads to a proportionately larger increase in output, and as a result, per unit costs fall (Cowen & Tabarrok, 2015). This can be the case in a firm where, say, a merger with a similar firm allows them to reduce duplicate inputs and yet maintain or increase their collective output. Diseconomies of scale describe the opposite situation: growth in inputs leads to a proportionately smaller increase in output. Considerations of economies of scale can apply to public as well as private enterprises (Cowen & Tabarrok, 2015).

At the turn of the twentieth century, several British scholars tested the relationship between a city's size and per capita municipal expenditures. Baker (1910) analyzed 72 English cities and discovered that the per capita expenditures minimized at around a 90,000 population. Beyond that size, all city services except for electricity and gas increased in cost per capita. Likewise, a study by Oxford University (1938) found diseconomies of scale for urban services in cities surpassing 250,000. The National

4Davis et al. (2015) note that this figure includes not only agencies conducting large mail or telephone surveys, but also those doing nothing more than simply soliciting comments from visitors to their department websites.

Resources Committee (1939) observed an increase in per capita costs in city expenditures for municipalities greater than 275,000 population. Duncan (1956) analyzed municipal budget data for 1942 and noticed that per capita costs were minimized in cities with populations between 50,000 and 100,000. Hirsch (1959) tested 149 governmental units in the St. Louis metropolitan area and in Massachusetts to analyze what effects urban growth and municipal consolidation have on city service expenditures. His results indicated a $1.24 decrease in per capita expenditures as population increased from 1,000 to 110,000. However, they also indicated a $3.62 increase in per capita expenditures when population increases from 110,000 to 300,000 and a $12.26 increase for 300,000 to 500,000. Thus, diseconomies of scale started at 110,000 and grew with additional population increases. In analyzing different types of services specifically, Hirsch (1959) concluded that the per capita costs of public education, fire and police protection, and garbage collection were unrelated to the size of the population, while government administrative costs tended to be minimized in a 'medium-sized' community, and water and sewage services have such large economies of scale that few cities have reached a point at which diseconomies start to occur.

Further studies continue to suggest that diseconomies of scale in municipalities exist. Ostrom (1972) considered thirteen studies of American cities; the primary conclusion was that there is no association between the size of the city and the average cost of city services. Derksen (1988) analyzed studies of Dutch consolidation, concluding that they resulted in no efficiency gains. Boyne's (1995) survey of studies in the United Kingdom found diseconomies of scale. Martin (1995) analyzed research in a variety of European cities that had mixed results and were therefore considered inconclusive. In

reviewing studies of American and Canadian cities, Bish (2001) reported that most government activities at the local level do not have economies of scale beyond a small service area. Byrnes and Dollery (2002) found mixed results in their survey of thirty-two studies in America, the United Kingdom, and Australia. The weight of the evidence suggests that, overall, most municipal services are not subject to economies of scale and that municipalities minimize their per capita costs in populations less than 100,000.

Assuming this figure is accurate for policing, precisely where economies of scale are maximized is an important question for police agencies. The next section will further discuss police services and economies of scale.

Economies of Scale and Policing Services

In addition to analyzing municipal services more generally, researchers have also examined police departments specifically for economies (or diseconomies) of scale. As mentioned above, Hirsch (1959) included policing in his study of municipal services. Using 1955-1956 data from 64 St. Louis police departments, Hirsch (1959) estimated the total per capita cost of police protection as a function of night-time population, night-time population density, total miles of streets, percentage of population that was non-white, percentage of population under 25, income of business establishments, measurements of the scope and quality of police protection (based on independent ratings by a panel of police experts), and the assessed value of real estate. Despite variations in night-time populations,[5] per capita expenditures did not vary much. Hirsch (1959, p.238) concluded: "it can be said that in this case relatively poor police services were offered at about equal

[5]That is, populations that resided in the communities studied, as areas zoned solely for business do not have residential populations at night, and therefore lack the supervision that non-zoned or mixed use areas have (Jacobs, 1961).

per capita expenditures regardless of the size of the community, partialling out the effect of other factors". Thus, Hirsch claims to have found no economies of scale in policing.

Walzer (1972) used a linear regression equation to estimate the presence of economies of scale in Illinois police departments. In contrast to Hirsch (1959), he operationalized policing quality with an 'index of service' based on number of offenses cleared, number of accidents investigated, and the number of miles traveled by police vehicles as a proxy for general police services. In order to make these components of the index comparable, Walzer (1972) used a weighting system based on the amount of time required to complete these tasks.[6] Although this methodology attempted to incorporate a measure of police service beyond that of only crime control, it is unclear that accidents investigated and miles traveled provide an accurate measure. Indeed, several community policing strategies, which involve police officers getting out of their vehicles and interacting with the community in a non-enforcement context, would not be measured by Walzer's methodology, and would actually result in a lower index of service due to the opportunity cost of logging miles traveled. Therefore, it is doubtful that Walzer's (1972) index of service provides a superior measure of police performance to more popular measures such as crime rates (Davis et al, 2015).

Like Hirsch (1959), Walzer (1972) used a cost function. He found a positive relationship between average cost of police protection and city size, as well as average cost of police protection and population density, suggesting that diseconomies of scale exist. Walzer (1972) attributed this latter relationship to the idea that these areas contain

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6Walzer's (1972) estimated average time to investigate and resolve a traffic accident is 80 minutes. Converting miles traveled into an approximated time involved calculating average speed and then dividing total miles traveled by that figure to estimate a time. However, Walzer (1972) is not clear on how he produced a figure for average time involved in clearing criminal offenses.

closely tied minority groups who make it easier for suspects to disappear as well as higher density areas having greater traffic congestion, leading to slower police response times. A concern he had with this methodology is that some police activities, such as record keeping, may be more conducive to centralization than others, such as neighborhood patrol. He recommended studying what happens to specific service costs individually as scale expands (Walzer, 1972).

Beaton (1974), similar to Hirsch (1959), investigated the effect population has on per capita police expenditures. His data were from New Jersey cities, and he controlled for rate of population change, per capita tax base, density, crime rate, per capita debt service, per capita municipal pension costs, population employed as blue collar craftsmen versus service occupations versus professional/managerial, age of population, and level of commercial and industrial activity. Using a single equation least squares multiple regression analysis, he found economies of scale for populations below 2,000 and diseconomies for larger populations. However, Beaton stated that,

> The purpose of this report is to show that the use of the model employing a single equation least squares estimation of the determinants of per capita police expenditures for intrastate systems of cities is likely to lead to incorrect results. (1974, p. 346)

If his results appear unlikely (i.e., the size for which the per capita costs of running a municipal police department is minimized in a service area of about 2,000 population), that is the point. Beaton (1974) was trying to demonstrate that use of a single equation least squares estimation is inappropriate for this research question. One reason is that, in his analysis, cities with over 2,000 population had widely disparate patterns of regression estimates between cities growing and declining in population. Thus, his results do not

shed much light on the question of economies of scale in policing, but do pose questions of the validity of the previous results using this method (Beaton, 1974).

Criticizing earlier studies for using a single output aggregate, including Walzer (1972), Darrough and Heineke (1979) estimated a multiple output function, calculating the average and marginal costs of solving burglary, larceny, robbery, auto theft, and crimes against the person, the marginal rates of transformation between these outputs, and determined an estimate of economies of scale based on how these various police activities affect total cost. They used a translog cost function model[7] with a sample of approximately 30 cities nationwide. Their results suggested that scale economies vary widely over the sample cities, which ranged in population from around one third of a million to just over one million, with decreasing, then constant, then increasing returns to scale with increasing output. This suggests that larger cities (of around 1 million population) have economies of scale in the provision of police services (Darrough & Heineke, 1979). The conclusions drawn from their findings, however, are questionable since the smallest city in their dataset – Birmingham, AL – had a population of 300,000, therefore excluding the possibility of finding economies of scale being maximized at a smaller city size.

Using data from Florida police departments, Gyimah-Brempong (1987) based his methodology on Darrough and Heineke's (1979), using a translog cost function. However, he defined slightly different measures of police performance: five of the outputs are based on the seven FBI index crimes with all personal crimes consolidated into one output, property crimes into four outputs, and the remaining output used

[7]Darrough and Heineke's (1979) reason for employing a translog function was “due primarily to the fact that most past studies of law enforcement agency production technology have adopted linear logarithmic functions which are special cases of the translog function” (p. 182).

population as a proxy to represent all other police activities unrelated to arrest. Gyimah-Brempong (1987) found that economies of scale were maximized in cities with populations between 25,000 and 50,000.

Finney (1997) analyzed Los Angeles County, which is characterized by a relatively large degree of intergovernmental integration, where over 45% of jurisdictions are provided police services by other governments. Finney used a single product translog cost function, modeling police departments as maximizing output (which Finney defined as the inverse of the crime rate and arrests) subject to cost constraints. Results indicated that the average cost of producing more of these outputs grows at an increasingly faster rate. Whereas the average per capita expenditure for the 14 police departments in the sample was $177.36, Finney (1997) estimated that consolidating them into one department (with their arrest output remaining the same) would result in a per capita cost of $472.78.

Drake and Simper (2002) determined that there are significant scale effects in policing among departments in England and Wales. They used a multiple output translog cost function with the output being defined in terms of clearance rates for each police force, traffic offenses that resulted in prosecutions, warnings or fines, and total breathalyzer tests administered (the issue of drunk driving being an increasing priority for the English and Welsh police). Drake and Simper (2002) acknowledged that, though less than half of what police do in the community can be modeled based on quantifiable data, they can still estimate a production function. They argued that since the probability of arrest is linked to number of arrests (and convictions), clearance rate should serve as a good proxy for crime prevention and repression activities. They found that the largest

police forces (with over 4,500 employees) displayed significant diseconomies of scale, while those departments with under 3,000 employees had economies of scale (Drake & Simper, 2002).[8]

Southwick (2005) examined cities in New York (excluding New York City) that choose to provide police services on their own (i.e., did not contract out). Unique to Southwick's study is a measure of market power, wherein he tried to determine whether market power affects costs. While firms in the private sector with sufficient market power will tend to have higher prices, municipal police do not charge prices and do not try to maximize profits. Rather, the effect of greater market power is likely to be realized in the form of slacking, or reduced effort towards efficiency (Wyckoff, 1990). Also differentiating Southwick's study is that he took the number of police personnel, both sworn and non-sworn, into account. This was to test the question of whether mergers of police service areas lead to cost savings due to elimination of duplicate positions (Southwick, 2005).

Southwick (2005) used a two stage least squares simultaneous equations model of production and demand functions. The production function models the production of safety (in terms of absence of crime), while the demand function models demand for policing services. Southwick's (2005) sample included 150 communities in New York state who provide their own policing services. His data are from the years 1995 through 2000. Each observation in his dataset (n = 669) describes a city during a particular year, i.e. one city can serve as six observations in the dataset. His findings indicate that, at

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8Having under 3,000 employees includes a very wide range of police department sizes and gives little guidance as to what the optimum-sized police department is, especially in the American context. According to the most recent Census of State and Local Law Enforcement Agencies, 49% of American police agencies employed fewer than 10 full-time officers (Reaves, 2011).

population levels below 22,350, both crime rates and police per population are higher than they could be at a larger community size and therefore could benefit from mergers with nearby communities. The same applies to populations above 36,000, implying that they may realize efficiency gains by separating into smaller communities. Southwick also found a positive relationship between market power and crime, as well as between market power and size of police department. Southwick concluded that, if the goal is to save money, police mergers should not take place if the resulting police organization would be protecting a population greater than 50,000. If the goal is to minimize crime, the resulting community subsequent to a police merger should not be much larger than 35,000 (Southwick, 2005). Southwick (2005) also concluded that the cost savings from mergers due to eliminated redundant job positions are outweighed by the greater costs of management. Lithopoulos (2015) suggested that a reason why this may be the case is that the ratio of officers assigned to patrol decreases as agency size increases.

As mentioned in the introduction, and as is evident from this review of the literature, research on scale economies in policing has neglected considering police departments in low population, low density states. This is somewhat ironic, considering the fact that the majority of American police departments are small, with almost half employing ten or fewer full-time officers (Reaves, 2011). It is precisely these types of cities for which research on scale economies in policing is most relevant, as police departments of major cities are the least likely to have their departments replaced by outside contractors based on economies of scale justifications. Furthermore, their lower population levels (and the consequently fewer opportunities available to attract incoming residents) mean that these cities face comparatively greater competition and must

maintain efficiency in their services in order to retain residents. High tax burdens can create a vicious cycle in which the taxes contribute to some residents choosing to emigrate, leaving the remaining residents to shoulder a proportionally greater burden, which, along with deteriorating city services, may cause even further emigration. Among Idaho cities that have their own municipal police department, the average population they serve is 16,753, whereas the average population of the counties in which those cities are located is 64,582 (U.S. Census Bureau, 2015). This means that, even if diseconomies of scale occur at a relatively small population, as long as that figure is significantly larger than 16,325, some Idaho municipalities may benefit from contracting out their services to their county sheriffs. Therefore, this research is important for those cities that wish to provide quality services in an efficient manner.

CHAPTER THREE: METHODOLOGY

In order to further explore the question of economies of scale in policing, this study proposes to test a sample of municipal policing agencies in less populated, rural areas. The bulk of the literature suggests that the optimally-sized police department, in terms of minimizing per capita cost, serves a population between 20,000 and 50,000 citizens. The present study replicates the method used by Southwick (2005),[9] whose methodology is described above.

Sample and Sampling Design

The dataset for the current study consists of all cities in Idaho that produce policing services on their own, i.e., do not contract their services from the county sheriff, and had the pertinent data available (n = 57).[10] The unit of analysis is cities – there are five observations (one observation per year for 2010-2014) for each city in the dataset, resulting in 285 total observations.[11]

Model

This method uses the following simultaneous equation model, where the police's production of safety, or production function, (based on crime rate), is modeled as

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9That is, with one exception: race. Whereas one of Southwick's (2005) variables – percentage of population that is non-white – is used as a proxy to represent likelihood of criminal victimization, such a proxy is not likely to be very helpful in a relatively racially homogeneous state such as Idaho. Therefore, this variable is replaced with an index of socioeconomic status (SES) based on poverty rates. Criminal victimization is correlated with SES (Shaw & McKay, 1942; Chilton, 1964; Bursik & Webb, 1982; Bunch, Clay-Warner, & Lei, 2015); therefore, SES is an appropriate substitute.

10Some cities in the dataset either did not provide their report crimes to the FBI in certain years or did not have budget data available upon request.

11 The actual number of observations for particular estimations will be fewer than the total because some of the observations have incomplete data for certain variables.

Crime = f(police, density, socioeconomic status, population, HH)

where HH is the Herfindahl-Hirschman Index of market power (defined in more detail below). The demand for police services, or demand function, is defined as

Police = f(crime, assets, unit cost, population, HH)

where unit cost is the wage rate of police personnel (both sworn and non-sworn) and assets are assessed (taxable) property values. Crime is defined by the FBI's Index Crimes: murder, rape, robbery, aggravated assault, burglary, larceny, and motor vehicle theft.[12] Since the total number of incidences for these various crimes varies widely, an averaging method is used to better estimate the above equations. The averaging method employed operates as follows: the average number of incidences of each crime across all municipalities in the study will be calculated for each year. Each city's percentage of that average will be used as a measure of that type of crime for that city. This will be calculated for each type of crime in each city. Then, the average of each city's percentages of each type of crime will be calculated to create a single measure for the relative crime level in that city. This is to make each type of crime equal in terms of its relative effect on the overall average, so that a more serious but rarer crime, such as murder, has a greater effect on a city's average than a robbery.

Data Sources and Variables

The equations will be estimated based on data for the five year period of 2010-2014. The National Incident Based Reporting System (NIBRS) provides the data on crime rates. Number of police employees is from *Crime in Idaho* (Idaho State Police,

12 Although the limitations of using crime rates to evaluate police performance was noted in the previous chapter, they are used here to remain a faithful replication of Southwick (2005), who states, "There are traffic control objectives and service objectives as well, but the focus here will be on crime as the leading measure of success or failure by the police" (p. 462).

2011, 2012, 2013, 2014, 2015). The data regarding police expenditures was collected through public records requests to individual cities. The data for variables regarding population, density, socioeconomic status are from the 2010 U.S. Census. Data from the Idaho Tax Commission is used for the assets variable.

The dependent variables are levels of crime and police population. The independent variables tested for their effect on levels of crime are population density, socioeconomic status, population, and police market power. The independent variables tested for their effect on levels of police are crime, wage rate for police personnel (both sworn and unsworn), total property value per population, population, and police market power.

Thus, the equations to be estimated are

$$C = a_0 + a_1D + a_2SES + a_3P + a_4POP + a_5/POP + a_6HH$$

and

$$P = b_0 + b_1C + b_2W + b_3A + b_4POP + {}_{b5}/POP + b_6HH$$

where the variables are defined as

a) C4 or C7 = crime = a community's average percentage of the average number of crimes for all communities for that year. Computed respectively for violent crimes and for all seven index crimes.

b) P = POLPOP = police = number of police divided by the city's population in thousands.

c) D = DENSITY = city's population in thousands per square mile.

d) SES = Socioeconomic status, based on the poverty rate of each community

e) W = WPOL = wage rate = total real (inflation adjusted) expenditures for police personnel, divided by the number of police.

f) A = ASSETS = real (inflation adjusted) full property value divided by the population in thousands.

g) POP = population = total population protected by the particular police department.

h) 1/POP = POP1 = inverse of population, added to make the equation quadratic (the equation is made quadratic to estimate optimal size).

i) HH = Herfindahl-Hirschman Index = the market share of a police department is calculated by dividing the city population protected by a police department by the total population in the county and squaring this figure. This is done for all the cities with municipal police departments in a particular county, as well as for the county sheriff. These figures are then added together to estimate the market power city police departments have in each county.

Table 1. Variables

Variable	Source	Reported As	Level of Analysis	Level of Measurement	Variable Type
C4/C7	NIBRS	Rate	City	Ratio	Independent & Dependent
POLPOP	Crime in Idaho	Rate	City	Ratio	Independent & Dependent
DENSITY	2010 U.S. Census	Rate	City	Ratio	Independent
SES	2010 U.S. Census	Rate	City	Ratio	Independent

WPOL	Public Records Requests	Rate	City	Ratio	Independent
ASSETS	Idaho Tax Commission	Rate	City	Ratio	Independent
POP	2010 U.S. Census	Raw Number	City	Ratio	Independent
HH	2010 U.S. Census/ Crime In Idaho	Raw Number	County	Interval	Independent

Internal and External Validity

The internal validity of a research design is concerned with questions of how confident we can be regarding the causal effect the independent variables have upon the dependent variable (Crano, Brewer, & Lac, 2014). There are issues with the causality implicitly theorized by the production function since variation in crime rates over time has a wide range of theoretical causes, from immigration (Bell, Fasani, & Machin, 2013) to the demographic changes resulting from court decisions regarding abortion (Levitt & Dubner, 2006), that are not accounted for in the model. It is possible that outside variables other than changes in the numbers of police, population, population density, poverty rates, or police department market power affect crime rates. Similar considerations apply to the demand for police services equation. Another issue is the implicit assumption that police departments do not differ in terms of their culture and service orientation, or that these differences are irrelevant in terms of their ability to

prevent crime. Given the assumption that a police department's market power can affect its performance, one would expect that its policing strategies would as well.

The external validity of this Southwick's (2005) methodology is actually the question at hand in this study. The source of Southwick's (2005) dataset is New York, a state that is far more populous and dense than Idaho. Although Southwick's (2005) results suggest that the optimal size of a population protected by a city police department in terms of lowest cost is between 25,000 and 50,000, and between 17,500 and 22,000 for lowest levels of crime, it is unclear whether these population sizes are optimal for policing in Idaho. The simultaneous equations model fails to explain much of the variance in crime and numbers of police in Idaho cities, and thus is of doubtful use in estimating optimal population sizes a sparsely populated state. The purpose of this study is to test the applicability of Southwick's (2005) model in a state that is much different than New York.

Explication of Two Stage Least Squares Model

Two stage least squares (2SLS) regression is used in this model because of the assumed bidirectional relationship between crime (C4 and C7) and number of police per population (POLPOP) [Southwick, 2005]. 2SLS uses instrumental variables that are uncorrelated with the error term in order to compute estimates for endogenous predictor variables and requires at least as many instrumental variables as there are predictor variables (Wooldridge, 2015). For each regression, the following were used as instrumental variables: population (POP), socioeconomic status (SES), density (D), assets (A), police wage rate (WPOL), and Herfindahl-Hirschman Index rating (HH).

The raw data presented a number of issues for running the regressions. One of them was the outlier of the city of Boise, which in 2014 had a population of 216,282 whereas the median population in the dataset is 3,979 citizens. To see how this biased the model, the regression was run both with and without Boise in the data set. Even without Boise, a histogram of the data showed that population in Idaho is severely skewed to a few outlier cities. Since linear regression assumes that the data being tested is normally distributed (Blalock, 1979; Berry & Feldmen, 1985), the natural log of the population variable was used in the regression. Similarly, there were concerns about skewness for the measures of crime. Because of Southwick's (2005) averaging method for calculating an index of crime, greater variability in crime figures between cities was created than would exist using standard crime rates. To correct for this, the natural log of C4 and C7 were calculated and used in the regression analysis.

CHAPTER FOUR: RESULTS

This section includes tables of the descriptive statistics of the dataset, correlations between the variables, and the results of the two stage least squares regressions. The value ranges for the variables are provided in Tables 2 (with Boise) and 3 (without Boise). The highest crime community, Boise, has a crime rating 13,999 times the lowest, using the seven index crimes. Eleven communities in the dataset experienced years where no index violent crimes were reported. The population ranges from a low of 895 in Cascade to a high of 216,282 in Boise, with Nampa being the second largest city in the dataset at 88,211 citizens. Taxable property values divided by the population ranged from $11,708.80 in Wilder to $1,825,347.51 in Sun Valley.

The average HH value is 4769 (4784 without Boise), whereas in Southwick's (2005) New York dataset, the average was 2786.[13] This much higher number is likely due to just how relatively sparsely populated Idaho is. Due to the fact that a police department's 'market share' is calculated based on the ratio of population they serve relative to the county's total population and that most of the counties in the dataset have only two or three police agencies in the entire county, their HH value is quite high. The way HH is calculated, a county with one municipal police department and a county sheriff would be considered a duopoly. This is the modal type of county in the dataset.

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[13]According to the U.S. Department of Justice (2015), markets with an HH index rating greater than 2,500 are considered highly concentrated.

Table 2. Variable Descriptions (with Boise)

Variable	Mean	Std. Dev.	Minimum	Maximum	Cases
C4	1.00002	2.3	0.000	16.36	270
C7	1.00004	2.15	0.001	13.99	270
POLPOP	2.41	1.24	0.618	7.9	283
SES	0.038	0.01	0.016	0.0853	285
DENSITY	1805.29	795.44	140.6	3615.62	285
ASSETS	86756.48	200515.84	11708.18	1825347.51	285
WPOL	65004.80	17094.89	26828.5	106781.05	276
HH	4769	1021	3165	7458	285
POP	16325.13	32664.94	895	216282	285

Table 3. Variable Descriptions (without Boise)

Variable	Mean	Std. Dev.	Minimum	Maximum	Cases
C4	1.00002	1.89	0.000	10.44	265
C7	0.99998	1.79	0.002	9.53	265
POLPOP	2.42	1.24	0.618	7.9	278
SES	0.038205	0.01	0.016	0.09	280
DENSITY	1790.26	794.43	140.61	3615.62	280
ASSETS	86740.78	202303.02	11708.18	1825347.51	280
WPOL	64299.77	16432.5	26828.5	106672.07	271
HH	4784	1023	3165	7458	280
POP	12836.74	19743.04	895	88211	280

Table 4 provides the correlation across the variables for the whole dataset (Table 5 for the dataset without Boise). The two measures of crime, C4 and C7, are highly

correlated at 0.99, which is to be expected. Crime is highly correlated with population at 0.95 and 0.96 for C4 and C7, respectively, with Boise. Even without Boise, however, the correlation remains high at 0.88 and 0.91. Berry and Feldman (1985) state that multicollinearity can be considered minor until it reaches 0.8. But, if the purpose of the model is prediction, rather than explanation, multicollinearity is not problematic for the model as a whole, but only for individual variables. Regardless, the relationship between crime and population is addressed through the two stage least squares process. As well, the collinearity between C4 and C7 poses no problem because they are always used in separate regressions.

The next highest correlation is between assets and number of police per population at 0.66. Police protection appears to be a normal good.[14] There is also a relatively high negative correlation between density and number of police (-0.60). Apparently, populations living in greater densities require (or are perceived to require) fewer police officers per person to maintain public safety. When communities are more densely populated, police have to cover less ground to respond to calls. Other than population, there were no further collinearity concerns.

14 In economics, a 'normal good' is defined as a good for which the quantity demanded increases as one's income increases (Cowen & Tabarrok, 2015).

Table 4. Correlation Matrix (with Boise)

	C4	C7	P	SES	D	A	W	HH	POP
C4	1.00	0.99* (.000)	-0.15* (.014)	-0.14* (.025)	0.33* (.000)	-0.04 (.554)	0.49* (.000)	0.30* (.000)	0.95* (.000)
C7	0.99* (.000)	1.00	-0.16* (.010)	-0.14* (.018)	0.35* (.000)	-0.04 (.510)	0.50* (.000)	0.33* (.000)	0.96* (.000)
P	-0.15* (.014)	-0.16* (.010)	1.00	-0.19* (.002)	-0.60* (.000)	0.66* (.000)	-0.05 (.384)	-0.20* (.001)	-0.19* (.001)
SES	-0.14* (.025)	-0.14* (.018)	-0.19* (.002)	1.00	0.12 (.050)	-0.26* (.000)	-0.39* (.000)	-0.45* (.012)	-0.19* (.002)
D	0.33* (.000)	0.35* (.000)	-0.60* (.000)	0.12 (.050)	1.00	-0.34* (.000)	0.11 (.071)	0.48* (.000)	0.39* (.000)
A	-0.04 (.554)	-0.04 (.510)	0.66* (.000)	-0.26* (.000)	-0.34* (.000)	1.00	0.23* (.000)	-0.06 (.281)	-0.04 (.481)
W	0.49* (.000)	0.50* (.000)	-0.05 (.384)	-0.39* (.000)	0.11 (.071)	0.23* (.000)	1.00	0.24* (.000)	0.49* (.000)
HH	0.30* (.000)	0.33* (.000)	-0.20* (.001)	-0.15* (.012)	0.48* (.000)	-0.06 (.281)	0.24* (.000)	1.00	0.38* (.000)
POP	0.95* (.000)	0.96* (.000)	-0.19* (.001)	-0.19* (.002)	0.39* (.000)	-0.04 (.481)	0.49* (.000)	0.38* (.000)	1.00

*Correlation is significant at the 0.05 level (2-tailed)

Table 5. Correlation Matrix (without Boise)

	C4	C7	P	SES	D	A	W	HH	POP
C4	1.00	.99* (.000)	-0.15* (.017)	-0.01 (.901)	0.37* (.000)	-0.06 (.335)	0.41* (.000)	0.33* (.000)	0.88* (.000)
C7	0.99* (.000)	1.00	-0.15* (.013)	-0.02 (.705)	0.39* (.000)	-0.06 (.307)	*0.43 (.000)	0.37* (.000)	0.91* (.000)
P	-0.15* (.017)	-0.15* (.013)	1.00	-0.20* (.001)	-0.60* (.000)	0.66* (.000)	-0.03 (.618)	-0.19* (.001)	-0.22* (.000)
SES	-0.01 (.901)	-0.02 (.705)	-0.20* (.001)	1.00	0.14* (.017)	-0.26* (.000)	-0.37* (.000)	-0.13* (.028)	-0.09 (.122)
D	0.37* (.000)	0.39* (.000)	-0.60* (.000)	0.14* (.017)	1.00	-0.35* (.000)	0.07 (.258)	0.47* (.000)	0.47* (.000)
A	-0.06 (.335)	-0.06 (.307)	0.66* (.000)	-0.26* (.000)	-0.35* (.000)	1.00	0.24* (.000)	-0.07 (.281)	-0.07 (.238)
W	0.41* (.000)	0.43* (.000)	-0.03 (.618)	-0.37* (.000)	0.07 (.258)	0.24* (.000)	1.00	0.21* (.000)	0.43* (.000)
HH	0.31* (.000)	0.37* (.000)	-0.19* (.001)	-0.13* (.028)	0.47* (.000)	-0.07 (.281)	0.21* (.000)	1.00	0.48* (.000)
POP	0.88* (.000)	0.91* (.000)	-.215* (.000)	-0.09 (.122)	0.47* (.000)	-0.07 (.238)	0.43* (.000)	0.48* (.000)	1

*Correlation is significant at the 0.05 level (2-tailed).

Tables 6 and 7 list the regression results, with the production function (crime) being provided in Table 6, demand function (police per population) shown in Table 7, results with Boise displayed on the left, and results without Boise listed on the right. Each column represents one of the systems of equations, with the production function on the upper half and the corresponding demand function on the bottom half. The only statistically significant predictor variable for crime across all regressions was population, indicating that in Idaho, as population grows, so does crime. In the model with Boise, the

slope for POP was 1.425 and 1.415 for C4 and C7, respectively. For the model without Boise, POP's slopes for C4 and C7 were 1.533 and 1.552, respectively. POLPOP was statistically significant as a predictor for C7 in both models (with a slope of -.172 with Boise and -.192 without), suggesting that greater numbers of police have a small effect on property crime, but not on violent crime. This makes sense based on the fact that a sizable portion of property crime occurs in the public sphere where police patrol and can have a deterrent effect, whereas violent crime tends to happen in the private sphere outside of the view of the police (Sherman & Weisburd, 1995). For the demand functions, police wages were the only statistically significant predictor of police per population for all four regressions, with assets being statistically significant as a predictor for POLPOP in every regression except for violent crime with Boise. As one would expect, the quantity demanded for police per population decreases as the price increases, and as assets per population increase, so does police per population. However, their effect sizes are small; the absolute value of the largest slope is 3.594E-5, indicating that while police wage and assets are statistically significant variables, only large changes in them will correspond with a noticeable change in police per population. The inverse of the population also was a statistically significant predictor of POLPOP in the models without Boise, indicating that cities with smaller populations will tend to have a greater number of police per population.

All models of both functions were statistically significant at $p < 0.05$. Of the production function models, the one predicting C7 with Boise included in the dataset explained the greatest percentage of the variance ($R^2 = .685$). Of the demand function models, the one with C4 as a predictor of POLPOP was the strongest ($R^2 = .275$). As a

whole, the models predicting crime were much stronger than those predicting police per population. Therefore, we can have greater confidence in Southwick's (2005) model in predicting the ideal size for Idaho police departments in terms of minimizing crime than we can for minimizing cost. Further analysis and comparison with Southwick's (2005) results will be addressed in the following section.

Table 6. Regression Results – Production Function

	With Boise		Without Boise	
	R = .827 F = 92.650* C4	R = .886 F = 155.894* C7	R = .803 F = 76.107* C4	R = .869 F = 129.526* C7
Constant	-13.299* (.009)	-12.968* (.000)	-13.993* (.036)	-13.992* (.002)
POP	1.425* (.001)	1.415* (.000)	1.533* (.009)	1.552* (.000)
SES	-4.039 (.613)	-3.462 (.520)	-5.170 (.520)	-3.512 (.512)
DENSITY	.000 (.373)	.000 (.105)	.000 (.372)	.000 (.108)
POLPOP	-.077 (.514)	-.172* (.032)	-.090 (.476)	-.192* (.023)
HH	-6.041E-5 (.456)	-3.351E-5 (.539)	-5.808E-5 (.486)	-3.902E-5 (.482)
POP1	296.168 (.919)	1324.014 (.498)	766.498 (.834)	1963.456 (.421)

*Statistically significant at $p < 0.05$

Table 7. Regression Results – Demand Function

	With Boise		Without Boise	
	R = .525 F = 16.223* POLPOP	R = .492 F = 16.456* POLPOP	R = .447 F = 10.433* POLPOP	R = .446 F = 10.380* POLPOP
Constant	-12.000 (.871)	-4.805 (-.083)	-24.994 (.086)	-25.268 (.105)
POP	1.500 (.839)	0.809 (.139)	2.833 (.073)	2.861 (.090)
C4	.296 (.939)		-.112 (.815)	
C7		0.717 (0.219)		-.124 (.815)
ASSETS	3.043E-6 (.050)	3.321E-6* (.000)	2.686E-6* (.001)	2.681E-6* (.002)
WPOL	-3.467E-5* (.034)	-3.594E-5* (.001)	-3.278E-5* (.004)	-3.268E-5* (.004)
HH	9.154E-5 (.576)	8.561E-5 (.238)	5.404E-5 (.737)	5.762E-5 (.705)
POP1	11736.641 (.389)	10543.905 (.919)	15652.617* (.014)	15730.252* (.017)

*Statistically significant at $p < 0.05$

CHAPTER FIVE: DISCUSSION

The estimation results from the Idaho dataset are quite unlike the results from Southwick's (2005) New York dataset. In Southwick's crime estimation, all variables were statistically significant at .05, except density in the C7 estimation. In his estimation for police per population, all variables except wages, the HH index, and the inverse of the population were statistically significant. This could be attributed to a number of reasons. Southwick analyzed 150 communities; this analysis covers 57 towns and cities. Southwick's crime rating for the seven index crimes ranged from 0.054 to 5.253; Idaho's ranged from .001 to 13.992. Southwick had several communities in his dataset that had HH ratings that would not automatically be flagged by the Department of Justice if they occurred in the private sector; Idaho has none. These differences lead to a dataset that describes a very different state and to a regression analysis that puts the external validity of Southwick's (2005) methodology into question.

Table 8. Comparison of New York and Idaho Datasets and Regressions

	New York	Idaho
Number of communities in dataset	150	57
Range in crime rates	0.054 to 5.253	.001 to 13.992
Statistically significant variables in explaining crime	Every variable except density in the C7 estimation	Population, police per populations
Statistically significant variables in explaining police per population	Every variable except WPOL, HH, and POP1	WPOL, Assets, and POP1
Mean HH rating	2786	4769

In Idaho, levels of crime largely appear to be a function of population as evidenced by it being the only statistically significant predictor of crime rates in all regressions. Smaller communities tend to be more ethnically and culturally homogeneous and less transitory and therefore have lower levels of crime regardless of the efficiency of the local police force (Rapoport, 1982; Unger & Wandersman, 1985; Bursik, 1999). Idaho is mostly a collection of small, relatively homogeneous communities; it is likely that these characteristics outweigh any effects police per population, density, or socioeconomic status may have on serious crime.

The utility of the Herfindahl-Hirschman Index in this context is also questionable, both at the theoretical level and in Idaho's case specifically. That is, what competition can exist between public police agencies that are funded by taxation rather than through voluntary purchases in a market setting? This author can conceive of only two possible sources of competition for a police agency and both are remote and comparatively weak when compared with competition in a market setting.

The first is the threat of losing revenue from citizens who choose to leave a community and settle elsewhere. Some may choose to do this because they find the neighborhood in which they live unsafe; however, the amenities offered by residing in a community are a package-deal and level of safety is just one consideration among several. As well, it is unlikely that one will be able to pay incrementally to reach the optimal level of policing according to their budget constraint. By moving to a community with a higher level of safety, one will likely have to pay for the entire package of public services that come with the new community (e.g., public schools, infrastructure) rather

than just policing itself. Thus, this package-deal is part of an institutional framework that further protects public police agencies from competition.

The second source of potential competition is the threat of having one's municipal police department shut down and replaced by a contract with the county sheriff. This threat is particularly relevant to the present study due to the implications economies of scale may have for small municipal police departments. At the same time, cities with a population that would be considered relatively large in Idaho do contract out their policing services. The largest city in Idaho that contracts its policing services is Eagle (Ada County Sheriff, 2016), which is home to 19,908 people (U.S. Census, 2015). By contrast, Compton, California, which previously had its own police department and now contracts with the L.A. County Sheriff's Department (L.A. County Sheriff's Department, 2009), has a population of over 90,000 (U.S. Census Bureau, 2010), more than any city in Idaho except Boise. This threat of competition, however, is also quite remote. The size of most county sheriffs' offices outside of Ada and Canyon county are not much larger than the municipal police departments with which they supposedly compete (Idaho State Police, 2015), thereby rendering them less able to subsume the duties of city departments.

The method by which Southwick (2005) operationalizes market power implies that counties with a higher number of police departments will be more competitive than counties with a smaller number. This may apply in terms of the first source of competition if municipalities are close enough together such that an individual can change police departments without having to also change jobs, but regardless of how geographically proximate the next police jurisdiction is, addresses and the school that children attend will have to change. Furthermore, police departments do not have data on

citizens leaving their jurisdiction due to dissatisfaction with police. Ultimately, it is very unlikely that any individuals in the police department have an incentive to be efficient due to competition.

In Idaho, the majority of counties have three or fewer police agencies. None have more than five. Based on how the U.S. Department of Justice (2015) classifies the intervals of the HH Index, the market power variable in Idaho operates more like a constant: there are no police departments in Idaho that operate in any environment other than a highly concentrated one. Therefore, Southwick's (2005) modeling of market power may not apply in Idaho, or potentially in other sparsely populated, highly rural states.

Southwick (2005) used his model to estimate the population at which crime and police per capita are minimized. He found that the range between which both are minimized (but face trade-offs between one another) is 22,350 to 36,000 people. Based on the fact that this model serves as a poor predictor of crime and police per population in Idaho, it is inappropriate to use it to predict populations at which crime and police per population are minimized.

Study Limitations

Perhaps the greatest weakness of this methodology is the use of crime rates as a proxy for police performance. The majority of police time is not spent dealing with FBI Index crimes (Marvell & Moody, 1996), only a large increase in police presence can actually deter crime (Cameron, 1988), and the most common police strategies are not effective in crime prevention (Bayley, 1994; Benson, Kim, & Rasmussen, 1994). As mentioned above, reported crime rates have validity issues as measures of crime, as not all crime is reported to the police. Until police departments collect more valid statistical

measures of their performance, such as those suggested by Whitaker et al. (1982), Alpert and Moore (1993), or Davis (2012) few other options are available.

A related issue is that using crime rates as a measure of police performance assumes that the proportion of crime reported to the police is equal across all communities (Maltz, 1975). This may not be the case; a community whose victims believe that calling the police is not worth the hassle will have a lower proportion of reported crime compared to a community that has confidence in its police protection. If it is the case that smaller communities tend to have less effective policing that leads to fewer crimes being reported, as argued in Kelling (1999), then false diseconomies of scale may be produced using this technique. This is unlikely, however, as Ostrom, Parks, and Whitaker's (1978) extensive study of 1,159 police departments in the United States and Loveday's (1990) analysis of police service amalgamations in England and Wales both found that smaller police departments make more efficient use of their employees and assign them in greater proportion to functions that actually reduce crime and increase public safety. Furthermore, local community control of police is found to be more effective in meeting the needs of citizens than large police departments under city-wide control (Ostrom & Whitaker, 1973). Thus, it is more likely that residents of larger cities will be less inclined to call the police due to the belief that police will be less responsive to their needs.

Further limitations of this study include the relatively small number of observations (n = 285) compared to Southwick (2005) [n = 669], which may bias the results. As well, the model does not take different styles of policing into account, implicitly assuming that the only difference between police departments in this respect is

their market power. Although operationalizing a measure of a department's policing style would likely be a convoluted (and possibly unfruitful) task in trying to control for this factor, this limitation should be acknowledged.

Policy Implications

On their face, the results of this study provide no evidence that larger police departments display greater efficiency than smaller departments, and thus do not lend support to the justification of department consolidation on such grounds. However, due to the limitations of the dependent variable of crime rates, the implications of the results should be taken with a grain of salt. While this study and most of the studies cited in the literature review rely upon crime rates, arrests, citations, expenditures, or inputs (such as miles traveled) as measures of police output, Ostrom et al. (1973) consider such measures to be fundamentally flawed. Rather, Ostrom et al. (1973, p. 424) argue that "the measurement of output of services received by *and* evaluated by citizens provides the appropriate means for assessing the quality of a public service." What is left out of most measures of output is the perception of the recipient of police services.

As noted previously, the majority of police departments make little or no effort to obtain feedback from citizens about their opinions and evaluations of the services they receive from the police (Davis et al., 2015). While such a disregard for consumer preferences may be the norm for police organizations, who do not depend on voluntary financial contributions to remain in operation, it is hard to imagine the same behavior lasting long within organizations that do depend on voluntary exchange. A police department that evaluates its performance solely using crime rates and arrests is akin to an auto manufacturer evaluating its cars purely based on their horsepower and fuel

efficiency. In the latter case, consumers desire more from their cars than simply power and high gas mileage and are willing to make trade-offs for other attributes, such as comfort, reliability, price, and storage capacity. In the same way, citizens desire more from their police, including more open communication (Grinc, 1994) and serious consideration of citizen input (Lyons, 2002).

Furthermore, American police departments are currently facing a 'crisis' of legitimacy (Cook, 2015) due to highly publicized incidences of the use of lethal force against minorities.[15] This is particularly true in minority neighborhoods in which police are seen as an occupying force and treated with suspicion (Peck, 2015). By not considering citizen perceptions of the police as part of their performance, the police are communicating to these neighborhoods that their opinions do not matter. In addition, police are undermining their effectiveness in their traditional goals of law enforcement and order maintenance since community support and cooperation is crucial for their mission (Glensor et al., 1999) Without citizen feedback, police departments lack an essential component of evaluating their performance and studies of their efficiency will be marred by the methodological issues of the data that they do collect. Therefore, the strongest policy implication of this study is for police to obtain more valid measures of their performance, especially from those receiving their services.

Recommendations for Further Research

Despite the lack of alternative measures of police output, there are still methods with the potential to answer questions about the relationship between police organization

15 Although the percentage of people reporting that they have 'quite a lot' or 'a great deal' of confidence in the police has dropped five percentage points since 2013 (Cook, 2015), police remain one of the most supported of public institutions. So while the 'crisis' may be exaggerated, especially regarding the so-called 'war on cops' and the frequency at which violent officer deaths occur (Officer Down Memorial Page, 2016), police legitimacy is becoming more questionable.

size and efficiency. Serving as a good example is Ostrom et al.'s (1973) study of police performance within an urban area where police services had been consolidated in some neighborhoods and not in others. Their measurement of police output involved surveying citizens about both their direct interactions with police and their evaluation of services provided to their neighborhood. Among other observations of the general tendency for citizens in those neighborhoods with independent police forces to be more satisfied with their police, a higher proportion of that group rated police-citizen relations as good, the job being done by police in their neighborhood as good or outstanding, and the police response as being very rapid (Ostrom et al., 1973). Although surveys of citizens about their perceptions of police are not methodologically flawless, they appear, in comparison to crime rates, to be a more valid measure of police performance. And, although Ostrom et al.'s (1973) study was of only six neighborhoods and therefore speculative in terms of its wider applicability, its utility should not be discounted.

While case studies and field studies are often seen as methodologically inferior to using aggregated data and sophisticated statistical and econometric models, Elinor Ostrom's theoretical contributions to policing were only possible through the former methods (Boettke et al., 2013). Commenting on Ostrom's penchant for using multiple methods, including case studies and fieldwork, Boettke et al. (2013) note,

> In complex social environments, the so-called qualitative methods can often illuminate consequences and motivations that are disguised by more aggregative methods. The most obvious way in which this is true is that in-depth fieldwork or case study may reveal a factor to be at play that the researchers would never have considered if they were less familiar with their subject. (p. 411)

A suggestion for further research, therefore, is to use multiple methods, including field research and case studies, for evaluating the efficiency of police departments and other

organizations whose output is not easily captured in single quantifiable outputs. Questions that should be answered include: What do citizens want from the police? Is there a correlation between citizen satisfaction with police and crime rates? Are citizens more satisfied with the police after contracting with the county sheriff? These are important questions for research of police organization efficiency.

Additionally, a worthy question for further research is why small communities choose to have their own municipal police departments, especially given the widespread perception that police officers in larger police departments are better trained (Sandy & Devine, 1978; Oliver & Meier, 2004) and more efficient (Finney, 1997). King (2014), in a study of Ohio police departments that disbanded in the 1990s, found that crime is essentially irrelevant both in terms of being a causal factor in the reasons for disbanding and in how rural police are evaluated by their constituents. Rather, police departments were primarily disbanded for reasons of budgetary issues, misconduct, or rancor with town sovereigns. In addition, small communities may choose to have their own police departments for reasons of greater local control or pride (King, 2014), rather than for reasons of efficiency. This suggests that, for small departments, it might be even more crucial to take citizen perceptions into account, as their very existence may be at stake.

As well, further research on why police departments disband would be useful. To understand police departments as organizations, they must be analyzed over their full life course, from conception to death (King, 2009). As King (2014) notes, excluding disbanded departments from our observations is akin to studying the effects cholesterol has on one's health while excluding those who have died from heart disease. Assessing the reasons for disbanding gives us knowledge of other reasons, besides efficiency, why

communities choose to contract their policing services and what police departments can do to provide citizens greater satisfaction.

Further research of police departments serving smaller, rural areas is necessary in order to have a richer understanding of the effects of size on police performance and operation. Rural police face unique challenges in terms of stress and working conditions (Sandy & Devine, 1978; Oliver & Meier, 2004) and 71 percent of police departments serve populations of less than 10,000 residents (Reaves, 2015). As previously noted, the vast majority of research of economies of scale in policing analyzes urban areas with large police departments. Unfortunately, this research may not be applicable to most American police departments. Furthermore, a methodology that takes the idiosyncrasies of both rural policing and individual departments into account may be necessary. Despite the fact that Southwick's (2005) methodology is unique in terms of including a measure of economies of scale and in employing a simultaneous equations model, it is unlikely that the methodologies used by the other researchers mentioned in this study would lead to vastly different results. For the most part, they use crime and arrests as measures of police performance and similar control variables.

CONCLUSION

This study investigated the question of what extent economies of scale exist among police departments in a rural, low-density state. Previous research tended to find either no economies of scale or diminishing returns to scale after a city reached a fairly modest size, typically between 20,000 and 50,000 residents (Hirsch 1959; Walzer, 1972; Gyimah-Brempong, 1987; Finney, 1997; Southwick, 2005). The results of the present study showed that, in Idaho, crime is largely a function of population. Since the median population among the cities in the dataset is about 4,000, it appears that crime is minimized at a much lower population than is suggested by other studies. The present study also showed that a higher number of police per population had a negative effect on property crime, but not violent crime.

This study performed a replication of one of the most recent papers published in the literature about this topic. It found that the methodology that served as a good predictor of crime and police per capita in a relatively populous, high density state was a poor predictor of those variables in a low population, low density state. Furthermore, it questions the validity of some of the measures used, particularly crime rates as a measure of police performance and the Herfindahl-Hirschman Index as a measure of market power among police departments. Police are expected to do much more than fight crime and the effect of their efforts on crime rates may be modest. Police are also a public institution funded by taxation; it is not clear that they face competition that can affect their revenues. It is recommended that both police departments and policing researchers

use more accurate and meaningful measures of their performance, as well as citizen satisfaction. Suggestions for further research include studying questions regarding why small communities choose to start and fund their own municipal police departments and why some of them are disbanded. Finally, additional research of rural areas and economies of scale in policing is needed to more fully answer this research question.

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