Empirical analysis of an augmented Becker model of criminal behavior

Andrew W. Pryor

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EMPIRICAL ANALYSIS OF AN AUGMENTED BECKER MODEL OF CRIMINAL BEHAVIOR

By

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B.A., University of Montana, 2002

Presented in partial fulfillment of the requirement for the degree of

Master of Arts

The University of Montana

2005

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Date

8-31-05
Abstract

Pryor, Andrew W., M.A. July 2005

Empirical Analysis of an Augmented Becker Model of Criminal Behavior (81 pp.)

Chairman: Dr. John Wicks

This thesis empirically tests models to identify criminal determinates. The approach is a first step in the quantitative evaluation of strategies designed to eliminate or reduce the societal loss associated with crime. Two established models explaining behavior are tested. The results of these models are compared to a model developed and tested in this thesis. This model contains both economic and social psychological variables and is termed the augmented Becker model.

The individual level of the data collected on the unique crime of copyright infringement makes it possible to test all three models; economic theory provides the logical framework. The theory is based upon the idea that a criminal considers the benefits and costs of the crime. Traditionally, changing the size of the penalty and the probability of its imposition would change the amount of crime by changing the individual's benefit/cost structure. The use of individual level data allows inclusion of respondents’ attitudes about music theft and their perception of what others think as variables. While these variables are borrowed from social psychology, they are evaluated in the same benefit/cost structure as the economic variables. Statistical tests reveal that the augmented Becker model explains music theft better than the other approaches.

The statistical results indicate that chance of getting caught, changing people’s attitudes, societal influences, and age are significant in explaining the probability of music theft. This suggests that marketing efforts to change these variables could be compared with policies increasing enforcement to better determine the best course of action. Identifying the cost associated with the manipulation of significant variables in the augmented Becker model is a subject for further study.

Focusing on music theft makes it possible to identify the individual characteristics of those acting in a legal/illegal manner. These individual characteristics, evaluated within the framework of the economics of crime, are important determinates of theft. Their addition to the model has the potential to enhance available options in the development of policies reducing the broader problem of criminal behavior.
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Acknowledgements

Completion of this thesis required the energy and involvement of many people. The genesis of the concept of testing music theft must be credited to Dr. James Reardon, Professor of Marketing at the University of Northern Colorado. In addition to Jim's inspiration, he helped on the survey design along with Denny McCorkle and the students of the fall 2004 Seminar in Economics. Seminar members were also responsible for the difficult work of data collection. Specific members of the seminar require thanks for their extra efforts: Travis Brown for typing the survey and Kynan Spethman for assisting in debugging the data.

I would like to express my sincere gratitude and appreciation to the faculty/staff of the economics department and my committee members. First, Dr. Carol Bruneau introduced me to the Theory of Reasoned Action; for that and for the fact she is on my committee I am appreciative. This thesis would not have been possible without the assistance or Dr. Douglas Dalenberg. Doug's intelligence, work ethic and patience were instrumental to this work. I have always admired these qualities and I am truly thankful that he put them to work assisting me with, among other things, the econometric challenges of this thesis. I would like to thank Stacia Graham, my reluctant office mate, for her humor and proofreading efforts. Lastly, a very special debt of gratitude is owed to Dr. John Wicks. In addition to the brainstorming/fishing/PitkinPremium sessions, the profanity, badgering, arguing and general abuse made this thesis possible. Many thanks John. I consider myself lucky to be among the students John has supported as a thesis director for I now know, as they do, the depth of his good nature. It has been my sincere pleasure to work with all involved, if given the choice I would gladly do it again................just not right away.

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Chapter 1

OVERVIEW OF STUDY

Crime is an important economic topic. An empirical estimate of the yearly cost of crime concluded that the toll is $4,100 on each American or $1.7 trillion for the entire economy (Anderson, 1999). The fact that crime places a large burden on the economy provides one rationale for its economic study. In addition to this, economics is the study of choice; one aspect of crime includes the choice to engage in it. Due to the large amount of societal loss and the strength of economic theory in explaining individual choices, economics provides a logical framework for evaluating criminal behavior.

This thesis is primarily concerned with the evaluation of the choice to engage in a criminal behavior. Understanding why individuals choose to engage in criminal behavior is elemental to developing strategies aimed at reducing the damage the behavior causes. Economic theory, as proposed by Gary Becker, a University of Chicago economist and Nobel laureate, provides the foundation for the empirical analysis presented in this thesis. Becker's model explains how rational individuals, evaluating whether or not to engage in a criminal act, weigh the expected chance of getting caught and the cost of the expected penalty against the expected gains from the act. The standard economic decision rule applies: if benefits outweigh costs the behavior is undertaken. From its behavioral underpinnings, the model explains how policy makers can influence the crime rate by changing the probability an individual gets caught (e.g., increased expenditures on police) or
by changing the penalty (e.g., increased fines, prison terms, etc.). The model provides for the useful evaluation of policy alternatives.

While the quantitative nature of economics is helpful in assessing optimal policies, economics does not hold a monopoly on the academic study of choice and is by no means the dominant discipline for the study of criminal behavior. Because of this, the analysis of choice presented here is based upon an economic framework but also relies on literature and research from diverse fields.

Academic disciplines contributing to this analysis include the fields of social psychology, marketing, sociology, and criminology. A particular emphasis is placed upon theoretical and empirical work from the field of social psychology. Research within this field led to the development of behavioral models. Among the preeminent models is Martin Fishbien and Icek Ajzen's Theory of Reasoned Action. This theory explains how overt behavior is related to attitudes and pressure from peers. Basically, someone who feels positively about an activity and who has strong social motivation toward it will participate in the activity. The Theory of Reasoned Action is not specific to criminal behavior; however, it possesses usefulness in explaining this type of behavior. For example, it is likely that a person evaluating whether or not to participate in a crime would base this decision, in part, on what those important to her (e.g. friends, family, co-workers, etc.) think about the criminal behavior. Compelling evidence exists that behavior is unmistakably altered simply by the immediate or anticipated presence of others (Milgram, 1965), thus other people play a large role in determining individuals' behaviors. This example shows how variables from the Theory of Reasoned Action might be important determinates of criminal behavior and demonstrates one reason for the inclusion of diverse disciplines in this thesis.
Economic theory provides the foundation for the empirical work presented in this thesis. More specifically, the criminal decision is evaluated within the framework of utility maximization. According to this framework, individuals making the decision to steal have weighed all of the expected costs and benefits, and expect the benefits to be greater. The traditional economic approach described above identifies two major variables that affect expected utility. They are the chance of getting caught and the penalty. This thesis theorizes and empirically tests the idea that the variables identified in the Theory of Reasoned Action – attitudes and social influences – also affect the expected utility of engaging in a criminal behavior. It is hypothesized that the Becker variables impose real expected costs (e.g. fine, imprisonment, death, etc.), while the variables from the Theory of Reasoned Action impose “psychic” costs (e.g. guilt, shame, spurn, etc.). The possible advantage to this approach, termed the augmented Becker model, is the wider range of options available to those interested in reducing crime. For example, marketing efforts designed to change attitudes might prove a more cost effective strategy to reducing crime than increasing the penalty.

While this theory holds promise for expanding the economic explanation of criminal behavior, it cannot be tested as suggested by Becker. That is, aggregate level data cannot be used. Because there are no aggregate measures of attitudes and peer pressure; data for these variables must be collected individually. Collecting individual level data on criminal behavior presents some problems. It is important to select a criminal behavior that is widespread and that people feel comfortable discussing. This helps to ensure accuracy and a large sample size. Music theft provided an ideal crime for survey data. The reasons for this include the fact that 25 percent of Americans ages 12 and older currently own a PC-based Compact Disc Recorder/Burner. Further, 12 percent reported they have copied a pre-recorded
music CD owned by someone else rather than actually purchasing that particular CD (Ispos, 2003). A 2003 estimate showed that music-swapping services now attract 40 million users in the United States alone (Ispos, 2003). Due to the proliferation of computer users and their access to the technology enabling theft, illegal music acquisition was the crime chosen in which to collect data on.

Logistical regression provides the basis for the analysis of this thesis. This is due to the effectiveness of the logistical regression in analyzing models with binary dependent variables (e.g. legal/illegal behavior). In this case, the logit explains how independent variables affect the probability of illegal behavior. Separate regressions are run to test three models of behavior. The models are the economic model proposed by Becker, the Theory of Reasoned Action and the augmented Becker. Each model contains two or more significant independent variables and fit the data reasonably well. These results suggest that each model could fit the data reasonably be used to explain music theft. Closer inspection, however, reveals the augmented Becker outperforms the other models. The logistical regression run on the augmented Becker model provides evidence that chance of getting caught, attitudes, societal influences and age of the respondent are all significant in explaining music theft.¹

The significance of the augmented Becker model allows for quantitative evaluation of policy options that are not possible using the traditional economic approach. Implementation of policy suggested by the augmented Becker model could prove more cost effective. For example, the results of the Becker model presented here suggest that chance of getting caught affects the probability that one will engage in music theft. Increasing enforcement of the laws might increase the chance of getting caught and thus decrease the probability of theft.

¹ The variable names are Caught, Attitude, Norms (peer pressure) and Age. Norms represent a proxy for subjective norms as described in the literature chapter.
More enforcement requires more resources; however this may not be the best use of these resources. The augmented Becker model suggests that the probability of crime can also be decreased by changing people’s attitudes and societal influences. Marketing efforts to change these variables might be more cost effective than increasing enforcement. This example illustrates how the augmented Becker model provides more options for the implementation of potentially effective strategies aimed at reducing the broader problem of theft and the losses associated with it.

The results of this thesis provide a first step in quantifying policy alternatives related to theft. Identifying the cost associated with the manipulation of significant variables in the augmented Becker model is a subject for further study. Other topics for further study include testing the augmented Becker model on other criminal behaviors and testing whether current attempts to change attitudes and societal influences affect the probability of criminal behavior. Assuming results of future studies of criminal behavior are consistent with the results presented here, the additional variables of the augmented Becker model are likely to produce policies that are improve the cost effectiveness of preventing losses associated with criminal behaviors.
Chapter 2

REVIEW OF LITERATURE

Criminal behavior is widespread, diverse and costly to society. Because of this, all of the social sciences contain at least some literature explaining and analyzing criminal behavior. The wide range of literature is likely due to the fact that crime touches everyone; a better understanding of crime might result in its reduction. While scholarly works from diverse social sciences were consulted in the development of this thesis, the theory proposed in Chapter 3 relies heavily upon the contributions of economics and social psychology. This chapter presents criminal behavior within the context of each discipline. Economics is covered in section 2.1 and social psychology is discussed in section 2.2.

2.1 Economic Perspective

This section presents the economic perspective of theft behavior. First, subsection 2.1.1 describes the economic framework of crime. This discussion includes the distributional effects and the efficiency losses associated with theft. Second, subsection 2.1.2 summarizes the economic theory developed by Gary S. Becker. The theory explains theft behavior in economic terms, with an emphasis on minimizing the efficiency loss associated with theft. Subsections 2.1.3, 2.1.4, and 2.1.5 examine the empirical work based upon Becker’s theory. Lastly, subsection 2.1.6 discusses some criticisms of the Becker approach to crime.
2.1.1 The Distributional and Efficiency Effects of Theft

Within the theoretical framework of economics crime can have two effects, transferring or redistributing wealth and decreasing efficiency. These effects are best explained with an analogy. Consider an economy to be like a giant pie. Transfers and redistributions change who gets what piece; efficiency determines the size of the pie. While some crimes redistribute wealth, most crimes reduce efficiency. Thus, criminal behavior results in a smaller pie. This problem is the focus of economic theory regarding crime.

Efficiency losses occur when market forces do not reflect the entire benefits or costs associated with a transaction. In the case of theft this occurs in four situations. They are: (1) opportunity cost of the labor of thieves, (2) loss of time and money by potential victims and the state in deterrence, (3) destruction of the product or property in the act and (4) re-direction of production into activities that cannot be stolen (Usher, 1987, p.236). Each of these situations does not occur with every theft; however, each has important implications within the framework of the economic model of crime presented in subsection 2.1.2.

Efficiency losses furnish a quantifiable means of evaluating criminal behavior, which leads to the perception that economics overlooks the personal physical and emotional consequences of criminal behaviors such as violence, suffering and a loss of personal safety. The ideal reduction of efficiency losses associated with criminal behaviors includes these factors. Thus, through the study of efficiency, it is possible to reduce problems not generally associated with economics. The economic study of crime

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2 The market generates "efficient" allocation of resources if there does not exist an alternative feasible resource allocation that can make some individual better off without making someone else worse off.
provides a framework for the reduction of all efficiency losses. The desired result of such studies is an increase in the size of the pie.

2.1.2 Economic Theory: Becker

The question of how to minimize the efficiency loss due to theft was first taken up in Gary S. Becker’s 1968 work *Crime and Punishment: An Economic Approach*. This model “formulates a measure of the social loss from offenses and finds those expenditures of resources and punishments that minimize this loss” (p. 170). The model suggests that policy makers can minimize social loss through the manipulation of two variables; offender cost and probability of conviction per offence.

Becker posited that the efficiency losses attributable to crime could be minimized through the use of incentives and punishments. To help explain how theft works in an economic system Becker developed a set of behavioral equations explaining crime and its related costs. The equations explain: (1) net damage to society; (2) the cost of apprehension and conviction; (3) the supply of offences; (4) and punishment. These equations form (5) the optimality conditions needed to minimize societal loss.

1. Damage

Becker believed that crime caused damage to society related to the number of offences (O) in the following functional form.

\[ D(O) = H(O) - G(O) \]  

Where,

\[ D = \text{damages f(O)} \]
\[ H = \text{harm to the victim f(O)} \]
\[ G = \text{gains to the criminal f(O)} \]
This formula is intended to capture all costs and benefits associated with the criminal act. In this model damages include not only pecuniary costs but psychic costs as well. An example of a psychic cost is the loss of safety a person feels after being a victim of a crime. The fact that these costs are included in the model suggests that many studies whose results are based upon the monetary cost of crime underestimate the actual cost.

2. The Cost of Apprehension and Conviction

The cost of apprehension and conviction is expressed by the production function

\[ A(\text{Activity}) = f(m,r,c), \] i.e. manpower, materials, and capital used in capturing criminals.

The total cost is expressed as:

\[ C = C(A) \quad (2.2) \]

For a better empirical measure of "activity" Becker assumed that (p) the ratio of the probability a person gets convicted to all offences multiplied by the number of offences approximated the output of police and courts. This function is:

\[ A \approx pO \quad (2.3) \]

Becker substitutes equation 2.3 into equation 2.2 differentiates and gets:

\[ C_p = \frac{\partial C(pO)}{\partial p} = C'O > 0 \quad (2.4) \]

and

\[ C_O = C'p > 0 \quad (2.5) \]

These equations explain how, as long as probability of offence \( p(O) \) is greater than zero, the increase in the probability of conviction or number of offences increases the total cost to society of the crime.
3. Supply of offences

Economic theory explains that a rational person will engage in the action with the highest expected utility. This is known as utility maximization. For a person operating within the framework of utility maximization, legal behavior should not be taken for granted. Theoretically, utility optimizers will choose to engage in an action that they feel best suits them regardless of the legality of the action. Thus, if a person commits an act of theft it is presumed that she does so because her expected utility, or reward, from the act outweighs the alternatives. This assumption, that crime represents a possible optimal allocation of a person’s resources, allowed Becker to develop a function that explains why people steal. It follows the form:

\[ O = O(p, f, u) \]  \hspace{1cm} (2.6)

Where,

- \( O \) = the number of offences a person commits in a specific time period
- \( p \) = the probability of conviction per offence
- \( f \) = the individual’s punishment per offence
- \( u \) = a portmanteau variable representing “all other influences”\(^3\)

In this model only a convicted person pays. Raising the probability of conviction or increasing the punishment per offence decreases the number of offences carried out per period. This is explained by the following partial derivatives:

\[ O_p = \frac{\partial O}{\partial p} < 0 \]  \hspace{1cm} (2.7)

and

\[ O_f = \frac{\partial O}{\partial f} < 0 \]  \hspace{1cm} (2.8)

\(^3\) Becker suggests education or a rise in the income available in legal activities as possible “\( u \)” variables.
An increase in either \( p \) or \( f \) would reduce the number of offences because either the “price” would be higher or the probability of “paying” the higher “price” would be greater. This works by changing the individual’s expected utility function. The utility is:

\[
EU=pU(Y-f)+(1-p)U(Y) 
\]  

(2.9)

Where,

- \( Y \) = income, monetary and psychic from an offence
- \( U \) = the individual’s utility function
- \( f \) = the monetary equivalent of the punishment

This function shows how increases in \( p \) and \( f \) result in a decrease in expected utility. It also shows how a change in the probability of punishment and a change in penalty that result in equal expected income do not have the same effect on the individual. Because the change in the probability has a greater effect on the expected utility of the individual, a change in this variable will theoretically cause a greater reduction in crime.

These equations show how individuals choose to “supply” criminal behavior. The equations follow the economists’ analysis of choice in describing how a person commits an offence. The proposition is that people decide to become criminals because their costs and benefits differ; they expect crime to pay.

4. Punishment

Punishments cost both the thief and society. The only direct monetary measure of punishments is fines. In this case, the cost of administration is subtracted from the fine resulting in the net societal cost of the punishment. It is apparent that fines can have net social benefits, however many punishments cost society. For example, imprisonment

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4 The effects of punishment are discussed further in part 4 of this subsection.
costs society directly through expenditures on prisons. It indirectly costs society through the forgone earnings of the criminal and the loss of the value placed upon restrictions in consumption and freedom of the convicted. The total social cost of the punishments is described by:

\[ f'' = bf \]  

Where,

\[ f'' \] = social cost  
\[ f \] = cost to offender  
\[ b \] = the coefficient that transforms \( f \) to \( f' \)

Becker believes that the coefficient \( b \) that transforms \( f \) into \( f' \) varies greatly for different kinds of punishments. He believes that \( b=0 \) for fines, while \( b>1 \) for torture, probation, parole, imprisonment, and most other punishments.

5. Optimality Conditions

With the behavior equations in place Becker was able to answer the question of how many resources to expend to minimize the efficiency loss associated with theft, at least theoretically, by combining them all into the functional form of:

\[ L = L(D,C,bf,O) \text{ or } L = D(O) + C(p,O) + bpfO \]  

Where,

\[ L \] = social loss  
\[ D \] = net damage from the act of theft  
\[ C \] = cost of apprehension  
\[ bf \] = offender costs
This model suggests that policy makers can minimize social loss only through changes in offender costs (f) and the probability of conviction per offence (p). A greater expenditure on police, courts, technology, and other measures increases the probability that a thief gets caught. Increases in the sizes of the punishments (i.e. higher fines or more prison time) cause decreases in crime. The marginal costs associated with the decrease in crime must be weighed against the marginal benefits of the decreased in crime. According to this theory, finding the best combination of these costs and benefits determines how to minimize efficiency losses due to criminal behavior.

2.1.3 Economic Empirical Work: Ehrlich

An economist who has contributed to the empirical testing of the economic theory of theft is Isaac Ehrlich. His 1973 work, Participation in Illegal Activities: A Theoretical and Empirical Investigation, supports Becker’s theory. Ehrlich begins his analysis with a discussion of what he calls the “criminal prospect.” Ehrlich believes that the criminal prospect has a choice to violate the law or to remain law abiding. If a violation occurs the offender has two probable outcomes: getting away or getting caught. The first outcome produces an increase in wealth, while the second entails a penalty.

Based upon the Becker approach, Ehrlich’s models include the idea that an increase in probability of getting caught and punishment once caught affect the decision
of whether or not to engage in a criminal activity. Ehrlich believes that there is another important variable, the marginal value of time, and proposed the following modified model:

\[ O = O(p, f, w_i, w_l, u, \pi) \] (2.12)

Where,

- \( O \) = Number of Offences
- \( p \) = Probability of getting caught
- \( f \) = Offender Costs (punishments)
- \( w_i \) = The marginal value of time devoted to illegal activities
- \( w_l \) = The marginal value of time devoted to legal activities
- \( u \) = error term
- \( \pi \) = “other variables” including such things as “personal family wealth, efficiency at self-protection, the amount of private insurance provided by his family (or criminal organization)” (p. 533)

Ehrlich tested this model empirically using data from the Uniform Crime Reports of the FBI on crimes committed in the United States from 1960, 1950, and 1940. After running regression analysis on the data Ehrlich concludes:

The rate of specific crime categories . . . varies inversely with estimates of the probability of apprehension and punishment by imprisonment, and with average length of time served in state prisons. Crimes against property are also found to vary positively with the percentage of families below one half the median income (crimes against the person are not affected by income). (p. 549)
The significance of these results lends support to economic model of crime developed by Becker and supplemented by Ehrlich. The model suggests that through the use of punishments, changes in the probability of getting caught, and the increasing marginal value of time devoted to legal activities (i.e. better employment), it is possible to affect the crime rate.

2.1.4 Economic Empirical Work: Corman-Mocan

The pioneering work by Becker and Ehrlich paved the way for the economic study of crime. There have been many attempts to test the model empirically. Corman and Mocan use time-series data to test a model based upon Becker’s theory. While the Corman-Mocan model is conceptually similar to Becker’s they have added a proxy legal market opportunity and a variable for drug use. The model is expressed:

$$CR = f(Pol, Arr, Pov, Q)$$ \hspace{1cm} (2.13)

Where,

$$CR \quad = \quad \text{the crime rate}$$

$$Pol \quad = \quad \text{the size of the police force}$$

$$Arr \quad = \quad \text{criminal arrests}$$

$$Pov \quad = \quad \text{poverty (a proxy of legal market opportunity)}$$

$$Q \quad = \quad \text{drug use}$$

The authors test this model with data provided by the city government of New York. The data is a time series with an entry for every month from 1970-1996. Five types of crime were investigated including murder, assault, robbery, burglary, and motor vehicle theft.
For all five categories, a significant relationship was found between growth in the crime rate and number of police. Drug use had a small effect, and the poverty/market opportunity variable was not significant. These results support Becker's thesis that an increase in the probability of getting caught (more police) will cause a decrease in the crime rate.

2.1.5 Economic Empirical Work: Cornwell-Trumbull

Many studies have found a significant relationship exists between increases in the offender costs and probability of conviction with reduced crime rate (Ehrlich, 1975; Witte, 1980; Viscusi, 1986; Grogger, 1991; Levitt, 1997; Corman and Mocan 2000). Other studies have found either weak or nonexistent relationships between the variables (Myers, Jr., 1983; Cornwell and Trumbull, 1994). The following paragraphs examine a study by Cornwell-Trumbull that casts doubt on the robustness of the empirical results pertaining to the economic theory of crime.

Cornwell and Trumbull base their study on the economic model of crime. It is specified as follows:

\[ R = X'\beta + P'y + \alpha + \epsilon \]  

(2.14)

Where,

- \( R \) = the crime rate
- \( X' \) = variables controlling for the relative return to legal opportunities
- \( P' \) = a set of deterrent variables including probability of arrest, conviction and prosecution
- \( \alpha \) = fixed effects (cross sectional model only)
- \( \epsilon \) = disturbance terms
Based upon the statistical analysis of this model the authors conclude that previous studies using aggregate data might be flawed due to misspecification. Unobserved heterogeneity and simultaneity are some statistical consequences of using aggregate data in studies of crime. Controlling for these problems, this model is tested using panel and cross sectional data. In addition, a two stage least squares regression is used. The data and the statistical techniques led the authors to conclude that the probability of arrest does not provide as much deterrence as previous studies indicated.

These results bring to light potential problems of the economic approach to criminal behavior. Most of these problems occur due to the aggregate data used in past studies. According to the authors, using data of this type introduces endogeneity. This specification error biases upward deterrent effects estimates, therefore any study that fails to specify the model correctly risks reporting erroneous results.

2.1.6 Criticisms of the Economic Theory of Crime

As the Cornwell-Trumbull study indicates problems exist when empirically testing the economic model of crime. Four principal criticisms exist. (1) Spurious correlation between the crime rate dependent variable and criminal enforcement variables might be due to measurement errors. (2) Criminal enforcement levels and crime rates may be simultaneous leading to an identification problem. (3) The variable for "crimes cleared by conviction" represents many crimes and the mix of crimes is affected by criminal enforcement efforts. (4) The potential gains to the criminal have not been adequately studied or specified in the models. These criticisms bring to light important issues that will require further study. Nevertheless, a majority of empirical work involving the economics of criminal behavior supports the efficacy of the model.
2.2 Social Psychological Perspective

In the field of social psychology it was originally believed that a person's attitude toward the act in question was the best way to explain behaviors. Through the course of time and examination of data, a general consensus grew: explaining behavior from attitude is unreliable. This consensus initiated the search for other variables important to explaining behavior. The search led to the incorporation of societal influences or norms in explaining behavior culminating in the Theory of Reasoned Action.

The evolution of behavioral research is discussed in subsection 2.2.1. Subsection 2.2.2 explains the Theory of Reasoned Action (TORA). Finally, subsection 2.2.3 concludes the chapter with a critical look at the ability of the TORA to explain behavior.

2.2.1 Development of Behavior Research

The possibility that attitude might explain behavior was evident from an early point in the social sciences. In 1918 Thomas and Znaniecki (Thomas, 1918) first used the concept of attitude to explain social behavior. The pair believed attitudes or "individual mental processes" determined people's actual and potential responses to different situations. This idea remains integral to many behavioral theories; however, studies done since suggest that attitude, as the sole explanatory variable of behavior, performs poorly.

One of the first researchers to question the explanatory power of attitudes was LaPiere (1938). He disagreed with the assumption that the response given to a printed or oral question reveals the attitude which would become operative in a situation of the kind referred to in that question stating: "The measurement of attitude as a means of predicting future behavior . . . [is] scientific nonsense" (p. 179). His investigation focused on the
consistency between the treatment of a Chinese couple in hotels and restaurants and the replies by owners of such establishments to a questionnaire about their acceptance of Chinese in general. He found virtually no consistency. Taking an interest in results of this experiment Kutner, Wilkins and Yarrow (1952) attempted to repeat it. Their results also showed no correlation between attitudes and behaviors. Based upon a survey of the previously discussed works along with other similar works from the period Deutscher (1966) argued that there was no reason to expect that attitude explains any behavior.

Despite unimpressive results regarding the attitude-behavior relationship, theorists interested in explaining behavior continued to believe that attitude played a key role. In time, it became generally accepted that attitude was responsible for only a small portion of behavior (Wicker, 1969). Freedman, Carlsmith, and Sears (1970) believed that attitude or change in attitude tends to produce behavior that corresponds with it. They qualified this thought with the idea that the attitude-behavior relationship depends on other variables that caused an inconsistency between the relationship.

One of the variables thought to cause this inconsistency was termed normative forces. When investigating marijuana use, Acock and Defleur (1972) found that attitude along with normative beliefs provided excellent explanation of behavior. The insight into the normative variables influence on behavior proved essential to the development of one of the most influential models of behavior, the Theory of Reasoned Action. A discussion of this theory follows in subsection 2.1.2.

2.2.2 Behavior Explanation: Theory of Reasoned Action

In 1975, based on previous behavioral studies, Fishbein and Ajzen developed the Theory of Reasoned Action (TORA). This theory remains the dominant theoretical
framework for explaining behavior within the field of social psychology. This is demonstrated by its use in countless studies including: blood donation (Bagozzi 1981; and Chang, Piliavin, and Callero 1988), recycling (Schultz and Oskamp 1996), substance abuse (Grube and Morgan 1990), voting (Granberg and Holmberg 1990), and weight loss (Netemeyer, et al, 1991).

Understanding the TORA requires the knowledge of the variables theorized to influence behavior as well as how those variables are measured. The following paragraphs begin with the mathematical construct of the TORA and a brief definition of the variables. The functional form of the TORA will guide a more detailed discussion of each variable in turn. The equation for the TORA follows the form:

\[ B = f(BI) = f(A_{act}, SN) \]  

(2.15)

Where,

- \( B \) = behavior
- \( BI \) = behavioral intention
- \( SN \) = subjective norms
- \( A_{act} \) = attitude toward performing the specific act in question

Because \( B \approx BI \) the TORA does not explain behavior (B) \textit{per se}, it explains behavioral intentions (BI). The construct called behavioral intentions is linked to actual behavior through "effort" or "the attempt to perform the behavior" (Ajzen, 1985, p.30). For example a lazy person might have the behavioral intention to get off the couch (i.e. survey results suggest she wants to get off the couch), yet if no effort is expended the behavior will not come to fruition. This example shows how the theory explains behavior intentions; however, it is important to realize that these intentions do not always
result in the expected behavior. The fact that the model explains behavioral intentions, not actual behavior, is one of its major criticisms; this is discussed in subsection 2.2.4.

Attitude toward performing the specific act in question ($A_{\text{act}}$) is the next variable of interest. This variable comes from the following equation:

$$A_{\text{act}} = \sum P_i a_i$$  \hspace{1cm} (2.16)

The variable $P_i$ represents the individual’s belief about the likelihood that the behavior in question will result in outcome $i$. This could also be thought of as the individual’s perceived probability that a consequence - either positive or negative – will arise from the act in question. The variable $a_i$ represents the individual’s evaluation of the outcome of $i$ or, put another way, the variable represents the perceived consequence of the act (Fishbein, 1978).

Generally semantic differential or Likert scales are employed to discover the variables associated with attitude ($A_{\text{act}}$) as well as subjective norms (SN). For example, a person might be asked to respond to a question regarding her interest in sports. A semantic differential might have the following response options, very interested, somewhat interested, or not at all interested. A Likert scale might ask the respondent to evaluate her interest on a scale from one to ten, ten being very interested. Fishbein employed the following semantic differential scales in his 1972 study measuring the effects of buying a plot of land as: foolish-wise, good-bad, harmful-beneficial, rewarding-punishing. The sum across the four scales was then used for attitude ($A_{\text{act}}$) (Ajzen and Fishbein, 1972).

The addition of the variable for subjective norms (SN) is an attempt to quantify how the individual in question will react to what she perceives to be the expectation of
her behavior by those around her and her desire to comply with those expectations. Normative forces affect behavior in two ways. First, groups exert influence on individuals by affecting sources of information and how they evaluate it. Second, groups assert their influence on individuals’ perception of the way they should behave. The variable subjective norms (SN) is an attempt to capture “peer pressure” on the individual’s behavior and takes the following form:

\[ SN = \sum (nb \times mc) \]  

(2.17)

Where,

- \( nb \) = normative beliefs
- \( mc \) = motivation to comply with the normative beliefs

Defined by Fishbein and Ajzen (1980) normative beliefs (nb) are subjective, that is, a person’s “perception that most people who are important to him think he should or should not perform the behavior in question” (p.57). The motivation to comply (mc) with the normative beliefs (nb) represents the individual’s desire to live up to the expectations of those around her.

The model calls for summing the multiple of all normative beliefs (nb) by their respective motivation to comply (mc). For example, a person responds to a survey that she respects grandma’s opinion (nb), she also makes a strong effort to comply with grandma’s opinion (mc). This same person respects the opinion of her friends, yet she makes a smaller effort to comply with these opinions. The Likert scale results for strong respect and motivation to comply with grandma’s beliefs would be multiplied together. Then they would be added to the Likert scale results of strong respect and weaker motivation to comply with friends’ beliefs multiplied together. The resulting number
would represent the individual's subjective norms regarding a specific behavior. Theoretically this is possible; however, in practice the variable for motivation to comply (mc) is difficult to quantify and is usually dismissed. (Azjen and Fishbein, 1980). Nevertheless, these variables provide an excellent explanation of behavior demonstrated by the use of the Theory of Reasoned Action in many behavioral studies.

2.2.3 Criticisms of the Theory of Reasoned Action

While successes in explaining behavior with the TORA have occurred, there remain criticisms of the theory. These criticisms center upon the imprecise link between behavior (B) and behavioral intention (BI) resulting in a reduced range of behaviors that can be explained using the theory. According to Liska (1984), there are two major problems with the theory: (1) The theory is only good at explaining simple tasks, and (2) the theory only explains behaviors that immediately follow the administration of the survey. Following is a discussion of these two problems.

The idea that the TORA does a better job explaining simple behaviors involves the relationship of behavior (B) to behavioral intention (BI). Presumably an individual's "effort" can be enough to transform a behavioral intention (BI) into a behavior (B). However, effects of effort change as behavioral complexity increases. The assistance of others and external constraints change the required effort. The more complex the behavior the less likely effort will transform a behavior (B) into a behavioral intention (BI) (Wright, 1998).

The other criticism of the theory, the inability of the TORA to explain behaviors that do not transpire shortly after the completion of the survey, is due to the instability of behavioral intentions over time. Eagly and Chaiken (1992) state that the TORA has
"largely abandoned the question of how intentions relate over broad time spans to behaviors." Fishbein and Ajzen note that maximizing the effectiveness of the TORA requires that researchers minimize the time interval between the measurement of intentions and behavior (1978).

The TORA is somewhat limited in the behaviors it can explain. Its limits include behaviors that are relatively simple and behaviors occurring shortly after the intention is reported. Empirically examining behaviors with the TORA requires addressing these limits. As mentioned, past studies have shown that when the limits are taken into account the TORA can provide a useful approach to the explanation of behavior.
Chapter 3

THEORIES OF CRIMINAL BEHAVIOR

The literature chapter discussed two distinct models of explaining criminal behavior. The model presented by Becker offers an economic perspective, while the Theory of Reasoned Action offers a social psychology viewpoint. Both theories offer insight into the causes of criminal behavior. Becker’s economic theory is influenced by the economists’ emphasis on the interplay of individual choices (Hirschleifer, 1998). The social psychology perspective explains how behavior is influenced by individual attitudes and the actual, imagined or implied presence of others (Albrecht, 1980). The previous chapter cites empirical evidence supporting the explanatory power of both models.

In this chapter, each theory is described in similar terms. There follows a discussion of the similarities and differences between the theories and their disciplines. The fact that each separately adds to the understanding of criminal behavior argues for combining the contributions of each into a synthesized theory. This synthesis takes the form of a Becker model augmented with variables from the Theory of Reasoned Action. This synthesis will be called the augmented Becker model.

3.1 The Becker Model

As discussed in the previous chapter, the Becker model of crime assumes that criminals are rational individuals maximizing their utility. It is assumed that criminals deciding on the best course of action evaluate both the expected income foregone by
devoting time to criminal activity and the expected value of the return from the activity, i.e. the costs and benefits. The standard economic decision rule applies: if benefits outweigh costs the behavior is undertaken.

According to the theory, if expected utility is positive, crime pays. To eliminate crime, policy makers must manipulate the variables of the expected utility function so that expected utility from crime is zero or less for all members of a society. Unfortunately, due to varying opportunity costs, the high cost of punishment, and the high cost of increasing punishment's probability, achieving zero or negative utility for all members of society would be very difficult - not to mention costly. Therefore, according to Becker, it is important to find a level of crime that "should" be allowed in order to minimize the societal loss associated with crime. Policy makers can do this by manipulating the level of money spent on policing and punishing, thereby affecting the expected cost of crime.

3.2 The Theory of Reasoned Action

Independent of the economists, social psychologists developed models to explain social behavior. One of the most widely cited techniques developed by social psychologists is the Theory of Reasoned Action. According to the theory intention to perform a behavior is a function of two basic determinants, one personal in nature and the other reflecting social influence. The personal factor is the individual's positive or negative evaluation of performing the behavior; this factor is termed attitude toward the behavior. It refers to the person's judgment that performing the behavior is good or bad. For example some may have a favorable opinion of music downloading while others do not. The second determinate of behavioral intention is the person's perspective of the
social pressures put on her to perform or not perform the behavior in question. Because it deals with forces that are perceived, this factor is termed a subjective norm.

The implications of this model are straightforward. If a causal relationship exists between the dependant variable on the one hand and the independent variables on the other, then it might be possible to reduce crime by changing people's attitudes and norms. For instance, marketing efforts could be focused on changing these variables.

3.3 Similarities and Differences of the Models

Both the economic and the social psychological perspectives are concerned with explaining behavior. However, because the conception of each model arose from different academic disciplines, the two models vary in their approaches to explaining behavior. Economics provides a theoretical base for the decision-making process through the concept of utility maximization. In social psychology attitudes, primitive instincts reinforced or repressed by socialization, cultural characteristics, group identifications, and evolution are potential determinates of behavior.

An economist assumes that an individual's decisions reflect attempts to achieve desired tastes and preferences. This is the basis of the economic theory on crime as it posits that people are making a choice based upon whether or not it adds to their utility. The discipline of social psychology contains no universally accepted or assumed motivation to behave in a particular way. In this case, an individual makes behavioral choices based upon her beliefs, attitudes and social forces. Thus, an economist might describe an individual's choice to eat a burger as maximizing the individual's happiness. A social psychologist would suggest that social forces (like not being Hindi) and the fact that the individual likes burgers resulted in her consumption of the burger.
3.4 The Augmented Becker Model

Empirical scrutiny of both Becker’s economic model of crime and the Theory of Reasoned Action reveals that both do well explaining criminal behavior. Thus, one might hypothesize that the economic variables of probability of getting caught and penalty along with the social psychology variables of subjective norms and attitudes are important to explain criminal behavior.

This thesis synthesizes the contributions of these models within the framework of the economic model of crime. The choice to augment the economic model with variables from the Theory of Reasoned Action rather than the reverse stems from the quantifiable advantages of the economic model allowing for policy that minimizes the social cost of crime. One advantage of the economic model is its inclusion of theory specifically designed to deal with criminal behavior allowing for a direct indication of policy prescriptions.

Recall from the previous chapter that the individual’s decision to engage in crime accounts for a small but important segment of the Becker model. The primary focus of the model is minimizing the social cost of crime. On the other hand, the Theory of Reasoned Action’s primary focus is predicting all types of behavior. If one is interested in predicting or explaining a broad range of behaviors, the Theory of Reasoned Action works well; however, because the economic model is geared specifically toward crime, it is likely to be more useful in the context of this thesis.

Another important reason for the choice of the economic framework is the fact that the model allows policymakers to manipulate the causal variables of crime to reach a socially optimal point; the social psychology model does not. Predicting crime more
accurately by including the economic variables within the framework of the Theory of Reasoned Action might be possible; unfortunately no policy prescriptions are apparent with this approach. In contrast, augmenting the economic model allows policymakers to influence the crime rate with a target of social optimality. The more variables which may be rigorously identified as crime rate causes, the more efficiently resources (e.g. expenditures on police, advertising campaigns, and increased punishments) can be redirected to minimize the social cost of crime. Thus, the subsequent analysis will focus on augmenting the Becker model with variables from the Theory of Reasoned Action.

The augmented Becker model is based upon a utility maximization framework. Recall that the Becker model posits that punishment and risk of getting caught influence the decision to steal by changing the return to the criminal act, or expected utility. The variables of the Theory of Reasoned Action could also affect expected utility. Consider subjective norms. These variables represent the influence others have on an individual's decision. For instance one would probably be less likely to steal if the opinion of others important to her was unfavorable toward thieves. Essentially, people want to please others whom they respect; therefore engaging in an act deemed bad or inappropriate by others reduces the expected utility of crime. In the same sense, a person thinking theft is bad might feel guilty for stealing. This feeling of guilt would also lower the expected utility of crime. In a sense these factors represent punishment imposed by the individuals on themselves. This example demonstrates the rationale for augmenting the Becker model with the variables of attitude and subjective norms.

The augmented Becker model presented here could allow policymakers to influence the crime rate not only by changing the probability of getting caught and
punishment but also by changing attitudes and subjective norms. A discussion of the implications of the addition of these variables is reserved for the conclusion of the thesis.
Chapter 4

DATA AND METHODOLOGY

Chapter 3 summarized the Becker model and the Theory of Reasoned Action and built an augmented model of criminal behavior. The purpose of that discussion was to set the stage for the testing of a crime-specific version of such a model. This chapter details the necessary variables to test these models and the procedures employed to measure each variable; however, before this discussion begins it is important to discuss some characteristics of the crime being studied. The following paragraphs explain the choice to examine criminal behavior through music acquisition.

The challenge to the researcher is to find a criminal behavior that people feel comfortable discussing. Recorded music provides such an opportunity because of the widespread acceptability of illegal acquisition. In a survey of 2,306 adults, Harris (2003) found three in four people agree with the statement: “downloading and then selling music is piracy and should be prohibited, but downloading for personal use is an innocent act and should not be prohibited.” Thus, surveys of music acquisition might provide insightful information regarding criminal behavior.

4.1 Variables Needed to Test the Models

This thesis tests three models, they are: (1) the individual decision portion of the economic model presented by Becker; (2) the Theory of Reasoned Action proposed by Fishbien; and (3) an augmented Becker model based upon the economic model with
elements from the Theory of Reasoned Action. This section explains what variables are needed to test the three approaches. The variables needed for the economic approach are discussed first, and the others follow.

Recall that the economic model of crime theorizes that the chance of getting caught and the penalty affect the expected utility of, or return to criminal acts. Traditional tests of this model have used variables such as crime rate, number of arrests per reported crime, number of police, sentencing guidelines and average punishment per crime. While each of these variables comes from an aggregate data source, that is not the only way to test this model. Individual survey data may be used to determine the causes of criminal behavior. For example, individual data could be used for the aggregate variable, arrests per crime, by asking survey respondents what they believe to be their perceived chance of getting caught.

The survey technique allows for the testing economic models of crime in a unique way. Instead of a community’s crime rate, individuals’ reporting of committing or not committing a crime is used as a dependant variable. Questions regarding the perceived risk of getting caught and perceived severity of punishment along with socio-economic variables allow for the testing of the economic model of crime based upon individual level data.

While it is possible to test the economic model of crime using aggregate or individual level data, testing the Theory of Reasoned Action requires individual level data. This is due to the fact that the model is based upon individual attitudes and norms; one can see the difficulty of collecting an aggregate measure of individual ethical and normative beliefs. Because the Theory of Reasoned Action requires individual level data
survey questions were developed based upon the literature. Likert scale responses to statements regarding attitudes toward theft, subjective norms, and ethical beliefs constitute the variables needed to test this model.

Combining the variables of the Theory of Reasoned Action with The Becker model allows for the testing of the augmented Becker model of crime. The augmented model hypothesizes that norms, and attitudes, together with the chance of getting caught, the severity of punishment, and socio-economic characteristics provide a better explanation of criminal behavior than does either model alone. The augmented model requires no further introduction of variables. It simply uses variables from both the Becker model of crime and the Theory of Reasoned Action.

4.2 Developing the Questionnaire and Collecting the Data

Guided by the literature, extended discussions by the Economics Research Seminar at the University of Montana formulated a set of questions that would provide data for testing the three previously described methods of explaining crime.

To gather data on these variables along with the variables from the Becker model, the Theory of Reasoned Action and the augmented Becker model a survey was developed containing 40 questions. A pilot run was used to determine if there were any problems with the implementation of the survey. The pilot run indicated minor changes, including removing respondents' names and addresses from the questionnaire. Appendix A provides a copy of the interview form.

Between February 2004 and October 2005 twenty-five interviewers from the Economics Research Seminar administered five hundred questionnaires within the city of Missoula Montana. Before the surveys were conducted interviewers were required to
take and pass and Institutional Review Board ethics course, and the interviewers received
instruction through coursework as well as individually regarding proper interviewing
techniques and responsibilities.

The administration of the interviews followed strict sampling procedures. Based
upon data and a map from the Missoula Office of Planning and Grants, interviewers were
sent to seventeen neighborhoods constituting the entire population of the city. Based
upon neighborhood population relative to the city population, a set number of surveys per
neighborhood were collected.

Throwing a dart or dropping a pen on each neighborhood map achieved randomness. The interviewer went to the randomly selected location and headed in
predetermined direction – north from the first point, south from the second, etc. - until
contacting a willing interviewee aged 18 or older. The interviewer then explained the
interview form to the interviewee who then wrote his or her responses to each question
on the form and handed it to the interviewer in a sealed envelope.

To ensure that the sample accurately represented the population, socio-economic
data was collected from the respondents and compared to the population. Table 4.1
shows this comparison.

| Table 4.1 Comparison of the Sample Means to the Population Means |
|---|---|
| Age | 30.3 | 31.51 |
| Males | 49% | 56% |
| Household | 2.23 | 2.77 |
| Renters | 49% | 58% |
Variation between the population and the sample may reflect the fact that the sample used in this analysis is not a sample of the total population; rather it is a sample of individuals that have acquired music in the last six months.

### 4.3 Reasons for the Use of a Survey

Because the study uses a survey rather than aggregate data there are implications regarding the results that differ from results produced by aggregated data. In the aggregate case, many studies of crime used the crime rate as a dependant variable. A researcher employing this technique might be able to conclude that a rise in punishment or probability of getting caught decreases the crime rate. However, the links to the individual reasons for committing a crime are not known. On the other hand, a survey allows for a determination of the relationship that exists between crime and the characteristics of the individuals committing it. This suggests individual behaviors that might be influenced to reduce crime through changes in police forces, penalties, and the use of marketing techniques aimed at influencing attitudes and norms.

From a policy standpoint, the aggregate investigation allows for policies that change the crime rate while the survey approach allows for policies that reduce the probability that an individual will steal. This difference is minimal until one examines the variables that are used in each approach. An aggregate investigation into crime results in a limited number of variables that can be manipulated by policy makers. Because aggregate data can be collected only for chance of getting caught and penalty—e.g. arrest rate and punishment—these variables are the only tools policymakers have to manipulate the crime rate. On the other hand, individual level data can explain individual reasons people steal. This data can be collected on a wide range of causal variable e.g.
attitudes, norms, and abilities. These numbers furnish policy makers with a much wider range of variables that might be manipulated to reduce the social cost of crime.

Another benefit of this type of research is that the survey is specific to this study. Other empirical works have used pre-collected data sources that lack one or more important variable. Many studies of this type are forced to use proxies for variables that are unavailable. Thus using individual surveys is a good way to eliminate the omitted variable problem.

In summary, a better understanding of individual reasons why people steal leads to an increase in the options policy makers have to manipulate the crime rate. Avoiding the omitted variable problem provides better testing of the economic model of crime. Taken together these two examples provide powerful reasons for using a questionnaire to study crime.
Chapter 5

EMPIRICAL ANALYSIS

The previous chapters laid the groundwork for the analysis of three models explaining criminal behavior that takes place in this chapter. The three models are Becker's economic model, the Theory of Reasoned Action, and the augmented Becker model. Analysis of each model is discussed, in turn, following an explanation of the binary logistic approach to their testing.

5.1 The Logit

Engaging in theft is a choice between stealing and not stealing. This is known as a dichotomous choice and can be measured as whether a person (a) engages in crime or (b) does not. One of the properties of dichotomous choice is the ability to express the dependent variable as the odds of an event occurring. Within this framework, the values of the independent variables' effect on (a) and (b) can be estimated using the logit model. The logit with its cumulative logistic distribution is not the only model of dichotomous choice; models such as the probit based upon the cumulative normal distribution are also available. The logit enjoys widespread use due to mathematical properties of the cumulative logistic distribution that allow for relatively simple analysis. The choice to use the logit model over other models of binary choice seems reasonable based upon the fact that the decision of which binary choice model produces the best estimations remains unresolved and in many cases makes little difference (Greene, 1990).
Because the logit model provides a sound method to explore dichotomous choice, it will be used to explain the relationship among the dependent variable and the independent variables of each model. The probability of whether an individual bought or stole her last acquisition of music is the dependent variable for all four models. This behavior (Theft) is dichotomous, therefore:

\[ \text{Theft} = 1 \text{ when the individual stole on her last acquisition} \]
\[ \text{Theft} = 0 \text{ when the individual bought on her last acquisition} \]

5.2 Becker Model Results

Five hundred respondents reported acquiring music. The choices of these 500 individuals are used in all three models. Here they are evaluated based upon the following Becker model adapted from the economic literature:

\[ p(\text{Theft}) = f[\text{Caught}, \text{Penalty}, \text{Age}, \text{Gender}, \text{Edu}, \text{Lowinc}, \text{Medinc}, \text{House}, \text{Rent}] \]

Where,

\[ p(\text{Theft}) = \text{the probability that a person steals} \]
\[ \text{Caught} = \text{a respondent's belief of her chances of getting caught if she attempted to act illegally (0-10, 10 being "great risk")} \]
\[ \text{Penalty} = \text{a respondent's belief regarding how severe her penalty would be if she got caught (0-10, 10 being "great risk")} \]
\[ \text{Age} = \text{age of respondent} \]

\(^7\) Appendix B presents the source of each variable in this and other sections of the analysis chapter.

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Gender = gender, where male is 1 female is 0

Edu = years of formal education (e.g. 1 year college = 13 years)

Lowinc = if respondent's household income is less than $25,000,

Lowinc = 1, otherwise Lowinc = 0

Medinc = if respondent's household income is between $25,001 and $50,000, Medinc = 1, otherwise Medinc = 0

House = the number of members in the respondent's household.

Rent = 1 if the respondent is renting, 0 otherwise

The summary statistics for the variables of interest are as follow:

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caught</td>
<td>0.00</td>
<td>10.00</td>
<td>2.42</td>
<td>2.41</td>
</tr>
<tr>
<td>Penalty</td>
<td>0.00</td>
<td>10.00</td>
<td>3.41</td>
<td>2.91</td>
</tr>
<tr>
<td>Age</td>
<td>18.00</td>
<td>85.00</td>
<td>31.78</td>
<td>14.25</td>
</tr>
<tr>
<td>Gender</td>
<td>0.00</td>
<td>1.00</td>
<td>0.55</td>
<td>0.50</td>
</tr>
<tr>
<td>Edu</td>
<td>3.00</td>
<td>25.00</td>
<td>14.91</td>
<td>2.30</td>
</tr>
<tr>
<td>Lowinc</td>
<td>0.00</td>
<td>1.00</td>
<td>0.44</td>
<td>0.50</td>
</tr>
<tr>
<td>Medinc</td>
<td>0.00</td>
<td>1.00</td>
<td>0.38</td>
<td>0.49</td>
</tr>
<tr>
<td>House</td>
<td>0.00</td>
<td>30.00</td>
<td>2.73</td>
<td>1.95</td>
</tr>
<tr>
<td>Rent</td>
<td>0.00</td>
<td>1.00</td>
<td>0.60</td>
<td>0.49</td>
</tr>
</tbody>
</table>

The minimum and maximum on caught and penalty are due to their Likert scale measurement from 0 to 10. In the case of caught, 10 represents a "great chance" of getting caught; in the case of penalty, 10 represents "great severity."

Table 5.2 shows the logit estimation of the data for the Becker model.

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Table 5.2
Becker Model Logistical Results

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>S.E.</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caught</td>
<td>-0.20</td>
<td>0.06</td>
<td>-3.49*</td>
</tr>
<tr>
<td>Penalty</td>
<td>0.00</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Age</td>
<td>-0.08</td>
<td>-0.20</td>
<td>-4.98*</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.16</td>
<td>0.22</td>
<td>-0.72</td>
</tr>
<tr>
<td>Edu</td>
<td>0.01</td>
<td>0.05</td>
<td>0.09</td>
</tr>
<tr>
<td>Lowinc</td>
<td>-0.51</td>
<td>0.39</td>
<td>-1.32</td>
</tr>
<tr>
<td>Medinc</td>
<td>-0.55</td>
<td>0.37</td>
<td>-1.48</td>
</tr>
<tr>
<td>House</td>
<td>-0.12</td>
<td>0.08</td>
<td>-1.42</td>
</tr>
<tr>
<td>Rent</td>
<td>0.28</td>
<td>0.30</td>
<td>0.92</td>
</tr>
<tr>
<td>Constant</td>
<td>2.40</td>
<td>1.07</td>
<td>2.25*</td>
</tr>
</tbody>
</table>

*Significant at α=.05, two sided

Before the interpretation of the model it is important to test for goodness of fit, to perform hypothesis test on the variables, and to test for significant coefficients. The Hosmer-Lemeshow tests whether the data fits the logistic curve. The test generates a p-value; a good fit is a p-value greater than .05, and in general the larger the p-value the better the goodness of fit. The Hosmer-Lemeshow p-value for this data is .357; thus the logit model fits the data.

A common test to determine if all of the slope coefficients are zero is the likelihood ratio test. The test is similar to the F test in an ordinary least squares regression. The likelihood ratio statistic is distributed chi-squared, and for this data set the calculated value is 87.89 with 9 degrees of freedom. The corresponding p-value is zero, so the joint hypothesis that the coefficients are all equal to zero is rejected.

One commonly used method of determining the significance of the variables in maximum likelihood is the asymptotic t-test. The t-test is performed using the standard errors from the information matrix and critical points from the standard normal table.
The *t*-tests of the coefficient for Caught, Age and the constant are significant at the five percent error level.

Because of the properties of the logit model, magnitudes of the coefficients are not easily interpretable; however, the signs of the coefficients are useful in revealing the direction of the effects. For example, because the coefficients of Caught and Age are negative, as their values increase the probability of theft decreases. For the categorical variables one could tell which trait is more likely to result in theft. For example, if gender proved to be statistically significant and the sign on the coefficient was negative, males would be more likely to steal.\(^8\)

Due to the difficulty of interpreting the meaning of the coefficients directly, other indirect methods of interpreting the logistical results are employed. Two of the most popular methods are examining the marginal effects and the elasticities of particular independent variables. Table 5.3 shows marginal effects calculated at the means, the means of the individual marginal effects, and the elasticity at the means.

<table>
<thead>
<tr>
<th>Significant Independent Variables</th>
<th>Calc at the Means</th>
<th>Mean of Individual Effects</th>
<th>Elasticity at Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caught</td>
<td>-0.035</td>
<td>-0.033</td>
<td>-0.373</td>
</tr>
<tr>
<td>Age</td>
<td>-0.014</td>
<td>-0.014</td>
<td>-1.990</td>
</tr>
</tbody>
</table>

An ordinary least squares regression produces a straight line; a binary logistical regression does not. Therefore, the slope is constantly changing. The slope could be increasing at an increasing or decreasing rate depending on what point is chosen along

---

\(^8\) The gender example is used for illustrative purposes; it is not statistically significant.
the function. The marginal value calculated at the mean is the slope of the logit function at the mean of the variable in question holding all other variables constant at their means. For Caught, evaluated at its mean, a one-unit increase in the Likert Scale value (i.e., a person moves one unit - out of 10 - closer to believing she has a "great chance of getting caught") translates into a decrease in the probability of theft of 3.5 percentage points. The average marginal effect, or the average slope as one goes from the lowest value to the highest value of an independent variable, is largest for Caught. This suggests that every unit increase for a person at the minimum who thinks there is a "great chance of getting caught" results in a 3.3 percentage point reduction in probability of theft. This is an average result that continues until the person reaches the maximum point where the individual thinks there is no risk of getting caught. The elasticity is a ratio of percentage changes. Thus, for Caught (at its mean) a ten percent increase would lead to a 3.7 percent decrease in the probability of theft. These statistics help to explain the magnitudes of the independent variables.

The previous values are exact measurements of the magnitudes of effects. The elasticity and the marginal effects calculated at the mean do not represent the entire range of responses but one point along the function. On the other hand, the mean of the marginal effects represents the entire range of responses. Although this statistic can be useful, it is very sensitive to extreme points on the function. Therefore because the first two statistics only explain one point along the function and the last statistic is sensitive to outliers, it is useful to look at the logistical function in graphical form. A graph of this type shows the relationships along the entire function.
Figure 5.1 shows how the individual’s perception of the probability of getting caught effects the probability she engages in theft. The probability of theft for a person believing she has a limited chance of getting caught (a value of one on the Likert scale) is approximately 27 percent. On the other extreme, a person believing she has a “great chance of getting caught” (a value of ten on the Likert scale) would likely steal approximately 7.5 percent of the time. The fact that Caught is statistically significant allows us to conclude that people who believe that they have a high chance of getting caught will have a lower probability of committing theft, all else constant.

Age is the other independent variable that is significant. The average person responding to the survey was approximately 32 years old. According to the regression when a person representing the average case turns 33 her expected probability of stealing would go down by 1.4 percentage points. In fact the data explains that on average 1.3
percentage point change in probability of theft could be expected across the spectrum of ages. Figure 5.2 shows the effect of age on the probability of stealing over the range of ages. Because age is significant, the conclusion can be drawn that an older person is less likely to steal than a younger person.

![Figure 5.2](image)

#### Figure 5.2
**Becker Model:**
**Effect of Age on the Probability of Theft,**
**All Else Constant at the Means**

Table 5.4 presents results measuring the predictive capability of this logit model. It looks at the predicted values of \( p(\text{Theft}) \) and compares them with the actual values. The model predicts buying correctly 92.7 percent of the time. The model predicts theft with only 25.5 percent success. Together the model correctly predicts legal and illegal behavior 73.2 percent of the time. Seventy one percent of the sample legally acquired their last music. In this case, since a person guessing “legal” every time would be correct 71 percent of the time, the 71 percent guess works nearly as well as the model.
Table 5.4
Successful Prediction by the Becker Model

<table>
<thead>
<tr>
<th>Observed</th>
<th>Predicted</th>
<th>Predicted</th>
<th>Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Buy</td>
<td>Theft</td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>329</td>
<td>26</td>
<td>92.7%</td>
</tr>
<tr>
<td>Actual</td>
<td>329</td>
<td>37</td>
<td>25.5%</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td>73.2%</td>
</tr>
</tbody>
</table>

Table 5.4 does not represent the goodness of fit of the model. The temptation to use the table for goodness of fit should be resisted according to Kennedy (2003). In addition, there is disagreement among scholars concerning the usefulness of the predictive ability of the logit model. The rational for such disagreement can be strong in cases were odds of a particular outcome are relatively high. Failure to steal music by respondents in this study is a case in point. Predicting the lack of stealing adds little to the understanding of criminal behavior. Since the goal of this study is to explain criminal behavior and furnish guidelines for its potential modification, prediction is not particularly relevant.

5.3 Theory of Reasoned Action Results

Separate analysis of the logit regression for the same sample of 500 individuals allowed for a test of the Theory of Reasoned Action. Testing of the model followed the equation:

\[ p(\text{theft}) = f(\text{attitude, norms}) \]

Where,

\[ p(\text{theft}) = \text{the probability that a person steals} \]
Norms = subjective norms, a respondent's belief of what people important to them think about music theft

Attitude = the sum of the respondent's attitudes toward performing music theft

Table 5.5 shows the statistics for the variables of interest.

Table 5.5
Descriptive Statistics of Theory of Reasoned Action

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>-20.00</td>
<td>20.00</td>
<td>1.02</td>
<td>6.50</td>
</tr>
<tr>
<td>Norms</td>
<td>-10.00</td>
<td>10.00</td>
<td>.12</td>
<td>5.91</td>
</tr>
</tbody>
</table>

The minimum and maximum values of -10 to 10 of norms reflect the minimum and maximum of their Likert scale measurement. The minimum and maximum of attitude are due to the aggregation of five attitude questions based upon the literature. This formula contains two questions about the industry (e.g., how fair is the amount artists earn, and how do you feel about the music industry) are averaged together and summed with three questions about personal beliefs (e.g. how ethical is theft, does it harm anyone, and should people who engage in it be punished). The range of the attitude scale, from +20 to -20, was arbitrary set to remind the reader that it includes five Likert scale values. These values represent attitude toward the act as well as ethical considerations as defined by the literature.

The following paragraphs discuss hypothesis tests. To evaluate the model three hypothesis tests are considered. The first test is the Hosmer-Lemeshow test to determine if the logit framework is appropriate for the data. It generates a p-value of .41, and
because .41 is greater than .05 this hypothesis test confirms that the model is appropriate for the data set. The second hypothesis test, used to evaluate whether or not the coefficients are zero, is the likelihood ratio test. The likelihood ratio statistic is distributed chi-squared. The test value for this model is 52.9 with 2 degrees of freedom. This value is greater than the critical value of 5.99 at the five percent error level. Thus, the joint hypothesis that all coefficients equal zero is rejected.

The next step in the analysis is to determine the significance of the variables in question with the classic t-test. A calculated value is compared to a critical value. In this model all coefficients are significant at the five percent error level. Table 5.6 presents these results.

<table>
<thead>
<tr>
<th>Table 5.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory of Reasoned Action Logistical Results</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Attitude</td>
</tr>
<tr>
<td>Norms</td>
</tr>
<tr>
<td>Constant</td>
</tr>
</tbody>
</table>

*Significant at α=.05, two tailed

The signs of the coefficients in a logit regression are particularly important. In this case both coefficients are negative. This means as the values of Attitude and Norms increase the probability of theft decreases. This is in line with the hypothesis of the theory chapter.

While the coefficients convey information regarding the direction of the effects, they reveal little about the magnitude of the effects. As discussed in the previous section, understanding the magnitude of the effects requires the calculation of the marginal
effects, the mean of the marginal effects and the elasticities. Table 5.7 presents these results.

Table 5.7
Magnitude of the Effects Theory of Reasoned Action Significant Independent Variables

<table>
<thead>
<tr>
<th></th>
<th>Calc at the Means</th>
<th>Mean of Individual Effects</th>
<th>Elasticity at Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>-0.013</td>
<td>-0.013</td>
<td>-0.050</td>
</tr>
<tr>
<td>Norms</td>
<td>-0.015</td>
<td>-0.014</td>
<td>-0.007</td>
</tr>
</tbody>
</table>

For Attitude evaluated at its mean, a one-unit increase in the index value (i.e., a person moves one unit closer to believing theft is ethical, no one gets harmed, etc.) translates into an increase in the probability a person will steal by 1.3 percentage points. The average marginal effect of norms between the values of -10 to 10 is -1.4 percentage points. The elasticity at the means is a ratio of the percentage changes; thus for Attitude a ten percent increase implies a .5 percent decrease in the probability of the theft, all else constant calculated at the means. Figure 5.3 helps to illustrate these effects.
A person with an attitude presumed to be completely accepting of stealing is represented by the value –20. According to the regression, an individual with this attitude has approximately a 60 percent probability of stealing. As attitude changes toward disapproval of theft, the probability of theft decreases to below 10 percent.

Changes in normative beliefs also change the probability that theft will occur. Figure 5.4 illustrates how different values of normative beliefs affect the summed value of attitudes.
The graph shows how Norms affect the relationship between Attitudes and theft. Norms are held constant at five levels as Attitude varies. The values of -20 for Attitude and -10 for norms represent an individual presumed to be the most likely thief. The regression shows that a person representing these values would likely steal around 78 percent of the time. This is the highest percentage of theft explained by the regression. This is represented on graph by the line with diamonds at the point where Attitude equals -20. Now, consider a person with the same Attitude value, -20, but with a Norm value representing no permissiveness to stealing (norm=10). This person has a far lower probability of theft than a person whose friends think it is ok; they would likely steal 42 percent of the time. As shown in Figure 5.4 Norms has the greatest impact on the
probability of theft when people have attitudes permissive to theft. It can be seen that there is a wider range of probabilities for a person with a permissive attitude as Norms change than at the other extreme. As Norms change from $-10$ to $+10$, a person with permissive attitudes probability of theft varies approximately 35 percentage points, while a person with a non-permissive attitudes probability of theft varies by 10 percentage points. As attitude becomes more permissive toward theft the change in normative beliefs has less of an impact on the probability of theft. The variables of the theory tested here are significant and helpful in explaining theft behavior.

Table 5.8

<table>
<thead>
<tr>
<th>Observed</th>
<th>Predicted</th>
<th>Predicted</th>
<th>Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Buy</td>
<td>Theft</td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>328</td>
<td>27</td>
<td>92.4%</td>
</tr>
<tr>
<td>Actual</td>
<td>115</td>
<td>30</td>
<td>20.7%</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td>71.6%</td>
</tr>
</tbody>
</table>

Table 5.8 presents results measuring the predictive capability of this logit model. It looks at the predicted values of $p(\text{theft})$ and compares them with the actual values. The model predicts buying correctly 92 percent of the time. The model predicts theft with only 20 percent success. Together the model correctly predicts legal and illegal behavior 72 percent of the time. The naive model, which considers all people to be buyers, predicts correctly 71 percent of the time. The predictive power of this model is minimal, however as noted earlier this may have little bearing on the conclusions of the study.
5.4 Augmented Becker Model Results

As discussed in the theory section, the augmented model explains how variables in both the Theory of Reasoned Action and the Becker model may affect crime through changes in expected utility. It takes the functional form:

\[
p(\text{Theft}) = f[\text{Attitude, Norms, Caught, Penalty, Age, Gender, Edu, Lowinc, Medinc, House, Rent}] \]

Because the variables are the same as in the two previous analyses, the summary statistics are not presented.

The same hypothesis tests discussed in the previous sections were used to determine the validity of the model. The Hosmer-Lemeshow test generated a p-value of .099 suggesting that the model fits. The likelihood ratio test generated the test statistic of 111. With eleven degrees of freedom the critical value is approximately 20; thus the slope coefficients are not zero.

The likelihood ratio test was also conducted to determine if additional variables were useful in explaining the data. Two hypothesis tests were performed; one testing the augmented model with variables from the Theory of Reasoned Action (restricting the Becker variables), and one testing the model with just the Becker variables (restricting the Theory of Reasoned Action variables). These tests resulted in a p-value of zero, confirming that the augmented Becker model is more useful in explaining the probability of theft than either of the other models alone.

Table 5.9 presents the results for the logit regression on this model. Significance is determined by the asymptotic \(t\)-test and is denoted by a star.
Table 5.9
Augmented Becker Model Logit Results

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>S.E.</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caught</td>
<td>-0.19</td>
<td>0.06</td>
<td>-3.23*</td>
</tr>
<tr>
<td>Penalty</td>
<td>0.05</td>
<td>0.04</td>
<td>1.05</td>
</tr>
<tr>
<td>Attitude</td>
<td>-0.06</td>
<td>0.02</td>
<td>-3.10*</td>
</tr>
<tr>
<td>Norms</td>
<td>-0.05</td>
<td>0.02</td>
<td>-2.27*</td>
</tr>
<tr>
<td>Age</td>
<td>-0.07</td>
<td>0.02</td>
<td>-4.35*</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.28</td>
<td>0.23</td>
<td>-1.71</td>
</tr>
<tr>
<td>Edu</td>
<td>0.02</td>
<td>0.06</td>
<td>0.27</td>
</tr>
<tr>
<td>Lowinc</td>
<td>-0.69</td>
<td>0.40</td>
<td>-1.71</td>
</tr>
<tr>
<td>Medinc</td>
<td>-0.70</td>
<td>0.38</td>
<td>-1.83</td>
</tr>
<tr>
<td>House</td>
<td>-0.10</td>
<td>0.09</td>
<td>-1.22</td>
</tr>
<tr>
<td>Rent</td>
<td>0.28</td>
<td>0.31</td>
<td>0.91</td>
</tr>
<tr>
<td>Constant</td>
<td>1.91</td>
<td>1.10</td>
<td>1.74</td>
</tr>
</tbody>
</table>

*significant at α=.05, two sided

The coefficients on Caught, Attitude, Norms, and Age are all significant. Because each of these coefficients is negative, an increase in their value represents a decrease in the probability of theft. Determining the magnitude of these effects requires the calculation of the three other statistics presented in Table 5.10.

Table 5.10
Magnitude of Effects of Augmented Becker Significant Independent Variables

<table>
<thead>
<tr>
<th></th>
<th>Calc at the Means</th>
<th>Mean of Individual Effects</th>
<th>Elasticity at Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caught</td>
<td>-0.032</td>
<td>-0.010</td>
<td>-0.354</td>
</tr>
<tr>
<td>Attitude</td>
<td>-0.011</td>
<td>-0.008</td>
<td>-0.050</td>
</tr>
<tr>
<td>Norms</td>
<td>-0.008</td>
<td>0.031</td>
<td>-0.005</td>
</tr>
<tr>
<td>Age</td>
<td>-0.012</td>
<td>0.011</td>
<td>-1.728</td>
</tr>
</tbody>
</table>

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The interpretation of Table 5.10 is similar to the previous analysis. For example, with Attitude evaluated at its mean, a one-unit increase in the index value (i.e., a person moves one unit closer to believing theft is ethical, no one gets harmed, etc.) translates into an decrease in the probability a person will steal by 1.1 percentage points. The average marginal effect of attitude as it varies from -20 to 20 is -.8 percentage points. The elasticity at the means is a ratio of the percentage changes. Thus, for Attitude a 10 percent increase implies a .5 percent decrease in the probability of the theft, all else constant calculated at the means. The following figures (Figures 5.4, 5.5, 5.6 and 5.7) help to illustrate these effects.

**Figure 5.5**
Augmented Model: Effect of Caught on the Probability of Theft, All Else Constant at the Means

![Graph showing the effect of the individual's estimate of the chance of getting caught on the probability of theft.](image_url)
Figure 5.6
Augmented Model: Effect of Attitude on the Probability of Theft, All Else Constant at the Means

Figure 5.7
Augmented Model: Effect of Normative Beliefs on the Probability of Theft, All Else Constant at the Means
Within the framework of the augmented model, each graphed variable affects the probability of theft holding all other variables constant at their means. The next figures are similar to Figure 5.8. However, instead of holding all variables constant, one other variable (Caught for Figure 5.9, Attitude for Figure 5.10 and Norms for Figure 5.11) is fixed at different levels. The following graphs show how age interacts with the three remaining significant variables.
Figure 5.9
Augmented Model: Effect of Age at Five Levels of Caught, All Else Constant at the Means

Figure 5.10
Augmented Model: Effect of Age at Five Levels of Attitude, All Else Constant at the Means
The interpretation of figures Figure 5.9, 5.10, and 5.11 are very similar to the interpretation of Figure 5.4 in the previous section.

The variables of Caught, Attitudes, Norms, and Age are significant in explaining theft within the augmented model. The augmented model also performs better than the Becker, or Theory of Reasoned Action models at predicting the behavior, as demonstrated in Table 5.11.

### Table 5.11
Successful Prediction by the Augmented Becker Model

<table>
<thead>
<tr>
<th>Observed</th>
<th>Predicted</th>
<th>Predicted</th>
<th>Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Buy</td>
<td>Theft</td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>323</td>
<td>32</td>
<td>91.0%</td>
</tr>
<tr>
<td>Actual</td>
<td>92</td>
<td>53</td>
<td>36.6%</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td>75.2%</td>
</tr>
</tbody>
</table>

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These results suggest that the Augmented Model is capable of predicting theft behavior correctly 75.2 percent of the time. This is 5.1, 2, and 3.6 percentage points better than the naive model (picking the most likely response each time), the Becker Model, and the Theory of Reasoned Action respectively.
Chapter 6

IMPLICATIONS AND CONCLUSIONS

The goal of this thesis was to examine empirically the highly complex nature of criminal behavior using theories tailored to identifying criminal antecedents. This approach allowed for the quantifiable evaluation of differing policy prescriptions designed to eliminate or reduce crime. Fundamental characteristics of the data choice, collection methods, theory, and analysis contributed to accomplishing the analysis presented in this thesis. Exploiting these characteristics facilitated the testing of the economic model of crime, the social psychological model and the development and testing of a theory encompassing both the economic and social psychological perspectives termed the augmented Becker model.

6.1 The Use of Individual Level Data

Individual level data has not typically been used in criminal studies due to the difficulty of collecting individual data and the belief that people do not wish to discuss their criminal activities. The reliance on aggregated data presents problems for, and limits the ability of, the researcher examining criminal behavior economically. Survey data is not without its problems and requires changing the way variables have been measured. Nevertheless, the advantages of using individual data outweigh the difficulty of its collection. Thus, this thesis uses a unique crime (music theft) and survey data to test three models of criminal behavior.
One benefit of individual level data is the avoidance of statistical problems. Empirical studies employing aggregate level data in their analysis have generated some impressive results (see Chapter 2); however, the use of aggregate data can be troublesome. Endogeneity stemming from the likely dependency of the probability of arrest or the size of the police force on the crime rate is difficult to handle econometrically. This simultaneity problem causes inconsistency in ordinary least squares estimators. Two-stage and three-stage least squares have been used by Ehrlich (1973), Phillips and Votey (1976), and Craig (1987) in an attempt to eliminate this problem. Although, it is probable that the results of these studies were corrupted by unobserved heterogeneity (Cornwell, Trumbull, 1994).

In addition to avoiding the econometric problems associated with aggregate data, there are three major advantages to the use of individual data. First, the theory of crime explains individual behavior, thus the need for individual data. Underlying the model is the idea that one can manipulate the crime rate by changing variables that affect individuals’ expected utility return from the criminal behavior. Because of this, the economic model of crime should be estimated with individual level data.

The second advantage of the individual level data approach is that survey data allows for the testing of additional variables. In this thesis it is theorized that the chance of getting caught and punishment are not the only variables that affect expected utility; individuals’ attitudes and their perceptions of what people important to them think (subjective norms) are also theorized to have an influence on individuals’ expected utility.
Collecting data on these variables requires a survey. The new variables make it possible to expand upon the conclusions of the traditional economic approach; however, because of the reliance on aggregate data, the crime literature reports no attempt to integrate these variables into the framework of the economic model of crime and empirically test it.

The final advantage of individual level data involves precise definition of all variables in the study. Collecting survey data allows for the direct selection of information to be gathered. This is an improvement to relying on data collected by others because it measures the exact variables suggested by the theory and makes it easier to identify the data’s strengths and weaknesses.

While avoiding some problems associated with aggregate data, individual level data is not above reproach. The fact that surveys can be subpoenaed and the information can be used to convict the respondent is a major concern. Because of the sensitivity of the information, it is important to keep information anonymous and choose a crime that people feel comfortable discussing; music theft was identified as just such a crime.

The use of music theft as the dependent variable – as opposed to the crime rate – is one example of a change in the way individual variables are measured. Traditional aggregate economic variables such as the number of arrests per crime reported, and the penalty for each crime must also be altered. These variables were replaced with the individuals’ reporting of their belief regarding the chance of getting caught and their belief regarding the likely penalty.

9 This idea comes from the attempts that have been made to manipulate attitudes and subjective norms to reduce the crime rate. The “friends don’t let friends drink and drive” campaign is an appeal to subjective norms, while Mother’s Against Drunk Driving uses video of children killed by drunk drivers to influence attitudes.
The use of music theft as the basis for the collection of individual data makes it possible to exploit the advantages of this approach and avoid the problems inherent in the aggregate approach. Individual data allows econometric problems to be avoided, improved testing of individual behavior, new conclusions to be drawn, and more accurate definition of the variables. Because of these benefits, survey data provides the foundation for the empirical analysis of this thesis.

6.2 Comparison of the Three Models

The three models presented in the analysis chapter are the Becker model, the Theory of Reasoned Action, and the augmented Becker Model. The Becker model is essentially aimed at exploring the relationship that Caught and Penalty have with theft. The Theory of Reasoned Action is a more general behavioral model. It is concerned with how the variables of attitudes and subjective norms affect behavior. The augmented Becker model is an attempt to combine elements from each of the proceeding models in an effort to provide a better understanding of criminal behavior.

All three of these models were tested using the technique of binary logistical regression. Binary logistical regression does not have a meaningful equivalent to the correlation coefficient of least squares regression. Because of this fact, there are no easy comparisons between the models. However, several scholars have devised formulas that approximate the correlation coefficient. Results of these formulas are presented in Table 6.1.
Table 6.1
Logistic Approximations for the Square of the Correlation Coefficient

<table>
<thead>
<tr>
<th></th>
<th>Becker</th>
<th>TORA</th>
<th>Augmented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estrella</td>
<td>0.17</td>
<td>0.10</td>
<td>0.22</td>
</tr>
<tr>
<td>Maddala</td>
<td>0.16</td>
<td>0.10</td>
<td>0.20</td>
</tr>
<tr>
<td>Crag-Uhler</td>
<td>0.23</td>
<td>0.14</td>
<td>0.28</td>
</tr>
<tr>
<td>McFadden</td>
<td>0.15</td>
<td>0.09</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Table 6.1 provides further evidence that the augmented Becker model explains criminal behavior better than the Becker or the Theory of Reasoned Action alone. This is due to the fact that every calculation of the proxy $R^2$ value is greater in the augmented model than in the other two. The Becker model and the Theory of Reasoned Action explain criminal behavior. Integrating the two models, however, within the framework of the economic model, increases the explanatory power of the model and provides those interested in crime prevention more options to reduce criminal activities.

6.3 Policy Implications

The economic model of crime is not geared toward ending crime _per se_; the goal is to minimize the efficiency loss associated with it. Thus, many economic studies have been designed to aid policy makers in selecting the optimal level of expenditures on enforcement (to increase the probability of getting caught) and penalties. For example, if criminal enterprises were costing society $500 a year it would be worth up to $500 to stop the activity. The basic economic model would try to stop the crime by dividing up the $500 among the most effective crime prevention strategies. More specifically, the marginal cost of prevention is compared to the marginal benefit of the reduction in crime. This could be a mix between funding more police and increasing the penalty, or all the...
money could go to increasing the penalty.\textsuperscript{10} This model does not include the social psychology variables. The addition of attitudes and norms gives policy makers more options to achieve an optimal solution to the problem of criminal behavior.

Understanding how this model helps in achieving an optimal crime strategy requires revisiting the results. In the logistic output of the augmented Becker model the coefficients for chance of getting caught, attitude, subjective norms and age were significant. Because of their significance, it could be concluded that manipulation of any of these variables could affect an individual's probability of engaging in music theft.\textsuperscript{11} Consider the possibility of changing what an individual representing the average case thought to be the probability of getting caught by one unit. This change would decrease theft by 3.2 percentage points. A similar change in attitude would decrease theft by 1.1 percentage points. A one unit increase in norms would decrease theft by .8 percentage points. If the costs of increasing these variables by one unit were known, it would be possible to choose the best course of action. This would help generate the optimal reduction of theft.

6.4 Industry Application

Implications exist for firms interested in preventing theft. Business and institutions suffering losses from theft could benefit from employing the same techniques described in the previous section. In addition businesses and institutions have other options available when attempting to mitigate the negative aspects of theft. This thesis

\textsuperscript{10} Some penalties carry additional cost to society (i.e., lost wages, lost productivity, etc); however for the illustrative case presented here this fact will be ignored.

\textsuperscript{11} Age, of course, cannot be manipulated.
has examined music theft; thus the examples used here are directly related to the music industry.

Typically, a company wishing to prevent theft has fewer resources available than the government to combat theft. For example they cannot arrest and convict people. Nevertheless, a company wishing to prevent theft may have means to deter theft unavailable to the government. In the case of music theft, age is a significant variable. The older the respondent, the less likely she is to steal. Based upon this result, the music industry may wish to introduce a differential pricing model based upon age. Student discounts and other offers aimed at young people might help to reduce theft in this segment of the population.

Another factor that the industry can influence is attitudes. Because perception of the music industry and recording artists are a component of the attitude variable, image is also important. Confidentiality clauses about the artists' compensation and marketing promoting qualities of the industry are some of the strategies that could be employed to reduce music theft.

Firms have a clear motivation for understanding theft behavior. According to the results, altering acquisition behavior requires changing the chance of getting caught, attitudes, norms, and age. Firms interested in persuading more people to buy their products have some ability to manipulate these variables.

6.5 Suggestions for Further Study

The economic model of crime and the Theory of Reasoned Action have been the basis for many studies. While each model has been evaluated separately, this thesis may be the first attempt to integrate these concepts within the framework of utility
maximization. In any case, there is little economic literature that encompasses both of these approaches at once. The implications of the augmented Becker model, along with the significance of the results, suggest that further research on this subject could be beneficial in gaining a better understanding of criminal behavior.

There are four specific suggestions for further study presented here. The first is to attempt to verify the conclusions of this study using other criminal behaviors. People might be forthcoming in divulging information about other criminal behaviors such as highway speed limits or hunting and fishing regulations. Even more deviant behaviors might be explored because, in general, respondents were forthcoming about their behavior. When administering the questionnaires the University’s Institutional Review Board appeared more concerned with the information than the respondents. If admitting to music theft is indicative of other studies on crime, survey responses should be obtainable.

The second suggestion for further study involves the variable for subjective norms. In the literature this is described as what others important to the individual in question think of her behavior. Generally, this variable is disaggregated into questions such as, “What would your co-workers think about this behavior?” and “What would your family think?” For this thesis this was not the case. The variable for subjective norms came from the Likert response\textsuperscript{12} to question 26 on the survey: “The fact that many other people download music for free makes it ok for me to do it.” While this question offers a decent proxy for the variable subjective norms, it would have been desirable to have disaggregated information consistent with the literature.

\textsuperscript{12} -10 = Strongly Disagree, 10 = Strongly Agree
Another area of study that could prove worthwhile would be an examination of the relationship of actions already undertaken to decrease the crime rate through manipulation of norms and attitudes. In Montana there are marketing efforts aimed at reducing the consumption of alcohol among young people, one of which is entitled the "most of us" campaign. This effort offers statistics claiming most people do not engage in alcohol consumption. It is an appeal to subjective norms. Evaluating campaigns of this sort would be valuable. The ability to alter norms and—if norm alteration proved successful—the effect changing norms have on behavior could provide policy guidance.

The final suggestion for further study presented in this thesis concerns evaluation of the costs associated with manipulation of the variables from the augmented Becker model. Consider the following scenario:

Increasing the chance of getting caught by one Likert scale unit decreases the probability of theft by 5 percentage points. Changing normative beliefs by increasing one Likert scale unit also decreases the probability of theft by 5 percentage points. It cost $50,000 to hire one more police officer; study indicates that the addition of this officer is expected to increase the likelihood someone gets caught by one Likert scale unit. A marketing campaign (e.g. billboards, print ads and commercials) is designed to influence normative beliefs. The campaign costs $200,000 and is expected to increase the Likert scale value of norms by one unit.

In this simple scenario, it is obvious a new police officer should be hired. The same five percent reduction in crime can be reached by a quarter of the expenditure. Some complications arise due to the changing slope of the logistical function. However, it is possible to calculate incremental increases or decreases in probability of theft and their corresponding Likert scale values. Because this possibility exists, knowing the cost

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13 Assume these figures are at the mean, all else constant.

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associated with moving a person along the Likert scale could help determine the best policy options. Techniques are available to evaluate these costs; their evaluation could prove worthwhile in determining the policy mix that best reduces criminal behavior.

6.6 Conclusion

Past economic studies of crime concentrated on aggregate data. This prevented the testing of some of the variables shown in this thesis to explain criminal behavior. Analysis of data collected from surveys revealed the traditional economic variable of Caught explains music theft. In addition to this result, Attitude and Norms were also significant in explaining theft. Integrating these results into the augmented Becker model revealed that all three variables explain theft more accurately. This result would not have been possible using aggregate data.

It has been shown that evaluating criminal behavior by analyzing individuals’ responses introduces Attitudes and Norms into the classic economic model of crime. Personal guilt (Attitudes), peer pressure (Norms), and the chance of getting caught (Caught) affect the expected utility of a criminal act. In theory, decreasing the expected utility gain from engaging in crime lowers the crime rate. Those wishing to decrease the crime rate need only reduce the crime’s expected utility. These two new variables extend the options available to parties interested in moderating criminal behavior. The results of this thesis establish an encouraging addition to the economics of crime. Combined with future empirical work, these results have the potential to inspire approaches that are more effective in minimizing the losses associated with criminal activity.
Appendix A

QUESTIONNAIRE SAMPLE

1) Do you have access to a computer?
   ____ Yes
   ____ No

2) If yes, is it connected to the Internet?
   ____ Yes
   ____ No

3) If yes, what type of Internet connection do you most often use?
   ____ Dial-Up (a slower connection)
   ____ DSL, Cable, Satellite, T1 or greater (a faster connection)

4) What ways do you have available to play recorded music? (check all that apply)
   ____ CD player (portable, auto or home)
   ____ Cassette Tape player
   ____ MP3 player (separate from your computer)
   ____ Computer
   ____ Phonograph (record player)

5) Have you acquired audio music in the last 6 months? (Purchased or downloaded for free or paid)
   ____ Yes
   ____ No

   If NO go to question number 35.

Consider the last time you acquired music (purchased or downloaded for free or paid).

6) _________ How many songs did you acquire (average CD has about 12-15 songs)?

7) On what form was the music?
   ____ CD
   ____ Data file (MP3, WAV, etc)
   ____ Tape
   ____ Record
8) Where did you get this music (check only one)?
   a)_____Bought NEW at a physical store
   b)_____Bought NEW at an Internet store
   c)_____Bought USED at a physical store
   d)_____Bought USED at an Internet store (e.g. half.com, amazon.com, etc.)
   e)_____Internet paid download (e.g. iTunes, Musicmatch, Rhapsody, BuyMusic.com, etc)
   f)_____Mail order (e.g. music club), advertisement (e.g. TV, radio), catalog
   g)_____Internet unpaid download (e.g. Kazaa, Morpheus, iMesh, etc.)
   h)_____You copied borrowed music from a friend
   i)_____Friend copied music for you
   j)_____Borrowed and returned
   k)_____Borrowed and did not return
   l)_____Promotional free music

Answer questions 9 a and b only if you paid for the last music (a,b,c,d,e or f).

9a) $__________________How much money did you spend?

9b) $__________________Assume the music had a higher price than you paid, how high
   would that price have to reach before you acquire the music without paying for it? (Go to
   question 11)

Answer question 10 a and b only if you checked g, h, or i in question 8.

10a) $__________________How much would this music have cost you if you bought? (Give
     your best estimate)

10b) $__________________How much less would your estimated price need to have been
     for you to have bought this music?

The following questions relate to how much time you spent in the process of getting the
music. Please read all four before answering them.

11) _______MINUTES How much time did you spend deciding which
     music you wished to get (research, reading reviews from magazines or the Internet,
     comparing music, listening to samples on the web, etc..) for this last music?

12) _______MINUTES How much time did you spend getting to the source
     of music you obtained (travel time to store, web surfing time, calling friends, etc.)?

13) _______MINUTES How much time did you spend actually acquiring
     this music (checkout time, browsing time, burning time, download time, etc.)?

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14) _______ MINUTES If you borrowed audio music from the library, friend, etc, and copied onto a personal source (e.g. CD, tape, computer) please add the time you spent returning the audio music.

The following questions relate to your attitudes – please mark vertically on the scale on where your attitude fits with the question. (When we say “free” music we do not mean promotional, streaming radio, or music provided by the artist for free.)

15) How much do you enjoy music?
Dislike Music
-10 0
Very Much Enjoy
10

16) How much do you enjoy copying your own tapes or CD’s?
Dislike
-10 0
Very Much Enjoy
10

17) How much does marketing (e.g. packaging, lyrics, posters, fan clubs, etc.) influence your purchase of audio music?
No Influence
-10 0
Great Influence
10

18) I use the web to discover new music.
Never
-10 0
Always
10

19) How comfortable are you using a computer?
Uncomfortable
-10 0
Comfortable
10

20) I am good at finding free music on the Internet.
Strongly Disagree
-10 0
Strongly Agree
10
21) I am good at finding paid music on the Internet.
Strongly Disagree
-10
0
Strongly Agree
10

22) How would you rate the quality of the sound on the last recording you acquired (not the artist)?
Terrible
-10
0
Outstanding
10

23) How fair is the amount recording artists earn?
Very undeserved
-10
0
Very deserved
10

24) How would you rate your attitude towards the recording industry?
Highly unfavorable
-10
0
Highly favorable
10

25) No one is harmed when people copy music.
Strongly Disagree
-10
0
Strongly Agree
10

26) The fact that many other people download music for free makes it ok for me to do it.
Strongly Disagree
-10
0
Strongly Agree
10

27) Recently some people have been prosecuted for copying music without permission. What is your opinion about them being prosecuted?
Strongly Disagree
-10
0
Strongly Agree
10
28) Acquiring individual songs of choice is better than acquiring a full album/CD.
    Strongly Disagree                      Strongly Agree
    -10                                    0                                    10

29) There could be risks such as bad quality or a virus from downloading unpaid music.
    How do you perceive such risks?
    None                                    Great
    0                                       10

30) If you illegally attained music, what is your chance of getting caught?
    None                                    Great
    0                                       10

31) If you should steal music and got caught, how severe do you think your penalty
    would be?
    None                                    Great
    0                                       10

32) How ethical is it to copy music without permission?
    Unethical                                Completely Ethical
    -10                                      0                                    10

33) Do you have a major credit card/debit (e.g. Master Card, Visa)?
    _____ Yes
    _____ No

34) How comfortable are you using the card to make on-line purchases?
    Very Uncomfortable                     Completely Comfortable
    -10                                      0                                    10

35) _____ What is your age?

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36) What is your gender?
    _____ Male
    _____ Female

37) ___________ Years of formal education (e.g. 1 year college = 13 years)?

38) What is your household income?
    _____ Less than $25,000
    _____ $25,000 - $50,000
    _____ More than $50,000

39) _____ Number of people in your household

40) Do you rent or own your dwelling?
    _____ Rent
    _____ Own

41) __________________________ Interviewer Name

42) ____________ Neighborhood Number
Appendix B

VARIABLE SOURCES

This appendix discusses the source of the variables measured for each model in the same order the models are presented in the text. First, recall that the Becker model includes the following variables: Caught, Penalty, Age, Gender, Edu, Lowinc, Medinc, House, and Rent. Every data point used for the analysis presented here comes from individual responses to specific questions on the questionnaire.

- Caught = question 30
- Penalty = question 31
- Age = question 35
- Gender = question 36
- Edu = question 37
- Lowinc = question 38
- Medinc = question 39
- House = question 40

The Theory of Reasoned Action requires some calculation for the variables as they are created using several different questions. Recall that variables necessary to test this model are Attitude and Norms. Attitude was calculated by taking an average of the individual's beliefs about the music industry (question 24) and music artists (question 23). The result is believed to capture the individual's feelings toward the people or firms...
harmed by theft. This result is added to the individuals personally held beliefs about the legitimacy of music theft, believed to be captured by the average of three factors: (1) whether they believe music theft causes harm to other (question 25), (2) their belief regarding the fairness of being prosecuted (question 27), and (3) the personal ethical belief of the individual towards theft (question 32). The following formula shows how attitude was computed:

\[
\text{Attitude} = \frac{1}{2}(\text{question 23} + \text{question24}) + \frac{1}{3}((\text{question25}*-1) + (\text{question27}) + (\text{question32})*-1)
\]

This formula produces a number in the range of -20 to 20. Question 25 and 32 are multiplied by negative one for proper scaling (e.g., so negative 20 represents the most permissive attitude toward theft).

The variable Norms is also multiplied by a negative one. Thus, the smaller the response the more likely the individual is to steal. Norms comes from the respondent’s answer to question 26 only.

The augmented Becker model uses the same variables as the Becker model and the Theory of Reasoned Action. No changes are made in their computation from the description above.
REFERENCES


