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DOES VIOLENT CRIME CAUSE INDIVIDUALS TO JOIN GANGS?

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Honors Thesis

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Abstract: This paper examines the hypothesis that violent crime causes gang membership. I construct a theoretical model of the individual's decision to join a gang based on the protection that gang membership provides from violent crime. Using data from the National Longitudinal Survey of Youth 1997 cohort and a probit specification, I test three different measures of the threat of violent crime: a dummy variable for experiencing gun violence, a dummy variable for being the victim of repeated bullying, and a dummy variable for being the victim of a violent crime. In my regressions, I find support for the hypothesis that violent crime causes gang membership. Each measure of violent crime is positive and highly statistically significant across all of my regression specifications.

I. Introduction

Gang activity is frequently covered by the media today as part of a number of growing urban problems. As of 1970, 270 cities in the United States reported having problems with gangs (Miller 2001). By 1998, the number of cities with gangs had increased to 2,547. Similarly, the number of counties reporting gang problems rose from 101 in 1970 to 1,152 in 1998. As of 2008, the estimated number of gangs in the United States was 26,500, for a total estimated 1 million gang members (Department of Justice 2008 and Department of Justice 2009). Casual observation suggests that gangs are the source of violence in their communities. For this reason they are specifically targeted by special law enforcement units and millions of dollars have been spent on anti-gang programs nationwide (Department of Justice 2006).

This paper argues that the conventional wisdom that gangs cause violence is at most only half the story. Rather than accepting that gangs are exogenous to violence, I test the hypothesis that violent crime causes gang membership. I find support for this hypothesis. Each measure of violent crime is positive and highly statistically significant across all of my regression specifications.

The next section of this paper reviews the economic literature on gangs. The third section outlines a theoretical model of the gang membership decision. The fourth section provides a conceptual model of gang membership and discusses my ideal data set. In the fifth section I discuss my actual data. I analyze Probit regression results in the sixth section. I consider the robustness of my results in the seventh section. The last section concludes with policy implications and describes directions for future research.

II. A Review of the Literature

II.I Economic Theory

Several theoretical models of gang formation appear in the economics of crime literature, based on the idea that gangs form to earn financial rewards from crime. Konrad and Skaperdas (1998) develop a theoretical model of extortion of productive enterprises by organized criminal gangs and consider how police enforcement affects gang behavior. Their model shows that the main harm from extortion comes from its distortion of investment decisions and that gangs may increase their criminal activity in response to increased police intervention. Mansour et al. (2001) develop a theoretical model for the formation of gangs as suppliers within black markets and examine the effects of crime deterrence on the market structure within which gangs operate. Their model shows that as police attempt to shut down suppliers in these black markets, the targeted gang splinters into competing units. This causes the black market to transition from a monopoly to a competitive market, which leads to lower prices and higher numbers of illegal goods sold**.** If violence is complementary to production, then police intervention will result in more violence occurring. This model is particularly timely given the recent battles between government troops and Mexican drug gangs (Grinberg 2009)**.** Poutvaara and Priks (2007) develop a model of criminal gangs in which gang leaders benefit financially from crime committed by gang members. The gang leader faces a trade-off between the benefits of larger gangs and the benefits of more violent crime. Changes in exogenous factors such as the unemployment rate can change the optimal size of the gang from the gang leader's point of view.

Other models in the literature examine non-financial incentives for gang formation. Vertinsky (1999) applies the economics of information and organization to criminal street gangs and models gangs as institutions for enforcing agreements. Essentially, criminals lack access to legal protection of their contracts and property rights and must rely on gangs and violence to enforce agreements. She also

considers implications of her model for criminal law. Skaperdas (2001) and Kumar and Skaperdas (2008) argue that gangs can be thought of as providing primitive state functions like protection. This model fits well with other theoretical models of the private protection of property rights in the absence of state institutions, like Dixit (2004). These models show that while gangs do provide protection for members, their emerging monopoly on force also allows them to engage in extortion. This is very similar to the behavior of other criminal organizations that provide protection services, such as the Mafia (Anderson 1995, Gambetta 1995, Varese 2001, Bandiera 2003, Hill 2006).

II.II Previous Empirical Research

Empirical research on gangs has focused on three issues: the functional role of gangs, the effects of gangs, and the reasons individuals join gangs. Cook et al. (2005) analyze the role of gangs in overcoming transaction costs in underground gun markets using data from Chicago gangs. By utilizing reputational and relational mechanisms, gangs overcome the information asymmetry and search cost problems in underground gun markets. They also find that many youths join gangs in order to gain access to guns.

Skarbek (2008) focuses on a specific California-based prison gang and how it prevents predation and misconduct within the gang using formal constitutional constraints. This system of institutionalized rules constrains the behavior of gang leaders. He also finds that the prison gang uses a series of dispute resolution mechanisms to reduce conflicts, which is important given that gang membership in this particular gang is for life. Leeson (2007) and Leeson (2009) consider the similar problem of internal predation among 17th and 18th century pirates. He highlights the use of a written constitution, along with voting procedures, as an internal governance mechanism. The interesting finding in all of these papers is that extra-governmental, criminal gangs have found a variety of ways to reduce conflict among their own members.

Not all of the empirical evidence suggests that gangs reduce conflict. In contrast, Grogger (2002) finds that civil gang injunctions in LA lead to a decline in violent crime by 5 – 10 percent in target areas during the first year. This suggests that banning gang members from certain locations reduces violent crime in those areas.

Mocan and Tekin (2006) investigate the effects of Catholic school attendance on the likelihood that teenagers engage in illegal behaviors such as joining gangs, selling drugs, and committing property crime using propensity score matching estimators. Their estimation method is intended to control for the endogeneity of school choice. They find that attending a Catholic school significantly reduces the propensity of males and females to join gangs.

Levitt and Venkatesh (2000) analyze the finances of a drug-selling gang in Chicago. They explain gang participation using a tournament model, where gang members are competing to become the next gang leader. Listokin (2005) uses Levitt and Venkatesh's data set to test the hypothesis that gang members are present oriented. This would imply that individuals join gangs because they heavily discount future punishment. The results suggest that gang members are future oriented, given the tournament wage structure.

Seals (2007) uses the National Longitudinal Survey of Youth 1997 cohort and a logit specification to determine if individuals join gangs when it is difficult to find a legitimate job. Among other controls, he includes the serious crime rate for each individual's county of residence, as well as dummies for witnessing someone getting shot in the pre-survey period and being the victim of a bully before the age of 12. Local labor market effects on gang participation are significant for individuals age sixteen and above.

Sobel and Osoba (2008) test the hypothesis that youth gangs form as protective associations using monthly Los Angeles gang membership data obtained from the LAPD. They conduct granger causality tests and find that homicides and aggravated assaults granger-cause gang membership, while gang membership does not granger-cause violent crime. This is true even when the data is disaggregated to differentiate the Crips, Bloods, and Hispanic gangs.

In addition to empirical evidence from the economic literature, there is also a large sociological and criminological literature on gangs. In particular, there have been many studies based on ethnographic interviews of gang members. What do gang members say are the reasons they joined a gang? The two most common reasons are social reasons (i.e. to be with family or friends who are in a gang) and protection from violence (Jankowski 1991, Padilla 1992, Klein 1995, Decker and Van Winkle 1996, Thornberry et al. 2003, and Peterson et al. 2004). Less frequently, gang members say they joined in order to sell drugs or make money. Important for the protection model of gang membership, studies find that few youths are coerced into gang membership and that it is possible to refuse to join a gang without serious consequences (Decker and Kempf-Leonard 1991, Fleisher 1995, Fleisher 1998, and Freng and Winfree 2004, Peterson et al. 2004). On the issue of exit costs, studies find that short-term and marginal gang members can generally leave the gang costlessly, while long-term or core gang members may encounter retaliation from the former gang or even rival gangs if they attempt to leave (Decker and Van Winkle 1996, Decker and Lauritsen 2002). Moving away may be the lowest cost option in these circumstances.

This paper's contribution to the literature is two-fold. First, I construct a theoretical model of the individual's decision to join a gang based on the protection that gang membership provides from violent crime. Second, I run various probit regressions using the National Longitudinal Survey of Youth 1997 cohort to see if having been the victim of a violent crime causes individuals to join gangs. This is an

improvement since Sobel and Osoba (2008) did not use individual level data, and Seals (2007) did not include any measures of survey period violence in his sample. I use three measures of violence: the lagged value of a dummy variable for experiencing gun violence (like witnessing someone getting shot), the lagged value of a dummy variable for being the victim of repeated bullying, and the lagged value of a dummy variable for being a victim of violent crime. I also use a more complete set of control variables than any paper in the literature. For example, Seals (2007) did not control for variables that the literature suggests are important, such as knowing someone in a gang or selling drugs.

III. Theoretical Model

In this economic model, an agent's utility function is assumed to be twice continuously differentiable and represents a continuous, locally nonsatiated, strictly convex preference relation. Agents are assumed to have an endowment of time (t) in hours, with $0 < t \leq 24$. An agent's utility (U) is assumed to be a function of two things: consumption and feeling secure. Consumption (C) is equal to the wage (w) multiplied by the number of hours worked. I assume $\frac{\partial U}{\partial C} > 0$. Feeling secure (F) is a function of two things: the frequency of violent crime (V), and gang membership (M). The time spent in a gang is either 0 or some constant g, where $0 < g < t$[1]. I assume $\frac{\partial U}{\partial F} > 0$, $\frac{\partial F}{\partial M} \geq 0$, and $\frac{\partial F}{\partial V} < 0$. I also assume $\frac{\partial^2 F}{\partial M \partial V} > 0$, which implies that there is a complementarity between violent crime and gang membership[2]. This means that as the frequency of violent crime increases, the contribution of gang membership to feeling secure increases. The last assumption is $\frac{\partial F}{\partial M} = 0$ if $V = 0$. This means that

[1] I ignore the intensive margin of gang membership, since I only observe the extensive margin in my data. Here I also implicitly assume that exiting the gang is costless. This should be reasonable for short-term gang members, which constitute most of the gang members in my data. If gang exit is costly, a more appropriate model would be one based on rational addiction (Becker and Murphy 1988).

[2] Alternatively, drop this assumption. The utility maximization results will then be ambiguous regarding the agent's choice. Thus, my regression results can be viewed as estimating the sign of this second derivative.

membership in a gang does not make the agent feel any more secure if the frequency of violent crime is zero.

Since the agent's utility function represents a locally nonsatiated preference relation, a utility maximizing agent will not leave any time left unused. Thus, there are only two possible utility maximizing choices. Either the agent will spend all of his time working, or he will join a gang and spend the remaining amount of time working. To see how the frequency of violent crime affects this choice, first assume that there is no violent crime. By the last assumption, gang membership does not make the agent feel more secure. The agent is thus choosing between two bundles: one contains consumption of w*t and some feeling of security (F_1), the other contains consumption of w*(t-g) and F_1. The agent will thus maximize utility by choosing not to join a gang. Now consider a situation where there is some frequency of violent crime (V > 0). The agent now has a choice between two bundles: one contains consumption of w*t and some feeling of security (F_2), the other contains consumption of w*(t-g) and an amount of feeling secure equal to $F_2 + \frac{\partial F}{\partial M}$. The agent's utility maximizing choice of bundle depends on the agent's preferences. Specifically, it depends on whether the agent prefers consumption of w*g or feeling more secure by $\frac{\partial F}{\partial M}$. Consider what happens as the frequency of violence increases, holding all else constant. The cost of choosing to join a gang, w*g remains the same. As V increases, F_2 decreases and $\frac{\partial F}{\partial M}$ increases. Thus, the benefit of joining a gang increases. This leads to my theoretical prediction: as violent crime increases, more people will choose to join a gang.

IV. Conceptual Model

At a more conceptual level, gang membership = f(social networks, threat of violence, interest in selling drugs, opportunity cost of membership). Knowing people in a gang and having an interest in selling drugs constitute the non-security related utility of gang membership. These variables have been

identified as important in the ethnographic interview literature. The threat of violence was previously discussed in the theoretical model. The opportunity cost of gang membership has generally been identified in the economic literature as foregone employment opportunities.

To test the theory, one should use very detailed individual level panel data. Ideally, I would observe each individual's opportunity cost of joining a gang (i.e. foregone wages), the number of people each individual knows in a gang, and their fear of being a victim of violent crime (a probability estimate). Controlling for the costs and the non-security related utility of gang membership, as each individual's fear of being a victim of violent crime increases, their probability of joining a gang should increase.

V. Actual Data

To test my theory, I use data from the National Longitudinal Survey of Youth 1997 cohort. It follows youths born between 1980 and 1984, and the survey is designed to be a representative sample of the youth population aged 12-16 in the US in 1997. It is collected annually (from 1997 through 2006) and contains a variety of individual and family characteristics, as well as variables measuring educational, criminal, and labor market outcomes. It is a very common microeconometrics dataset.

In the NLSY97, a gang is defined as "a group that hangs out together, wears gang colors or clothes, has set clear boundaries of its territory or turf, and protects its members and turf against other rival gangs through fighting or threats". These are not highly organized drug-selling gangs, they are not gangs exclusively organized around other monetary incentives (i.e. extortion), they do not operate internationally, nor are they prison gangs. These are youth gangs, of the type found in high schools and urban neighborhoods (though not exclusively). Note that protection for members is part of the definition of a gang.

Summary statistics from the NLSY97 data are shown in table 1. Any individual with missing values in the original survey was dropped. My data set consists of a total of 38,114 observations for the period 1997-2005. There are 548 observations of gang members in the data set. Although about half the data set is male, the sample of gang members is approximately 75% male. Gang members are also more likely to be Black or Hispanic and are more likely to live in an urban area than non-gang members. Gang members tend to be younger and have completed less education relative to the rest of the sample. Gang members also have lower cognitive ability than non-gang members, as measured by the Armed Services Vocational Aptitude Battery (ASVAB) test[3]. Gang members tend to come from families with lower household incomes. Gang members are much more active in selling drugs than non-gang members, and are more likely to carry around guns. Gang members are much more likely to have a friend or relative in a gang. It is not surprising that gang members are much more likely to experience gun violence. They are more likely to be a victim of repeated bullying, but not a victim of a violent crime.

[3] The ASVAB score is a percentile score for specific age cohorts based upon four components of the ASVAB which attempts to measure mathematical and verbal ability. The ASVAB is similar to the Armed Forces Qualification Test (AFQT).

Table 1

Summary Statistics

	Full-Sample	Gang Members	Non-Gang Members
Gang Member	0.014 (0.119)	--	--
Sex	0.495 (0.500)	0.763 (0.426)	0.491 (0.500)
Black	0.228 (0.420)	0.350 (0.477)	0.226 (0.418)
Hispanic	0.174 (0.379)	0.274 (0.446)	0.172 (0.378)
Lives in suburban area	0.496 (0.500)	0.370 (0.483)	0.498 (0.500)
Lives in urban area	0.322 (0.467)	0.421 (0.494)	0.320 (0.467)
Highest grade completed	11.289 (2.506)	9.536 (1.829)	11.315 (2.506)
Age	18.376 (2.741)	17.027 (2.281)	18.395 (2.741)
Household Income	55750.87 (54881.44)	34096.12 (36176.34)	56066.76 (55044.65)
Number of times sold drugs in last year?	1.696 (22.487)	18.491 (82.276)	1.450 (20.267)
Number of times carried gun in last 30 days?	0.236 (2.175)	2.701 (7.034)	0.199 (1.993)
Friend in a Gang?	0.091 (0.288)	0.682 (0.466)	0.082 (0.274)
ASVAB Score	49.722 (29.281)	28.962 (25.522)	50.025 (29.223)
Gun Violence*	0.031 (0.173)	0.202 (0.402)	0.028 (0.166)
Bullying Victim*	0.033 (0.180)	0.060 (0.238)	0.033 (0.178)
Violent Crime Victim*	0.011 (0.103)	0.011 (0.105)	0.011 (0.103)

Note: Sample contains 38,114 observations with 548 Gang members. All variables are dummy variables except Highest-grade completed, Age, Household income, Number of times sold drugs, Number of times carried gun, and ASVAB score. Means are shown with standard deviations in parentheses. *Summary statistics for gun violence, bullying victim, and violent crime victim reflect the 26,715 observations, the 27,024 observations, and the 33,292 observations without missing data for these questions, respectively.

VI. Actual Model and Results

I will test my theoretical prediction by estimating the following equation:

$$Gang_{i,t} = \beta_1 + \beta_2\theta_i + \beta_3\boldsymbol{\chi}_{i,t} + \beta_4\sigma_{i,t-1} + \beta_5\boldsymbol{\delta}_i + \beta_6\Omega_{i,t} + \beta_7\boldsymbol{\lambda}_{i,t} + \beta_8\boldsymbol{\rho}_{i,t-1} + \varepsilon_{i,t}$$

where $Gang_{i,t}$ is an indicator for current gang membership. I will therefore estimate this equation with a probit functional form. θ is a vector of individual i's time-invariant characteristics. These characteristics include ASVAB score, race, and gender. $\boldsymbol{\chi}$ is a vector of individual i's characteristics at time t. These characteristics include age, age-squared, citizenship status, highest-grade completed in school, and enrollment in school. σ is a vector of individual i's characteristics at time t-1. These include having a job, serving time in a correctional facility (such as a jail, prison, or juvenile detention facility), frequency of drug selling in the past year, frequency of carrying a gun in the past 30 days, gang membership, and knowing a friend or relative in a gang. δ is a vector of individual i's time-invariant family characteristics. These are dummies for each parent's level of education, and an indicator for the presence of the father during the first survey period. Ω is a vector of individual i's family characteristics at time t. These characteristics include household income and number of children in the household. λ is a vector of the characteristics of individual i's location at time t. These include regional dummies, Metropolitan Statistical Area (urban, suburban, and rural dummies), and the regional unemployment rate. ρ is a measure of violent crime experienced by individual i at time t-1. $\varepsilon_{i,t}$ is a standard normal error term. Economic theory predicts that the sign on β_8 will be positive.

There are two estimation issues with the above regression equation. Pairwise correlation coefficients suggest multicollinearity between age, age-squared, and highest-grade completed. I leave it

uncorrected. Additional problems arise from the lagged dependent variable. In many areas of microeconometrics, a lagged dependent variable is often included in a binary dependent variable model in order to test for state dependence[4]. A lagged dependent variable can also proxy for unobserved factors whose omission would bias estimation. However, this leads to the initial conditions problem. In my model, if the initial assignment of gang membership is not exogenous but is correlated with unobserved heterogeneity, then potentially spurious state dependence can be found[5]. This means that the estimates of the effect of the lagged dependent variable may be biased upwards. However, the bias does decrease with the length of the panel.

The first regression equation I estimate is the following Probit regression equation:

$$\text{Regression 1 (Probit): } \phi^{-1}(P) = \alpha + \beta_1(\text{Individual Characteristics}) + \beta_2(\text{Family Characteristics}) + \beta_3(\text{Gang Membership}_{t-1}) + \beta_4(\text{Shot}_{t-1}) + \text{Additional Controls}$$

Where: P is the probability of Gang membership being one, ϕ^{-1} is the inverse of the normal cumulative distribution function, Shot is a dummy variable for experiencing gun violence (like witnessing someone getting shot), and all of the other variables are defined as above. The results of Regression 1 are displayed in Table 2.

[4] See Chay and Hyslop (2000), Arellano and Carrasco (2003), and Halliday (2006).

[5] One way to solve this problem is to use pre-sample characteristics to instrument for the initial conditions. This is the fortuitous case of selection on observables.

Table 2 - Current Gang Membership Pooled Probit Regression Results

Dependent variable is Current Gang Membership Status (0 or 1) Independent Variables	Regression 1 Pooled Probit Coefficient (Z-statistic)	Regression 2 Pooled Probit Coefficient (Z-statistic)	Regression 3 Pooled Probit Coefficient (Z-statistic)
Male	0.363 (6.11)***	0.471 (8.41)***	0.452 (8.78)***
Age	0.122 (0.52)	0.103 (0.47)	0.131 (0.71)
Age-Squared	-0.003 (-0.42)	-0.003 (-0.44)	-0.004 (-0.75)
ASVAB	-0.004 (-3.15)***	-0.003 (-2.67)***	-0.004 (-4.27)***
Regional Unemployment Rate	0.239 (1.49)	0.085 (0.56)	0.089 (0.65)
Household Income (in thousands of dollars)	-0.002 (-2.71)***	-0.002 (-2.94)***	-0.001 (-2.23)**
L(Have a job?)	-0.086 (-1.43)	-0.098 (-1.82)*	-0.109 (-2.20)**
L(Went to a correctional facility?)	0.370 (2.47)**	0.198 (1.41)	0.147 (1.09)
L(Number of times sold drugs last year)	0.001 (1.41)	0.001 (2.34)**	0.001 (2.47)**
L(Number of times carried a gun in last 30 days)	0.016 (2.06)**	0.020 (3.41)***	0.018 (3.30)***
L(Friend in a Gang?)	0.542 (8.92)***	0.534 (9.66)***	0.557 (10.94)***
L(Gang Membership)	1.304 (15.59)***	1.375 (18.79)***	1.378 (20.43)***
L(Shot)	0.426 (4.54)***	-------	-------
L(Bully)	-------	0.317 (2.91)***	-------
L(Victim of Violent Crime)	-------	-------	0.707 (5.10)***
Intercept	-7.496 (-2.53)**	-6.657 (-2.65)***	-6.723 (-2.56)**
Number of Observations	26715	27024	33292
Pseudo-R^2	0.296	0.308	0.314
Log likelihood	-1186.240	-1466.104	-1720.637
Likelihood Ratio	chi2(71) = 997.99	chi2(71) = 1307.62	chi2(71) = 1573.04
Prob > Chi2	0.0000	0.0000	0.0000

Notes: * denotes statistical significance at the 10% level; ** denotes statistical significance at the 5% level; *** denotes statistical significance at the 1% level; Additional controls in each regression include: number of children in the household, race dummies, citizenship status dummies, region dummies, MSA dummies, time dummies, MSA and time interactions, school enrollment dummy, dummies for each parent's level of education, dummies for highest grade completed, and dummy for presence of father in first survey period.

With Regression 1, I find a positive coefficient on the lagged value of experiencing gun violence, as predicted by theory. This coefficient is statistically significant at the 1% level. The coefficients on being male, knowing a friend or relative in a gang, and gang membership last year are all positive and statistically significant at the 1% level. The coefficients on the number of times carried a gun and having been in a correctional facility are both positive and statistically significant at the 5% level. The coefficient on number of times sold drugs is positive but not significant. Household income and ASVAB

score both negative and statistically significant at the 1% level. The coefficient on age is positive while the coefficient on age-squared is negative, suggesting that as individuals get older they are more likely to join a gang (with the effect diminishing and then reversing over time). However, neither coefficient is significant. The coefficient on the regional unemployment rate is positive but not significant. The coefficient on having a job is negative but not significant.

I next estimate the following Probit equation:

$$\text{Regression 2 (Probit): } \phi^{-1}(P) = \alpha + \beta_1(\text{Individual Characteristics}) + \beta_2(\text{Family Characteristics}) + \beta_3(\text{Gang Membership}_{t-1}) + \beta_4(\text{Bully}_{t-1}) + \text{Additional Controls}$$

Where: P is the probability of Gang Membership being one, Bully is a dummy variable for being the victim of repeated bullying, and all of the other variables are defined as previously. The results of Regression 2 are displayed in Table 2.

With Regression 2, I find a positive coefficient on the lagged value of experiencing repeated bulling, as predicted by theory. This coefficient is statistically significant at the 1% level. Overall, the regression results are very similar. In this regression, the number of times carried a gun is statistically significant at the 1% level and the number of times sold drugs is significant at the 5% level. The coefficient on having a job is negative and statistically significant at the 10% level, while the coefficient on having been in a correctional facility is no longer statistically significant.

I then estimate the following Probit equation:

$$\text{Regression 3 (Probit): } \phi^{-1}(P) = \alpha + \beta_1(\text{Individual Characteristics}) + \beta_2(\text{Family Characteristics}) + \beta_3(\text{Gang Membership}_{t-1}) + \beta_4(\text{Victim}_{t-1}) + \text{Additional Controls}$$

Where: P is the probability of Gang Membership being one, Victim is a dummy variable for being the victim of a violent crime, and all of the other variables are defined as previously. The results of Regression 3 are displayed in Table 2.

With Regression 3, I find a positive coefficient on the lagged value of being the victim of a violent crime, as predicted by theory. This coefficient is statistically significant at the 1% level. The rest of the regression results are very similar to those of regression 2. The only changes are that household income is now only significant at the 5% level and having a job is now significant at the 5% level.

The marginal effects from regressions 1, 2, and 3 are shown in Table 3. They are calculated at the means of the covariates. Across regressions, the results mean that the probability impact of prior gang membership is between 6.9% and 9.5%. The probability impact of knowing someone in a gang is between 0.9% and 1.2%. For an individual with average characteristics, being exposed to gun violence raises the probability of being in a gang in the next period by 0.7%. Being the victim of repeated bullying raises the probability of being in a gang in the next period by 0.6%. Finally, being the victim of a violent crime raises the probability of being in a gang in the next period by 2.0%. These results are all statistically significant at the 1% level, except being the victim of repeated bullying, which is statistically significant at the 5% level.

Table 3 - Current Gang Membership Pooled Probit Marginal Effects

Dependent variable is Current Gang Membership Status (0 or 1) Independent Variables	Regression 1 Pooled Probit Marginal Effect (Z-statistic)	Regression 2 Pooled Probit Marginal Effect (Z-statistic)	Regression 3 Pooled Probit Marginal Effect (Z-statistic)
Male	0.003 (5.35)***	0.006 (7.37)***	0.005 (7.54)***
Age	0.001 (0.52)	0.001 (0.47)	0.001 (0.71)
Age-Squared	-0.00003 (-0.42)	-0.00003 (-0.44)	-0.00004 (-0.75)
ASVAB	-0.00004 (-3.06)***	-0.00004 (-2.63)***	-0.00005 (-4.14)***
Regional Unemployment Rate	0.002 (1.48)	0.001 (0.56)	0.001 (0.64)
Household Income (in thousands of dollars)	-0.00002 (-2.74)***	-0.00003 (-2.98)***	-0.00002 (-2.23)**
L(Have a job?)	-0.001 (-1.35)	-0.001 (-1.72)*	-0.001 (-2.04)**
L(Went to a correctional facility?)	0.006 (1.60)	0.003 (1.11)	0.002 (0.91)
L(Number of times sold drugs last year)	0.00001 (1.39)	0.00002 (2.29)**	0.00002 (2.43)**
L(Number of times carried a gun in last 30 days)	0.0001 (2.00)**	0.0002 (3.23)***	0.0002 (3.14)***
L(Friend in a Gang?)	0.009 (5.18)***	0.012 (5.88)***	0.011 (6.35)***
L(Gang Membership)	0.069 (5.62)***	0.095 (7.04)***	0.089 (7.43)***
L(Shot)	0.007 (2.80)***	-------	-------
L(Bully)	-------	0.006 (2.06)**	-------
L(Victim of Violent Crime)	-------	-------	0.020 (2.62)***

Notes: * denotes statistical significance at the 10% level; ** denotes statistical significance at the 5% level; *** denotes statistical significance at the 1% level; Additional controls in each regression include: number of children in the household, race dummies, citizenship status dummies, region dummies, MSA dummies, time dummies, MSA and time interactions, school enrollment dummy, dummies for each parent's level of education, dummies for highest grade completed, and dummy for presence of father in first survey period; Marginal effects are calculated at the means of the covariates.

Tables 4, 5, and 6 characterize the accuracy of regressions 1, 2, and 3. Regression 1 correctly predicts 22 of the 309 gang members and 26385 of the 26406 non-gang members. The model's prediction slightly beats a naïve rule of predicting all 0's. Regression 2 correctly predicts 42 of the 409 gang members and 26578 of the 26615 non-gang members. Again, the model's prediction slightly beats a naïve rule of predicting all 0's. Regression 3 correctly predicts 52 of the 479 gang members and 32764 of the 32813 non-gang members. As before, the model's prediction slightly beats a naïve rule of predicting all 0's.

Table 4 – Investigation of Regression 1

	True	True	
Classified	D	~D	Total
+	22	21	43
_	287	26385	26672
Total	309	26406	26715

Notes: Classified + if predicted Pr(D) >= .5, True D defined as Gang Member = 1, Correctly classified 98.85%, Naive Rule of all 0's correctly classifies 98.84%

Table 5 – Investigation of Regression 2

	True	True	
Classified	D	~D	Total
+	42	37	79
_	367	26578	26945
Total	409	26615	27024

Notes: Classified + if predicted Pr(D) >= .5, True D defined as Gang Member = 1, Correctly classified 98.51%, Naive Rule of all 0's correctly classifies 98.49%

Table 6 – Investigation of Regression 3

	True	True	
Classified	D	~D	Total
+	52	49	101
_	427	32764	33191
Total	479	32813	33292

Notes: Classified + if predicted Pr(D) >= .5, True D defined as Gang Member = 1, Correctly classified 98.57%, Naive Rule of all 0's correctly classifies 98.56%

Figures 1, 2, 3, 4, and 5 plot the residuals from Regression 3. Figure 1 plots the residuals vs. age. The plot shows the individuals for which the model over- and under-predicts gang membership. The residuals are largest in the middle of the age distribution. Figure 2 plots the residuals vs. ASVAB score. The plot shows that the model is missing (both under- and over-predicting) individuals at low ASVAB scores. Figure 3 plots the residuals vs. household income. As can be seen in the figure, the model does a good job of predicting individuals whose household income is high. The largest residuals are at low household income levels. Figure 4 plots the residuals vs. the number of times an individual sold drugs last year. The largest residuals occur at low levels of drug sales. Figure 5 plots the residuals vs. the number of times an individual carried a gun in the last 30 days. The residuals are largest on the two tails.

Figure 1: Residuals vs. Age

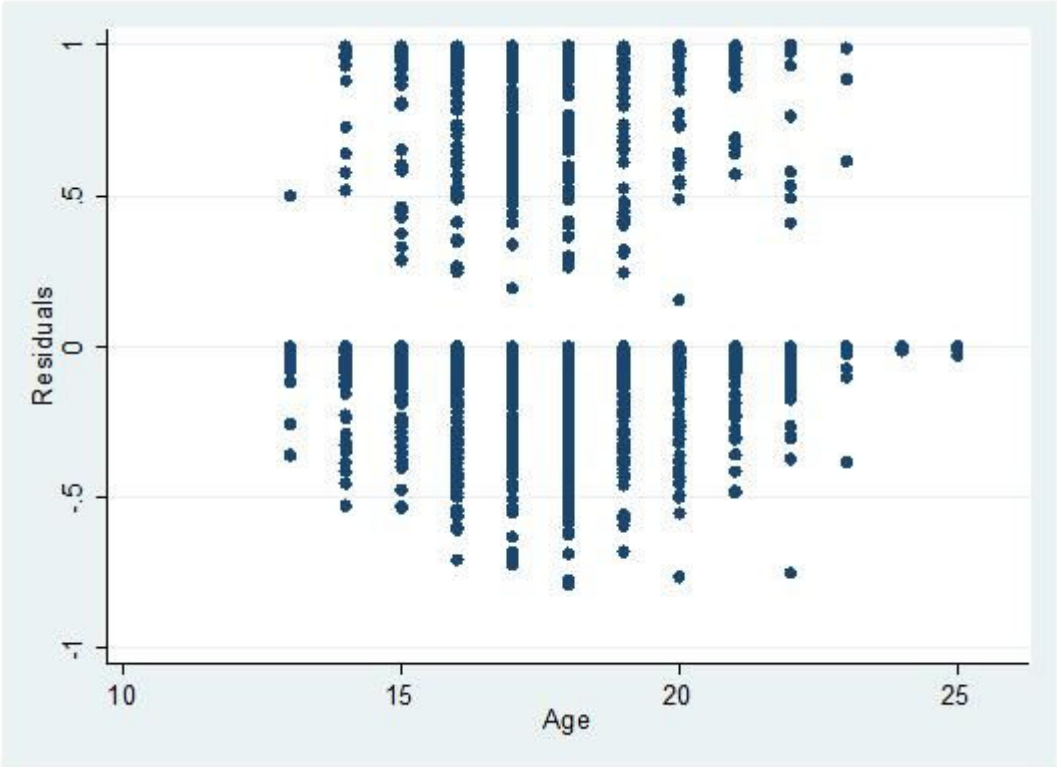


Figure 2: Residuals vs. ASVAB Score

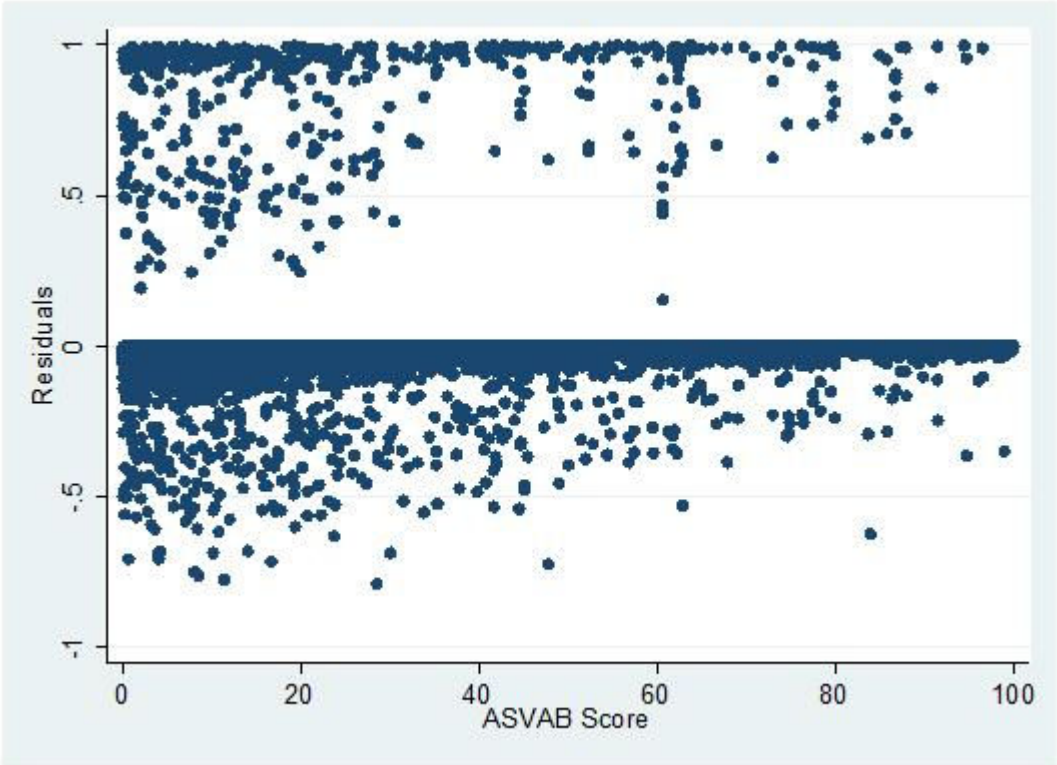


Figure 3: Residuals vs. Household Income

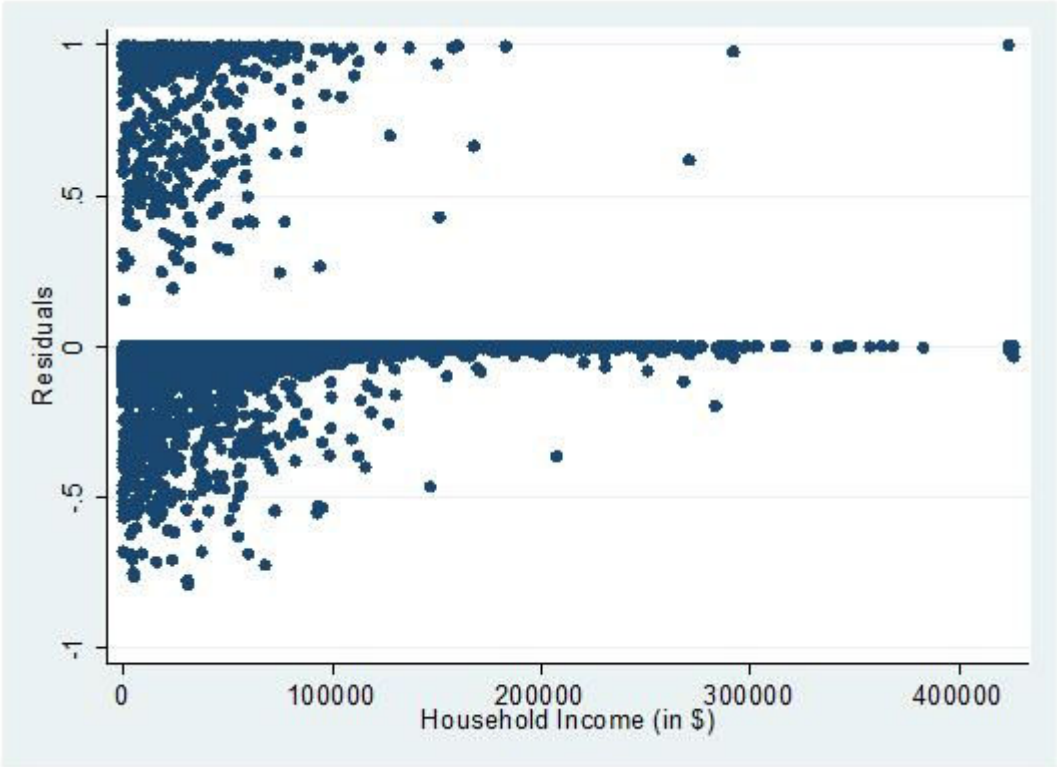


Figure 4: Residuals vs. Number of Times Sold Drugs in Last Year

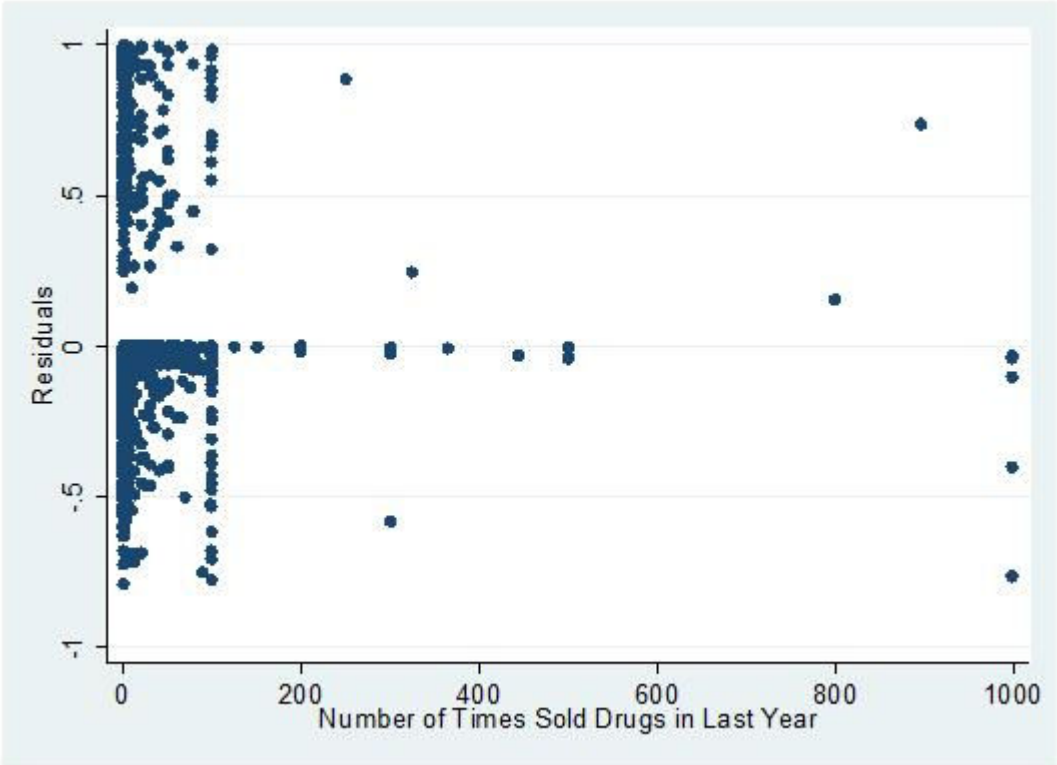


Figure 5: Residuals vs. Number of Times Carried Gun in Last 30 Days

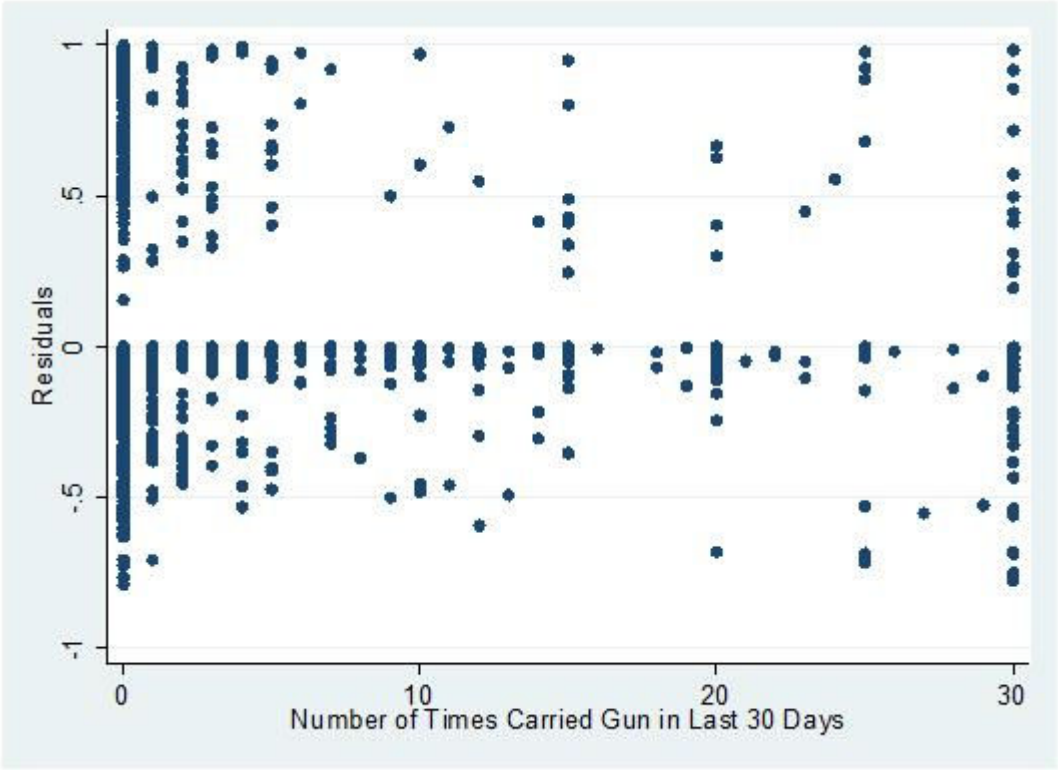


Figure 6 graphs the estimated probability of gang membership vs. ASVAB score using the estimates from regression 3. The blue line is the probit estimate of the probability of being a gang member as the individual's ASVAB score, when the individual was not the victim of violent crime last period and all other covariates are taken to be at their mean values. The orange line is the probability of being a gang member when the individual was the victim of violent crime last period, with all other covariates taken to be at their mean values. Each line is surrounded by a 95% confidence interval. The graph thus shows the difference in the probability of being a gang member because of violent crime. As can be seen in the figure, at its highest, being the victim of a violent crime raises the probability of joining a gang by 3%. This is about a 5 times higher probability of being a gang member. The impact is certainly statistically different from zero at all ASVAB scores. Figures 7, 8, and 9 graph the probability of gang membership vs. household income, the number of times carried a gun in last 30 days, and the

number of times sold drugs in last year, respectively. In Figure 7, being the victim of a violent crime raises the probability of being a gang member by at most 2%. This is again about a 5 times higher probability of gang membership. The confidence intervals show that the impact of being a victim of violent crime is not statistically different from zero at household incomes above approximately $330,000. Figure 8 shows the impact of being a victim of violent crime on the probability of being a gang member to be about 5%. This is about a 6 times higher probability that if the individual was not a victim of violent crime. The effect is statistically different from zero at all levels of carrying a gun. In Figure 9, the probability impact on gang membership of being a victim of violent crime is at most 20%. This is about a 3 times higher probability than when the individual was not a victim of a violent crime. The confidence intervals show that the impact is not statistically different from zero when the individual sold drugs more than 800 times a year.

Figure 6: Probability of Gang Membership vs. ASVAB Score

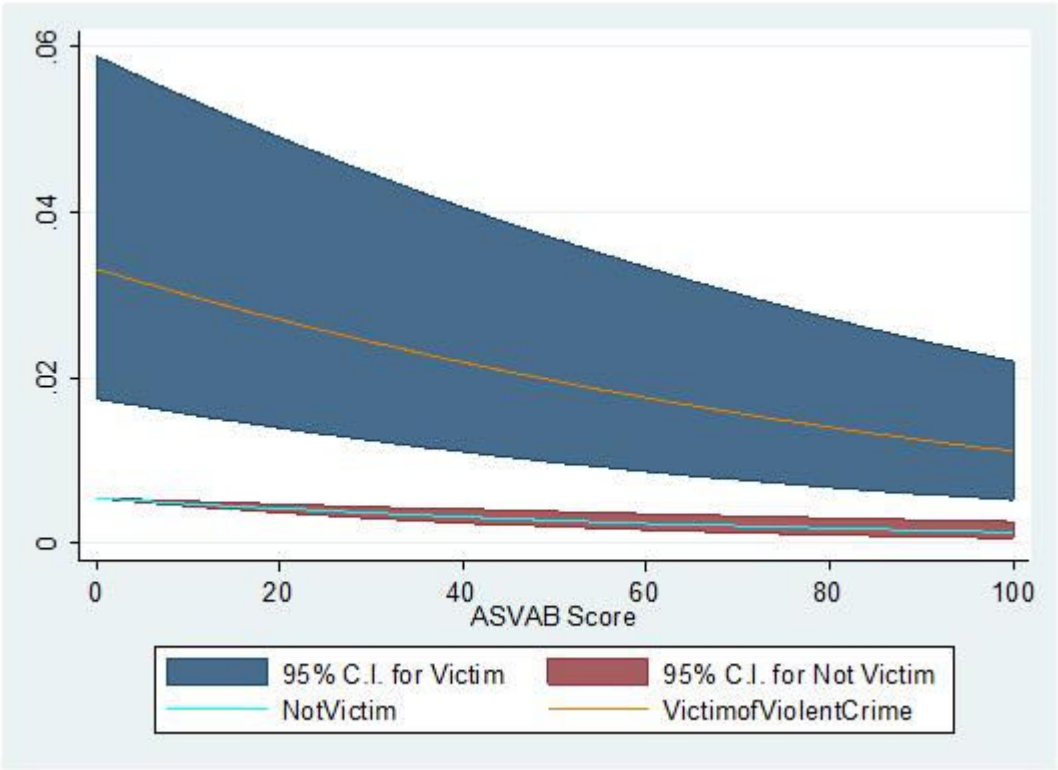


Figure 7: Probability of Gang Membership vs. Household Income

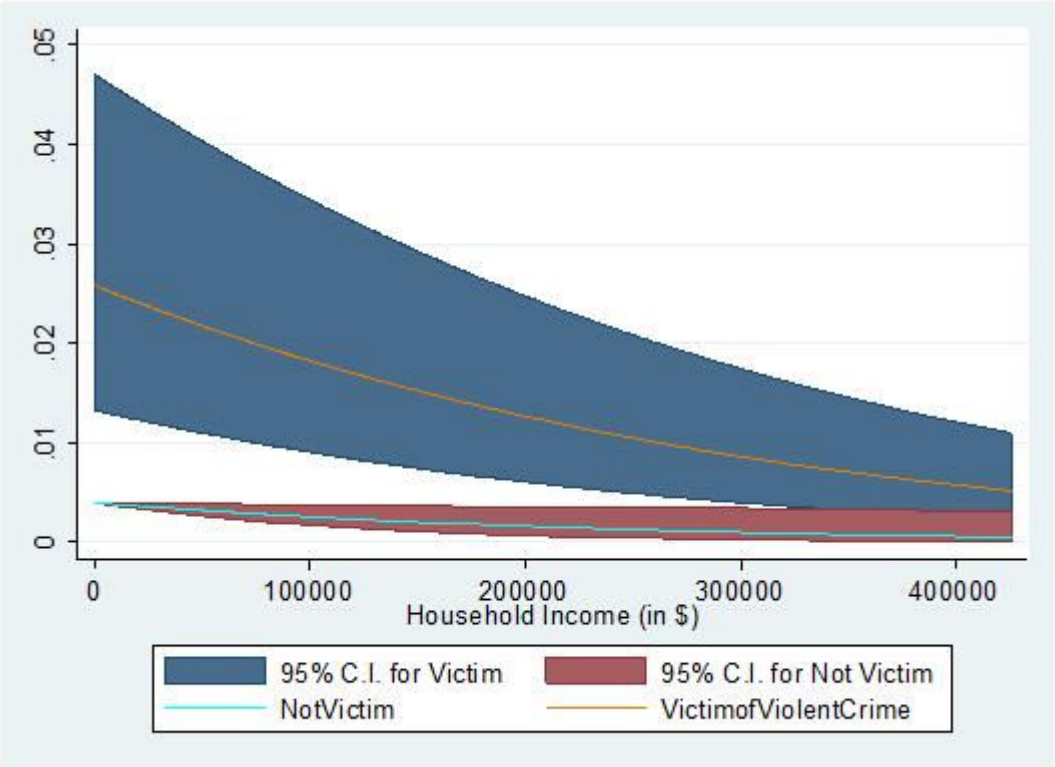


Figure 8: Probability of Gang Membership vs. Number of Times Carried A Gun In Last 30 Days

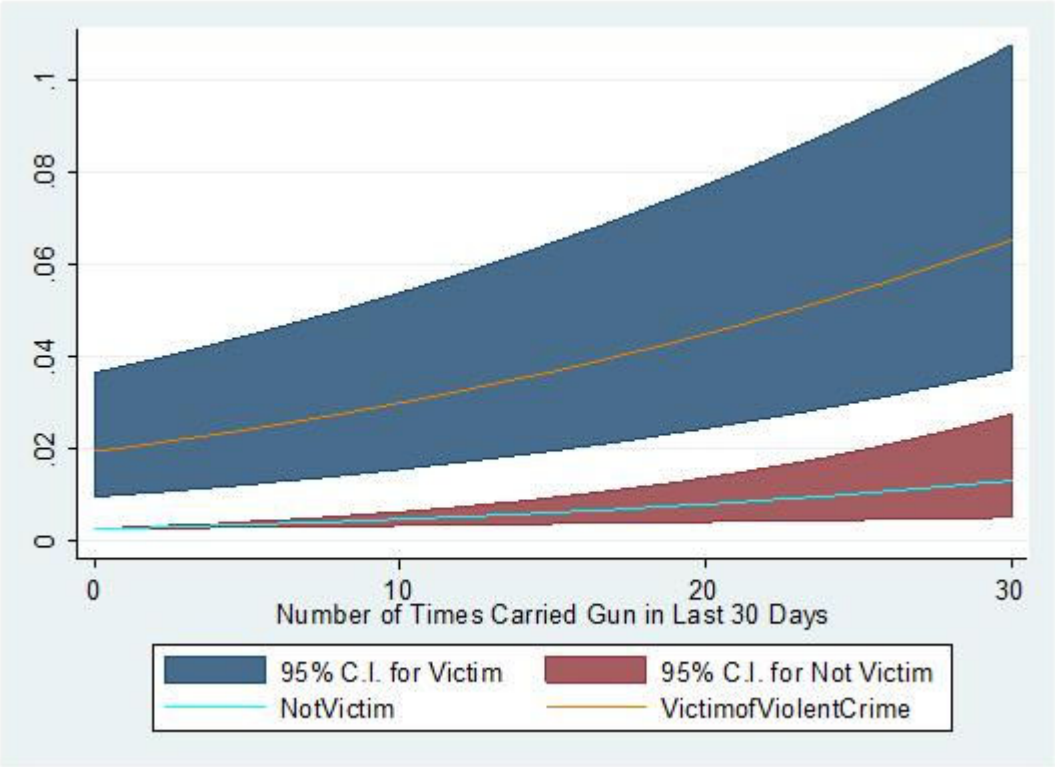
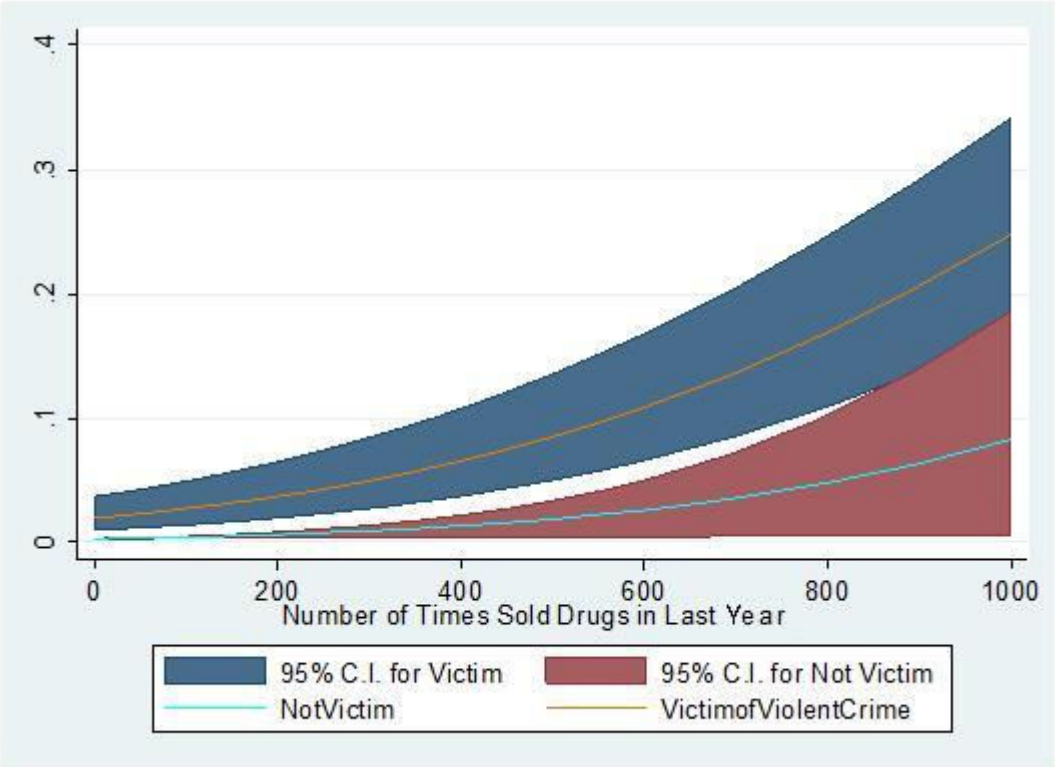


Figure 9: Probability of Gang Membership vs. Number of Times Sold Drugs In Last Year



VII. Robustness

To determine the robustness of my regression results, I completed four different procedures. First, I re-ran the regressions while restricting my sample to only those individuals living in an urban area. The overall regression results, including the results for the measures of violent crime, were very close to the original results.

Second, I ran regressions 1, 2, and 3 using random effects panel probit instead of pooled probit. The results are given in Table 7. The results are very similar to the original pooled probit results. In regression 4, the changes include the regional unemployment rate being statistically significant at the 10% level and having gone to a correctional facility during the year being now statistically significant at the 5% level. The coefficient on exposure to gun violence is a little larger than previously, but still

positive and statistically significant at the 1% level. Regressions 5 and 6 look very similar to Regressions 2 and 3. The measures of violence are still positive and statistically significant at the 1% level.

Third, I used Propensity Score Matching as an alternative way to estimate the treatment effect of being a victim of violent crime on gang membership. The propensity score was estimated using only regional dummies and year dummies. This specification had as much predictive power as much fuller specifications and yielded nearly the same results. However, none of the possible specifications had a Pseudo-R^2 that exceeded 0.08. Keeping that in mind, I estimated the treatment effect using the stratification method. The average treatment effect was estimated to be 0.012 with a bootstrapped standard error of 0.005 (using 1000 repetitions) and a t-statistic of 2.270. This treatment effect is a little larger than the estimated marginal effects of experiencing gun violence or repeated bullying, but is a little smaller than the estimated marginal effect of being a victim of violent crime. This suggests that in my original regressions there is minimal bias from non-random selection (due to unobserved heterogeneity) into being a victim of violent crime.

Finally, I generated a dummy variable for joining a gang during the year. The variable is only a 1 if the individual joined a gang (is in a gang at time t, but was not in a gang at time t-1), and is 0 otherwise. I then re-ran Regressions 1, 2, and 3 using this new variable as the independent variable. I no longer included lagged gang membership in the regressions. The results are given in Table 8. The results are very similar to the original results. All of the measures of violence are positive and statistically significant at the 1% level, except bullying which is significant at the 5% level.

Table 7 - Current Gang Membership Random Effects Panel Probit Regression Results

Dependent variable is Current Gang Membership Status (0 or 1) Independent Variables	Regression 1 Random Effects Panel Probit Coefficient (Z-statistic)	Regression 2 Random Effects Panel Probit Coefficient (Z-statistic)	Regression 3 Random Effects Panel Probit Coefficient (Z-statistic)
Male	0.411 (5.62)***	0.517 (7.63)***	0.509 (7.69)***
Age	0.033 (0.13)	0.092 (0.39)	0.091 (0.44)
Age-Squared	-0.001 (-0.13)	-0.003 (-0.40)	-0.003 (-0.55)
ASVAB	-0.005 (-3.64)***	-0.004 (-2.96)***	-0.006 (-4.50)***
Regional Unemployment Rate	0.297 (1.67)*	0.117 (0.71)	0.118 (0.76)
Household Income (in thousands of dollars)	-0.003 (-2.46)**	-0.002 (-2.72)***	-0.001 (-1.72)*
L(Have a job?)	-0.081 (-1.18)	-0.098 (-1.63)	-0.110 (-1.91)*
L(Went to a correctional facility?)	0.371 (2.09)**	0.187 (1.14)	0.164 (1.02)
L(Number of times sold drugs last year)	0.001 (1.50)	0.001 (2.07)**	0.001 (1.93)*
L(Number of times carried a gun in last 30 days)	0.019 (2.02)**	0.024 (3.52)***	0.023 (3.50)***
L(Friend in a Gang?)	0.588 (8.32)***	0.578 (9.09)***	0.611 (10.06)***
L(Gang Membership)	1.146 (10.97)***	1.209 (12.60)***	1.103 (11.71)***
L(Shot)	0.525 (4.74)***	-------	-------
L(Bully)	-------	0.360 (2.93)***	-------
L(Victim of Violent Crime)	-------	-------	0.741 (4.54)***
Intercept	-2.752 (-1.18)	-2.475 (-1.14)	-2.473 (-1.29)
Number of Observations	26715	27024	33292
Log likelihood	-1098.190	-1353.777	-1581.041
Wald Chi2	chi2(71) = 608.52	chi2(71) = 762.76	chi2(71) = 806.67
Prob > Chi2	0.0000	0.0000	0.0000
(LR Test rho=0) Chibar2(01)	17.63	16.46	37.08
Prob > Chibar2	0.0000	0.0000	0.0000

Notes: * denotes statistical significance at the 10% level; ** denotes statistical significance at the 5% level; *** denotes statistical significance at the 1% level; Additional controls in each regression include: number of children in the household, race dummies, citizenship status dummies, region dummies, MSA dummies, time dummies, MSA and time interactions, school enrollment dummy, dummies for each parent's level of education, dummies for highest grade completed, and dummy for presence of father in first survey period.

Table 8 - Joining A Gang Pooled Probit Regression Results

Dependent variable is Joining A Gang During The Year (0 or 1) Independent Variables	Regression 1 Pooled Probit Coefficient (Z-statistic)	Regression 2 Pooled Probit Coefficient (Z-statistic)	Regression 3 Pooled Probit Coefficient (Z-statistic)
Male	0.355 (5.59)***	0.438 (7.40)***	0.425 (7.77)***
Age	0.195 (0.78)	0.166 (0.71)	0.145 (0.74)
Age-Squared	-0.005 (-0.68)	-0.004 (-0.66)	-0.004 (-0.77)
ASVAB	-0.004 (-2.97)***	-0.003 (-2.71)***	-0.005 (-4.38)***
Regional Unemployment Rate	0.251 (1.45)	0.091 (0.56)	0.075 (0.50)
Household Income (in thousands of dollars)	-0.002 (-2.30)**	-0.002 (-2.61)***	-0.001 (-1.91)*
L(Have a job?)	-0.064 (-0.97)	-0.085 (-1.47)	-0.108 (-2.01)**
L(Went to a correctional facility?)	0.101 (0.52)	0.005 (0.03)	-0.071 (-0.41)
L(Number of times sold drugs last year)	0.001 (1.36)	0.001 (2.32)**	0.001 (2.35)**
L(Number of times carried a gun in last 30 days)	0.014 (1.59)	0.018 (2.66)***	0.014 (2.19)**
L(Friend in a Gang?)	0.581 (9.08)***	0.538 (9.20)***	0.576 (10.69)***
L(Shot)	0.393 (3.80)***	-------	-------
L(Bully)	-------	0.236 (1.96)**	-------
L(Victim of Violent Crime)	-------	-------	0.777 (5.52)***
Intercept	-8.193 (-2.67)***	-7.361 (-2.44)**	-6.956 (-2.78)***
Number of Observations	26715	27024	33292
Pseudo-R^2	0.169	0.154	0.168
Log likelihood	-987.552	-1205.489	-1408.467
Likelihood Ratio	chi2(70) = 401.76	chi2(70) = 438.84	chi2(70) = 569.58
Prob > Chi2	0.0000	0.0000	0.0000

Notes: * denotes statistical significance at the 10% level; ** denotes statistical significance at the 5% level; *** denotes statistical significance at the 1% level; Additional controls in each regression include: number of children in the household, race dummies, citizenship status dummies, region dummies, MSA dummies, time dummies, MSA and time interactions, school enrollment dummy, dummies for each parent's level of education, dummies for highest grade completed, and dummy for presence of father in first survey period.

VIII. Conclusion

This paper examines the link between violent crime and gang membership. I test the hypothesis that violent crime causes gang membership. I find support for this hypothesis. Each measure of violent crime is positive and highly statistically significant across all of my regression specifications.

One limitation to this paper is that the unemployment rate is at the regional level instead of the county level. I was unable to obtain the county level data since it is not public access data. A prior study

has shown that the county level unemployment rate is important in determining gang membership and I expect that my estimates of the effect of being a victim of violent crime would be larger if I used county level unemployment data.

My results imply that simply targeting gangs with law enforcement initiatives will not solve the problem. Since it has been shown that violence causes gang membership, and evidence suggests that more gang members leads to more violence, the results imply that there exists a positive feedback effect between violence and gang membership which should lead to a spiraling upwards towards a high gang membership equilibrium. This is consistent with the dramatic increase in gangs that has been observed in the past 30 years. In order to reduce the problem of gangs, the cycle of violence needs to be addressed. To the extent that this violence originates in schools, perhaps school choice initiatives (like vouchers) may be a way to better secure student safety. See Walberg (2007). Maybe more innovative proposals are needed, such as the privatization of neighborhood services and residential streets as in St. Louis and University City, Missouri and Laredo, Texas. By restricting non-resident access to streets and providing security, these measures lowered crime rates. See Foldvary (1994), Thompson and Green (1998), Benson (1998), Beito (2002), and Foldvary (2006).

Future research should address my limitations and explore the quantifiable aspects of the public policy implications. From a cost-benefit perspective, addressing the safety concerns of gang and community members might be a way to build more police-community cooperation and reduce gang activity. At the very least, my results suggest that the rational choice approach to modeling gang membership has explanatory power.

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