Firearm Violence and Effects on Concealed Gun Carrying: Large Debate and Small Effects

Jeremy G. Carter, PhD[1] and Michael Binder, PhD[2]

Abstract

Research has yet to identify a predictive relationship between crime and the issuance of aggregated concealed gun permits. The present study examines if a macro-level relationship exists between both concealed carry firearm applications and permits and violent crime committed with a firearm. Florida county-level data for concealed carry applications and violent crime are combined with police employment, socioeconomic, political, and firearm subculture variables across two temporal periods using both county and year fixed effects models. Unstandardized negative binomial regressions are employed with multiple alternative model specifications and diagnostic tests. Findings indicate a positive association between crime, especially those committed with a firearm, and concealed carry applications and permits. The effect size of firearm violent crime on concealed carry applications and permits is minimal. There is a demonstrable link between firearm violence and concealed carry applications and permits issued, net all covariates. Findings should be tempered by the minimal effect sizes.

Keywords

concealed carry, firearm violence, self-protective, time series, fixed effects

[1]Indiana University–Purdue University Indianapolis, USA
[2]University of North Florida, Jacksonville, USA

Corresponding Author:
Jeremy G. Carter, School of Public and Environmental Affairs, Indiana University–Purdue University Indianapolis, 801 W. Michigan Street/BS 4081, Indianapolis, IN 46202, USA.
Email: carterjg@iupui.edu

Introduction

The intersection of violent crime and gun carrying has been a focal point of considerable research and public debate. In the area of legal gun carrying, research has primarily focused on the relationship between states allowing citizens to carry concealed guns and an associated impact on crime (Ayers & Donohue, 1999; Black & Nagin, 1998; Kovandzic & Marvell, 2003; Lott, 2000; Lott & Mustard, 1997; Plassmann & Tideman, 2001). A more limited body of work has pursued explanations of legal gun carrying, specifically, concealed firearm carry permits. To date, four studies have explored indicators of aggregate-level concealed carry permits (Costanza & Kilburn, 2004; Costanza, Kilburn, & Miles, 2013; Gau, 2008; Thompson & Stidham, 2010), none of which have found a systematic relationship between crime and the issuance of permits to carry a concealed firearm.

This relationship merits further examination for two primary reasons. First, evidence suggests that violent crime is a predictor of legal gun ownership (Bordua & Lizotte, 1979; Kleck & Kovandzic, 2009) and legal handgun purchases (McDowall & Loftin, 1983). Moreover, fear of victimization has been linked to legal gun ownership within an individual's home (Miethe, 1995; Warr & Ellison, 2000) as well as carrying an illegal gun in public for purposes of self-protection (Bankston & Thompson, 1989; Vacha & McLaughlin, 2000; Watkins, Huebner, & Decker, 2008). Thus, it seems reasonable to assume violent crime could predict legal concealed firearm carrying. Second, a methodological hindrance to gun carrying and violence research is simultaneity (Marvell & Moody, 1996), wherein statistical models struggle to identify the direction of the causal relationship between crime and gun carrying. Research has predominantly focused on the effect of concealed carry laws on violence, not vice versa. Thus, only one side of the simultaneity equation has received the bulk of scholarly attention. To progress the discussion of violence as a predictor of legal gun carrying, the present research examines the linkage between violent crime and concealed carry gun permit applications and permits while employing methods to detect and correct for issues of simultaneity.

There are salient implications for exploring if individuals react to violent crime by seeking to legally carry guns. As the proportion of crimes committed with a firearm increase, so too does the likelihood that such crimes will result in fatal injuries (Cook, 1991). The extent to which criminals perceive increases in civilian gun carrying is uncertain. However, it is likely that criminals develop their perceptions of the prevalence of civilian gun carrying in response to the publicity surrounding concealed carry laws and incidents— what Zimring and Hawkins (1997) term an "announcement effect." Given the

media attention Florida receives related to legal gun carrying incidents as well as the sheer number of legal gun carriers, a total of 1,654,052 valid conceal and carry permits as of November 30, 2015 (Florida Department of Agriculture and Consumer Services, 2015), this announcement effect is worth consideration by policy makers and scholars alike.

Aggregated Data and Individual Rational Choice

The present research focuses on the influence of community violent crime rates on aggregate-level indicators of concealed carry permits applied for and issued to determine whether legal gun acquisition is influenced by patterns of local violence. This inquiry is predominantly driven by two areas of the literature: (a) individuals may react to factors associated with security and crime that influence the decision to rely upon guns for self-protection, and (b) aggregate data provide an avenue to discover patterns of individual rational choice.

To begin, scholars positing the collective security hypothesis contend that fear of crime, coupled with the perception of inadequate police response to protect citizens, influences individual decisions to rely upon a gun for self-protection (Carlson, 2012; Gau, 2008; McDowall & Loftin, 1983; D. A. Smith & Uchida, 1988; Young, McDowall, & Loftin, 1987). Black's (1980) articulation of the "self-help" hypothesis mirrors this argument. Scholars have tried to parse out the complexity of the collective security hypothesis through an understanding of legal guns as a response to crime (Garland, 2002; Simon, 2002, 2004, 2007). Individual decisions to seek out guns as a self-protective measure are influenced by the development of perceived risk of victimization.

Interactions among neighbors, friends, and family are believed to serve as exposure mechanisms that inform people of local victimization (Drakulich, 2015). In the same manner that these social interactions generate community cohesion, these same processes provide forums where crime and victimization can diffuse among community members (Bellair, 1997; Sampson, Raudenbushm, & Earls, 1997). An awareness of criminal activity within geographic areas can cause indirect victimization that has been found to increase fear (Tyler, 1980). Moreover, perceptions of increased risk severity heighten sensitivity to possible victimization and subsequent protective measures (Box, Hale, & Andrews, 1988; Warr, 1987; Wilcox-Rountree, 1998). Scholars have concluded that interpersonal violence, especially the most serious forms of violence, are more likely to diffuse among social groups (Browning, Dietz, & Feinberg, 2004; Cohen & Tita, 1999; Kleck & Kovandzic, 2009; Mears & Bhati, 2006; Morenoff, Sampson, & Raudenbush, 2001; W. R. Smith, Frazee, & Davison, 2000).

Given that rates of violent victimization vary greatly across geographic area that are racially heterogenic, economically disadvantaged, and socially disorganized versus those that are not (Lauritsen & Carbone-Lopez, 2011), aggregated data of larger geographic areas can assist in the discovery of trends at the individual level. The use of such aggregate data for individual choice is viewed as an appropriate empirical method to develop underlying behavioral models (Hartman, 1982). This approach is more commonly used in economics research to identify patterns of rational individual-level behavior in response to macro-level events (Becker, 1976). This method has been used by criminologists to explore individual decision making. For example, Levitt (1998) leveraged this theoretical approach in his examination of the sharp disparity between adult and juvenile sentencing from 1978-1993. He notes that

> . . . the divergence of juvenile and adult crime rates may not be the result of teenagers who differ categorically from earlier generations, but rather a [individual] rational response to a change in the relative incentives for juveniles and adults to engage in criminal activities. (Levitt, 1998, p. 1157)

The present research hypothesizes that as violent crime—especially crime committed with a firearm—increases within a county, individuals may make the rational decision to seek a concealed carry firearm permit for self-protection. As individual-level data are not readily available to explore this potential response, county-level data are used in an attempt to discover if such a relationship may exist. As will be discussed, the present study examines this potential criminal response through causality tests for simultaneity.

Aggregate Legal Gun Carrying

The following review of relevant literature centers specifically on studies seeking to explain aggregate levels of legal concealed gun carrying. There are four studies in this specific area of inquiry. First, Gau (2008) used 1,999 neighborhood-level data in the city of Spokane, WA, to explore the effects of social cohesion, police service levels, and crime as predictors of concealed carry permits within neighborhoods. Drawing on neighborhood surveys and administrative data using a weighted structural equation path model, Gau (2008) concluded that the level of police service had a negative indirect effect on neighborhood concealed carry permits through fear of crime. She also concluded that violent crime had no effect on permits, but fear of crime was a strong positive predictor of concealed carry permits. Gau (2008) argued that people may seek concealed carry permits as a method of self- and social-protection given positive effects of social cohesion and fear of crime, as well as low levels of police service within neighborhoods.

Second, Costanza and Kilburn (2004) examined rates of concealed carry permits in Louisiana. Using data from 1998, they found that rates of concealed carry permits issued in Louisiana were positively associated with median home income, political conservatism, White population, and less populated areas. When coupled with no observed effect from crime on the rate of permits issued, these findings led the authors to conclude the decision to seek a concealed carry permit was likely more symbolic of being a wealthy, politically conservative White person as opposed to someone in fear of crime (Costanza & Kilburn, 2004). Third, Thompson and Stidham (2010) built upon the Louisiana study by disaggregating race and including hunting permit rates under the belief that a sporting subculture would be predictive of concealed carry permit rates. Employing data from North Carolina counties in 2005, and controlling for similar socioeconomic and political variables as Costanza and Kilburn (2004), Thompson and Stidham (2010) concluded that income and crime had no significant effect on permits issued. However, the authors found evidence that a sporting subculture and political conservatism were positively associated with concealed carry permit rates.

Finally, Costanza et al. (2013) replicated the work of Thompson and Stidham (2010) using data from select towns in Connecticut in the year 2000. The authors concluded, again, that crime has no relationship with the rate of concealed carry permits issued. Support was also found for political conservatism's impact on concealed carry permits, while median household income was observed to have a negative effect. Moreover, using geographic data to account for spatial proximity and population density, the authors found that crime was highly correlated with population density in their data and that the latter was negatively associated with concealed carry permit rates. Such a finding may lend support to the notion that a symmetrical relationship exists between crime and concealed carry permits; however, such a finding was not observed in the Connecticut data, and future research in this area was encouraged. Replicating control measures and employing data across two longer periods of time in the state of Florida, the present study seeks to further this body of knowledge by establishing a county-level relationship between violent crime and concealed carry permits applied for and issued.

Method

The National Research Council (2004) noted that evidence from studies of concealed firearm carrying were sensitive to minor changes in model specification. This, coupled with the lack of supporting evidence to date associated with violent crime as a predictor of concealed carrying, has driven the present research to employ multiple model specifications using two different time periods. The current study utilizes county-level panel data from all 67 counties

in Florida. Due to limited availability of a key control variable, models utilize two temporal periods of 2005-2012 and 1996-2012. Data for one of the key control variables, hunting licenses, were not available until 2005. The current study utilizes a dosage effect of both the number of concealed carry permits applied for and issued in each county. Research to date has yet to employ applications as a variable of interest.

The decision to include applications for concealed carry permits is believed to be more reflective of persons seeking self-protective behaviors. Totals provided by the Florida Division of Licensing indicate that from 1987 to 2013 (Florida's shall-issue law went into effect in 1987), there is just over a 2% difference between applications received and permits issued. This difference may seem negligible; however, statewide totals do not account for variation of applications received and permits issued by county across time. County-level differences, such as incidents of violent crime, can vary and thus influence perceptions of the need to carry a firearm. Despite not being issued a permit, this 2% difference is representative of peoples' desire to carry a concealed firearm and thus merits inclusion. The driving research question for the present study is rather straightforward:

Research Question 1: Do increases in violent crime rates within a county prompt citizens to apply for concealed carry permits?

It is anticipated that violent crime committed with a firearm will have a different, and positive, effect on concealed carry permits applied for and issued in comparison with violent crime committed without a firearm.

Data

To test these questions, we use county-level data from each of the 67 counties in the state of Florida. Florida's Department of Agriculture and Consumer Services' Division of Licensing electronically provided county-level data on the number of civilian concealed carry weapons permit applications and permits issued.[1] Violent crime is measured using Uniform Crime Report (UCR) index offenses of violent crime (homicide, rape, robbery, aggravated assault) and was provided electronically by the Florida Department of Law Enforcement. To best isolate violent crime in the present study, index crimes are parsed out by those committed with and without a firearm as crime committed with a firearm may invoke more self-protective behavior (Cao, Cullen, & Link, 1997).

The present study includes seven specific control variables that theory and prior research suggest are corollary antecedents to both crime rates and

concealed carry applications and permits. Concealed carry permit holders predominantly reside in areas with higher per capita incomes (Costanza & Kilburn, 2004; Hood & Neeley, 2000). Thus, if counties with lower per capita incomes generally have higher levels of violent crime (Morenoff & Sampson, 1997), but lower permit rates, then failing to control for the economic well-being of counties might lead to a spurious negative relationship between permit rate and crime (Kovandzic & Marvell, 2003). To control for these potential confounds, we include the economic variables of unemployment and per capita income. County-level unemployment was gleaned from the U.S. Department of Labor's Bureau of Labor Statistics' Local Area Unemployment Statistics program. County-level per capita income data were taken from the U.S. Department of Commerce's Bureau of Economic Analysis.

Population density has been linked to protective gun ownership (Giblin, Burruss, Corsaro, & Schafer, 2012) and concealed carry permits in rural areas (Costanza et al., 2013; Thompson & Stidham, 2010). To control for this potential relationship, we include a measure of population density (population per square mile) using data obtained electronically from the Florida Office of Economic and Demographic Research. Because racial demographics have been linked to gun ownership (Dixon & Lizotte, 1987) and concealed carry permits (Costanza & Kilburn, 2004; Thompson & Stidham, 2010), we include the percentage of county population that is White (non-Hispanic) as determined from the most recent U.S. Census Report. Partisan composition of counties (measured by the percentage of registered Republicans) is included as it has been associated with legal gun carrying (Costanza & Kilburn, 2004; Costanza et al., 2013; Donohue & Ayers, 1999; Grossman & Lee, 2008; Thompson & Stidham, 2010). Party registration data were obtained electronically from the Florida Department of State's Divisions of Elections.

Gau (2008) concluded that police service levels had a direct negative effect on concealed carry permits, as well as a suppressive effect on fear of crime within neighborhoods. As such, the present study includes the total number of sworn officers from county, municipal, and university agencies within each county as taken from the Federal Bureau of Investigation's Uniform Crime Report Police Employee Data for each given year within our varying model specifications. Finally, gun ownership and gun carrying have been linked to southern and sporting subcultures (Bankston, Thompson, Jenkins, & Forsyth, 1990; Lizotte, Bordua, & White, 1981; Thompson & Stidham, 2010). Although the effect of such subcultures on individual gun behaviors is debatable, especially with respect to legal gun carrying for protection (Felson & Pare, 2010), it remains prudent to control for in the present

study. As our research design uses county fixed effects within a southern state (Florida), the southern subculture thesis is controlled for with our modeling choice. We include the total number of hunting licenses sold within each county for each year as a measure of sporting subculture. Hunting license data were obtained electronically from the Florida Fish and Wildlife Conservation Commission and was only available beginning in 2005.

Analytic Strategy

Analysis of UCR crime rates, especially at the county level, has been a source of debate in the literature (Maltz & Targonski, 2002; Osgood, 2000; Pridemore, 2005). The present study employs fixed effects negative binomial regressions to regress the number of concealed carry applications and permits on violent crime and a series of control variables. Using a negative binomial regression model to analyze overdispersed count data (such as concealed carry applications and permits noted in Table 1) is more efficient than ordinary least squares (Cameron & Trivedi, 2013) and is a more flexible modeling technique with less restrictive assumptions than traditional Poisson models (Gardner, Mulvey, & Shaw, 1995). Counties vary in size and therefore counts are not necessarily comparable across counties. Count models account for these differences by including the log of the exposure variable (county population) in the model with its coefficient constrained to one. Models are estimated in Stata using the "xt" commands (Cameron & Trivedi, 2013). Two-tailed tests are conducted to ensure proper interpretation of results.

Although some generalizability is lost from limiting the analysis to a single state, the benefit of improved estimation and controlling for statewide idiosyncrasies outweighs that cost. The overestimation of significance levels in county-level studies because of the "clustering" of error terms at the state level is a serious concern. Moody (2001) contended that scholars examining right-to-carry laws and crime using county-level data have overestimated the statistical significance of their findings because of correlation of variables within states. In such a situation, standard errors can be substantially biased downward, leading to inflated t ratios for the shall-issue law variable. Using Lott and Mustard's (1997) county-level data and robust Huber–White standard errors, which do not require independence of observations within clusters (e.g., shall-issue states), Moody (2001) found that the robust standard errors for the shall-issue law dummy variables in the homicide regressions were much larger than the conventional standard errors.

Most research on legal gun carrying has utilized county-level UCR data that have been argued to be highly suspect due to inconsistent (or missing)

Table 1. Florida County-Level Descriptive Statistics for Dependent and Independent Variables for 2005-2012 and 1997-2012.

	2005-2012				1997-2012			
n = 536	*M*	*SD*[a]	Minimum	Maximum	*M*	*SD*[a]	Minimum	Maximum
Concealed carry applications	1,380.49	2,116.36	6	13,123	831.48	1,583.38	1	13,123
Concealed carry applications per 100k	521.44	281.77	75.27	1,874.11	325.28	271.86	14.02	1,874.11
Concealed carry permits	536	7,963.54	48	87,998	5,664.58	9,981.7	19	87,998
Concealed carry permits per 100k	2,878.75	1,439.33	633.16	9,406.06	2,050.31	1,325.63	181.07	9,406.06
Violent crime with a firearm per 100k[b]	99.34	68.98	0	482.18	108.91	74.05	0	566.53
Violent crime without firearm per 100k	412.36	199.52	35.84	1,385.68	470.74	223.41	35.84	1,385.68
Unemployment rate	7.08	3.26	2.10	15.60	5.96	2.81	2.1	15.6
Income per capita[c]	32.54	10.02	15.47	66.43	27.936	9.73	11.21	66.43
Percentage White	70.78	14.29	15.40	91.20	74.58	14.29	15.4	97.1
Percentage Republican	35.02	11.33	7.90	63.30	33.6	13.41	3.66	63.7
Population per square mile	336.58	524.05	9.07	3,462.75	311.37	505.25	8.40	3,462.75
Sworn officers per 100k	222.56	117.73	57.24	1,115.84	218.94	98.16	51.81	1,115.84
Hunting licenses per 100k	1,197.39	1,290	39.70	6,115.23	NA			

Note. FDLE = Florida Department of Law Enforcement.
[a]Overall standard deviations are reported as opposed to within-county standard deviations. The latter is arguably more appropriate given the unit of analysis. However, overall standard deviations are believed to best describe the data and illustrate variance across the state of Florida as within-county standard deviations would be highly suppressed in cases where within-county measures (such as racial or political composition) are not likely to vary from year to year.
[b]Violent crime consists of data from the UCR: homicide, rape, robbery, and aggravated assault and is incidents per 100,000 of population. The remaining "0" in the "Violent Crime With a Firearm" variable is from three counties in 4 years. Each county is sparsely populated and sees very little violent crime, and even less violent crime with firearms. In addition, the authors discussed the "0" values with FDLE Crime Statistics Personnel and were assured those particular values were actually reported as "0" and not "missing."
[c]Income per capita is in thousands of dollars.

reporting and attempts to impute missing data are incomplete and change across time (Maltz & Targonski, 2002). Although county-level data are not without obstacles, Lott and Whitley (2003) noted that no data are perfect and that county data do not face as great an aggregation problem as state data and do not miss the large portions of the state lost by city-level data. Specific to this issue in the same state as the present research, in their study of Florida's shall-issue law, Kovandzic and Marvell (2003) removed 10 counties from their analysis because they believed errors existed with respect to crime reporting. These counties are each not very populous and thus do not report many crimes. For purposes of the present study, in-depth discussions were conducted with crime analysts and statistical personnel from the Florida Department of Law Enforcement regarding these reporting issues. Following these discussions, we concluded that the inclusion of all 67 counties was pertinent for the present study. However, in an effort to account for the possibility that there are missing or misreported data in these few counties, we provide two models for each model specification, namely, one model with all 67 counties and an additional model with limited counties wherein the 12 potentially under-reported counties[2] were removed from the analyses.

Each model utilizes both county and year fixed effects that account for time invariant cross county differences (local ordinances) and unobserved influences that affect each county equally in a given year (national economic conditions, state laws, or federal laws). The models measure the year-to-year deviations in concealed carry applications and permits for that county as a function of the treatment variables in each time period. The models measure the average treatment effect of the violent crime rate on the number of concealed carry applications and permits in *each county*, and the coefficients produced for the 67 county regression models represent an average of the treated counties' effects. Thus, the coefficients for the key independent variables in Tables 2 to 5 (violent crime committed with and without a firearm) reflect an average of within-county averages. Effects are estimated based on variation within counties, not a pooled cross-sectional estimate of the effects.

When combining data from multiple state and federal agencies, measurement is not always consistent. For example, UCR and census data are based on the calendar year; however, data from the state of Florida are based on the Florida fiscal year; July 1 through June 30. Therefore, to properly account for the theoretical expectation that increases in armed violent crime precedes increases in concealed carry permitting, lagged measures of federal data (violent crime, unemployment, income, race, partisanship, and population density) are employed. The lagged federal and

Table 2. Unstandardized Negative Binomial Regression Coefficients From Multiple Regression of Concealed Carry Applications on Violent Crime and Control Variables With County and Year Fixed Effects.

	All Counties Concealed Carry Applications 2005-2012		Limited Counties Concealed Carry Applications 2005-2012[a]		All Counties Concealed Carry Applications 1997-2012		Limited Counties Concealed Carry Applications 1997-2012[a]	
Violent crime with firearm	0.0006**	(0.0002)	0.0007***	(0.0002)	0.0009***	(0.0002)	0.0010***	(0.0002)
Violent crime without firearm	0.0001	(0.0001)	−0.0001	(0.0001)	−0.0002**	(0.0001)	−0.0002***	(0.0001)
Unemployment	−0.0418***	(0.0101)	−0.0369***	(0.0108)	−0.0408***	(0.0071)	−0.0378***	(0.0076)
Per capita income	0.0029	(0.0040)	0.0071	(0.0041)	−0.0014	(0.0025)	0.0014	(0.0026)
Percentage White	0.0081**	(0.0026)	0.0080**	(0.0028)	0.0002	(0.0012)	−0.0001	(0.0012)
Percentage Republican	0.0010	(0.0024)	0.0035	(0.0025)	−0.0015	(0.0017)	0.0019	(0.0018)
Population per square mile	−0.0009***	(0.0002)	−0.0007***	(0.0002)	−0.0008***	(0.0001)	−0.0006***	(0.0001)
Sworn officers per 100k	0.0003	(0.0002)	0.0002	(0.0002)	0.0005***	(0.0001)	0.0005***	(0.0002)
Hunting licenses per 100k	0.0002***	(0.0000)	0.0002***	(0.0001)				
Groups	67		55		67		55	
Observations per group	8		8		16		16	
n	536		440		1,072		880	
Wald χ²	5,344.85		4,951.53		18,472.90		17,591.57	

Note. Standard errors are presented next to the coefficients in each model. The negative binomial models were estimated with county and year fixed effects; those results are omitted.

[a]The following counties are removed from the analysis: Calhoun, Franklin, Gilchrist, Glades, Gulf, Hamilton, Holmes, Jefferson, Lafayette, Liberty, Okeechobee, and Suwannee.

*p < .05. **p < .01. ***p < .001 in a two-tailed test.

Table 3. Unstandardized Negative Binomial Regression Coefficients From Multiple Regression of Concealed Carry Permits on Violent Crime and Control Variables With County and Year Fixed Effects.

	All Counties Concealed Carry Permits 2005-2012		Limited Counties Concealed Carry Permits 2005-2012[a]		All Counties Concealed Carry Permits 1997-2012		Limited Counties Concealed Carry Permits 1997-2012[a]	
Violent crime with firearm	0.0004***	(0.0001)	0.0004**	(0.0001)	0.0008***	(0.0001)	0.0008***	(0.0001)
Violent crime without firearm	0.0001	(0.0001)	0.0001	(0.0001)	0.0001**	(0.0000)	0.0001**	(0.0000)
Unemployment	−0.0353***	(0.0063)	−0.0313***	(0.0067)	−0.0081	(0.0049)	−0.0033	(0.0053)
Per capita income	0.0012	(0.0028)	0.0028	(0.00029)	−0.0150***	(0.0022)	−0.0124***	(0.0023)
Percentage White	0.0057***	(0.0018)	0.0051	(0.0019)	0.0035***	(0.0008)	0.0034***	(0.0009)
Percentage Republican	0.0022	(0.0015)	0.0029	(0.0016)	0.0022	(0.0012)	0.0048***	(0.0013)
Population per square mile	−0.0005***	(0.0001)	−0.0004***	(0.0001)	−0.0009***	(0.0001)	−0.0006***	(0.0001)
Sworn officers per 100k	0.0002	(0.0001)	0.0002	(0.0001)	0.0005***	(0.0001)	0.0007***	(0.0001)
Hunting licenses per 100k	−0.0001	(0.0000)	−0.0001	(0.0001)				
Groups	67		55		67		55	
Observations per group	8		8		16		16	
n	536		440		1,072		880	
Wald χ²	12,641.34		11,798.19		16,996.97		14,940.21	

Note. Standard errors are presented next to the coefficients in each model. The negative binomial models were estimated with county and year fixed effects; those results are omitted.

[a]The following counties are removed from the analysis: Calhoun, Franklin, Gilchrist, Glades, Gulf, Hamilton, Holmes, Jefferson, Lafayette, Liberty, Okeechobee, and Suwannee.

*p < .05. **p < .01. ***p < .001 in a two-tailed test.

Table 4. Unstandardized Negative Binomial Regression Coefficients From Multiple Regression of Concealed Carry Applications on Violent Crime Types and Control Variables With County and Year Fixed Effects.

	Concealed Carry Applications 2005-2012				Concealed Carry Applications 1997-2012			
Firearm homicide	0.0025 (0.0037)				0.0130*** (0.0033)			
Firearm rape		0.0079 (0.0068)				−0.0087 0.0050		
Firearm robbery			0.0009*** 0.0004				0.0008** (0.0003)	
Firearm aggravated assault				0.0010** (0.0004)				0.0013*** (0.0003)
Unemployment	−0.0476*** (0.0100)	−0.0478*** (0.0100)	−0.0432*** (0.0101)	−0.0448*** (0.0100)	−0.0393*** (0.0072)	−0.0414*** (0.0058)	−0.0394*** (0.0073)	−0.0429*** (0.0072)
Per capita income	0.0018 (0.0040)	0.0002 (0.0019)	0.0023 (0.0040)	0.0024 (0.0040)	−0.0014 (0.0024)	−0.0019 (0.0024)	−0.0019 (0.0025)	−0.0017 (0.0025)
Percentage White	0.0083** (0.0026)	0.0039 (0.0026)	0.0079** (0.0026)	0.0082*** (0.0026)	0.0009 (0.0012)	0.0018 (0.0013)	0.0006 (0.0013)	0.0003 (0.0012)
Percentage Republican	0.0018 (0.0023)	0.0018 (0.0023)	0.0016 (0.0023)	0.0019 (0.0023)	−0.0016 (0.0017)	−0.0023 (0.0017)	−0.0023 (0.0017)	−0.0019 (0.0017)
Population per square mile	−0.0009*** (0.0002)	−0.0009*** (0.0002)	−0.0009*** (0.0002)	−0.0009*** (0.0002)	−0.0009*** (0.0001)	−0.0009*** (0.0001)	−0.0009*** (0.0001)	−0.0009*** (0.0001)
Sworn officers per 100k	0.0003 (0.0002)	0.0003 (0.0002)	0.0003 (0.0002)	0.0003 (0.0002)	0.0005*** (0.0001)	0.0005*** (0.0001)	0.0005*** (0.0001)	0.0004** (0.0001)
Hunting licenses per 100k	0.0002*** (0.0000)	0.0002*** (0.0000)	0.0002*** (0.0000)	0.0002*** (0.0000)				
Groups	67	67	67	67	67	67	67	67
Observations per group	8	8	8	8	16	16	16	16
n	536	536	536	536	1,072	1,072	1,072	1,072
Wald χ²	5,115.01	5,141.53	5,269.86	5,267.64	17,724.65	17,058.73	17,810.13	17,897.51

Note. All 67 counties are included in each model in Table 4. Models include all Florida counties. Standard errors are presented in parentheses below the coefficients is each model. The negative binomial models were estimated with county and year fixed effects; those results are omitted.
*p < .05. **p < .01. ***p < .001 in a two-tailed test.

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Table 5. Unstandardized Negative Binomial Regression Coefficients From Multiple Regression of Concealed Carry Permits on Violent Crime Types and Control Variables With County and Year Fixed Effects.

	Concealed Carry Permits 2005-2012				Concealed Carry Permits 1997-2012			
Firearm homicide	0.0061* (0.0026)				0.0124*** (0.0024)			
Firearm rape		0.0151*** (0.0047)				0.0125*** (0.0038)		
Firearm robbery			0.0007*** (0.0002)				0.0013*** (0.0002)	
Firearm aggravated assault				0.0007** (0.0002)				0.0014*** (0.0002)
Unemployment	−0.0376*** (0.0063)	−0.0377*** (0.0062)	−0.0356*** (0.0063)	−0.0374*** (0.0063)	−0.0088 (0.0051)	−0.0101 (0.0051)	−0.0076 (0.0050)	−0.0119* (0.0050)
Per capita income	0.0012 (0.0028)	0.0011 (0.0028)	0.0011 (0.0028)	0.0009 (0.0028)	−0.0133*** (0.0022)	−0.0129*** (0.0021)	−0.0145*** (0.0022)	−0.0143*** (0.0022)
Percentage White	0.0061*** (0.0018)	0.0060*** (0.0018)	0.0054*** (0.0018)	0.0062*** (0.0018)	0.0053*** (0.0009)	0.0054*** (0.0009)	0.0041*** (0.0009)	0.0044*** (0.0008)
Percentage Republican	0.0023 (0.0015)	0.0023 (0.0015)	0.0020 (0.0015)	0.0022 (0.0015)	0.0020 (0.0012)	0.0017 (0.0012)	0.0017 (0.0012)	0.0022 (0.0012)
Population per square mile	−0.0006*** (0.0001)	−0.0005*** (0.0001)	−0.0006*** (0.0001)	−0.0005*** (0.0001)	−0.0010*** (0.0001)	−0.0010*** (0.0001)	−0.0010*** (0.0001)	−0.0009*** (0.0001)
Sworn officers per 100k	0.0002* (0.0001)	0.0002 (0.0001)	0.0002 (0.0001)	0.0002 (0.0001)	0.0006*** (0.0001)	0.0005*** (0.0001)	0.0006*** (0.0001)	0.0005*** (0.0001)
Hunting licenses per 100k	−0.0001 (0.0001)	−0.0001 (0.0001)	−0.0001 (0.0001)	−0.0001 (0.0001)				
Groups	67	67	67	67	67	67	67	67
Observations per group	8	8	8	8	16	16	16	16
n	536	536	536	536	1,072	1,072	1,072	1,072
Wald χ^2	12,116	12,487.11	12,501.30	12,294.83	15,682.30	15,514.75	16,297.14	16,320.65

Note. All 67 counties are included in each model in Table 5. Models include all Florida counties. Standard errors are presented in parentheses below the coefficients is each model. The negative binomial models were estimated with county and year fixed effects; those results are omitted.
*p < .05. **p < .01. ***p < .001 in a two-tailed test.

partisan data have a 6-month overlap (July of Year X-1 through December of Year X-1) with data kept by the state of Florida (concealed carry applications and permits, hunting licenses, and sworn officers). This helps to ensure a proper temporal ordering of the independent and dependent variables.

The issue of simultaneity, the potential of an endogenous regressor variable being correlated with the error term, has been discussed and accounted for in previous gun and violent crime studies (see Kovandzic & Marvell, 2003; Marvell & Moody, 1996; Stolzenberg & D'Alessio, 2000). In an effort to test for simultaneity, a Granger causality test was conducted using two separate models. The first model uses the key independent variable (violent crime committed with a firearm) as the dependent variable, with 1-year lagged values of armed violent crimes and concealed carry applications. Results of this diagnostic model indicate violent firearm crime in the previous year predicts violent crime in the current year. Concealed carry applications in the previous year, however, have no effect on armed violent crime. These results lend confidence to the notion that criminals are not making the rational decision to use more violent force to commit crime.

The second model reverses the measures and employs applications as the dependent variable and firearm crime as the independent. Both of these diagnostic models were conducted for concealed carry applications as well as permits. Results indicate firearm violence is a positive and statistically significant predictor of concealed carry applications and permits. Although Marvell and Moody (1996) asserted the Granger test of causality is the most appropriate diagnostic of simultaneity, a Hausman (1978) specification error test was also employed as a supplemental analysis to determine whether simultaneity is a threat to the models presented. The Hausman test results confirmed those of the Granger test.[3] These results lend confidence that concealed carry applications and violent crime committed with a firearm are mutually exclusive and that models presented are free of simultaneity.

Results[4]

Table 1 provides the descriptive statistics for measures included in the present study within both the 2005-2012 and 1997-2012 time periods. Three generalities emerge from the descriptives presented in Table 1 and are consistent across both time periods. First, the concealed carry permit applications and crime rates data vary dramatically between counties and years. The minimums and maximums for each variable have very large ranges, partially due

to the variance in county populations, and partially do the length of the time series. Second, there are three counties in 4 years that did not encounter any violent crime committed with a firearm. Each county is sparsely populated and sees very little violent crime, and even less violent crime with firearms. In addition, the authors discussed the "0" values with Florida Department of Law Enforcement crime statistics personnel and were repeatedly told those particular values were actually reported as "0" and not "missing." The county data for all of the crime rates are censored at zero and also heavily right skewed. The control variables have much less variability (except county population size), as the standard deviations are less than half of the value of the mean. Finally, consistent with national trends, the average frequency of concealed carry applications and permits is notably higher during the shorter and more recent 2005-2012 time period.

Evidence presented in Table 2 suggests a relatively clear pattern of the effect of firearm crime on county-level applications for concealed carry permits. Across the two different time periods, and models that include both all counties and limited counties, firearm crime has a positive and statistically significant effect on concealed carry applications. Interestingly, significant negative effects are observed between non-firearm crime and concealed carry applications during the 1997-2012 period. This finding is consistent with the assumption that firearm violence has a greater influence on applications for concealed carry permits as compared with non-firearm crime.[5] Table 2 presents evidence in support of higher socioeconomic conditions, lower population density, race, and a sporting culture as predictors of concealed carrying. It is important to note the consistent, and relatively minimal, coefficients and standards errors across the models. Although statistically significant, the effects lack substantial influence on the increase of applications.

Table 3 presents results of the primary model specifications and concealed carry permits as the variable of interest. As expected, results pertaining to firearm crime almost mirror those within the aforementioned models exploring concealed carry applications. Crimes committed with a firearm have a significant positive effect on concealed carry permits. A negative relationship is again observed between non-firearm crimes and permits in the 1997-2012 period. Unemployment, race, and population density control variables are again significant. There are, however, notable differences from the applications model with respect to the control variables. Hunting licenses do not influence permits while police service levels have a positive effect on permits from 1997 to 2012. The latter finding is somewhat perplexing, as the direction of this relationship would seem to be reversed. This finding will be explained further in the "Conclusion and

Discussion" section to follow. Finally, the observed effect sizes are further reduced from the already minimal effects noted in the application models.

Firearm Violence by Crime Type

To further explore firearm violence and concealed carry permits, negative binomial models estimating the effects by crime type (homicide, rape, robbery, and aggravated assault) committed with a firearm are provided. Table 4 presents results of concealed carry applications across both time periods. Table 5 presents results of concealed carry permits across both time periods. Robbery and aggravated assault committed with a firearm are significant positive indicators across every model. Homicide with a firearm is a predictor in three of the four models (not in 2005-2012 applications). Interestingly, when permits are the dependent variable (Table 5), each of the four crimes is significantly positive during both time periods. Moreover, crime severity appears to influence effect size. Coefficients for homicide and rape are higher than robbery and aggravated assault. Although these effect sizes are slight at best, they further support the theoretical position that levels of violence may influence concealed weapons carrying.

Conclusion and Discussion

The findings in this research indicate that as counties in the state of Florida experience greater numbers of firearm violence, the citizens of those counties may react by applying for permits to carry a concealed firearm, net of relevant covariates. From a theoretical perspective, the finding of firearm crime as a predictor of concealed carrying is the first such demonstrable relationship and provides evidence that should solicit further investigation. The present study provides evidence in support of higher socioeconomic status (Costanza & Kilburn, 2004), lower population density (Costanza et al., 2013), higher proportion of Whites (Costanza & Kilburn, 2004; Thompson & Stidham, 2010), and a sporting culture (Costanza et al., 2013) as predictors of concealed carrying. Moreover, these models suggest that per capita income may be a more reliable socioeconomic measure across time. Although not directly measured in the present study, the findings suggest fear of crime may be correlated with an individual's desire to pursue a concealed carry license.

A theoretically perplexing finding was that police service levels were shown to have a positive effect on concealed carry applications and permits. This relationship is in the opposite direction as expected, as increases

in police service levels are believed to have a suppressive effect on concealed carrying. One plausible explanation for this finding may be that increases in violent crime were met with increases in police personnel, yet diagnostic tests revealed no correlation between firearm crime in Year 1 and police service levels in Year 2. It is also unlikely that additional police would be hired in response to firearm crime as public safety budgets in Florida were rather sparse and the temporal time frame is short for hiring purposes. Although it cannot be said for certain, this relationship may be spurious within the available data. Nonetheless, it appears prudent to include police service levels in future examinations of predictors of concealed carrying. Future studies should also attempt to capture individual-level perceptions and behaviors, as well as meso-/macro-level data similar to Gau's (2008) study. Relatedly, counties are typically large geographies that may consist of varying high- and low-crime areas within a single county. As the growing literature regarding crime and place has shown, micro units of place are more ideal than larger areas defined by formal boundaries (i.e., county lines). Future research examining concealed gun carrying and crime should attempt to gather micro–meso levels of data to better isolate environmental differences within counties, or perhaps on the boundaries between counties.

Deterrence and rational choice theory posits that an increase in the perceived costs of crime—the likelihood of encountering an armed victim—may deter criminal activity, particularly as the number of permits issued within a state increases over time (Lott & Mustard, 1997). The opposite effect is a policy issue that is commonly overlooked; the potentially undesirable and adverse changes in the behavior of criminals in response to perceptions of increased civilian gun carrying (Ludwig, 2000). For example, recent research suggests robbery offenders make determinations on the amount of force to use at the onset of a robbery based on their perception of a potential victim's likelihood that they are carrying a weapon (Kleck & DeLone, 1993; Lindegaard, Bernasco, & Jacques, 2014). Wright and Rossi (1994) interviewed imprisoned offenders who used firearms to commit their crimes and noted that approximately two thirds reported that the decision to carry a gun for purposes of committing their crime was influenced by the prospect of encountering an armed victim. It is plausible that such perceptions among criminals may lead to increases in the use of firearms to commit violent crime where previously such levels of force were not utilized. Respondents to the 2012 National Crime Victimization Survey indicated that only 7% of violent crime was committed with a firearm, a proportion that has been consistent since 2003 (Truman, Langton, & Planty, 2013).

Although the association found between armed violent crime rates and concealed carry permit application rates was consistent, it was also minimal in magnitude. It seems the level of debate surrounding violence and concealed carrying far outweighs any observed effects. While it appears armed violent crime is related to higher levels of concealed carry applications and permits, we acknowledge that other factors are just as—if not more—important and highlight the need for more refined research to parse out any plausible relationships. Moreover, it should be noted that the relationship between other explanatory variables (such as population density and unemployment) and concealed carry permit application rates was substantively larger than was found for armed violent crime. The impact of these findings on policy is less apparent. Although these findings may be statistically significant, the effects sizes are so small as to provide no reason to believe substantial policy changes would affect conceal carry application rates. Ostensibly, fewer guns on the street is a good thing; however, even an extreme reduction in violent crime would only have a minimal effect on the number of concealed carry applications and permits issued.

The present study is not without limitations. Fear of crime has been shown to influence civilian gun ownership (Miethe, 1995; Warr & Ellison, 2000), and we extend that argument to include concealed carry applications permits. However, we do not directly measure "fear of crime." We infer that actual crime (in our case, armed violent crime) motivates civilians to apply for concealed carry permits. In an optimal world, we measure fear of crime more directly, perhaps through surveys. However, that would bring with it a number of other complications. First, with a small fraction of the population actually applying for these licenses, it would be very difficult to include enough applicants in a random sample of Floridians. In addition, concealed carry applicants and permit holders are exempt from public record requests in Florida, which prevents a direct sampling of applicants and permit holders.

Another limitation, as mentioned previously, is that the appropriate unit of analysis in macro-/meso-level research has been a point of contention among scholars. The less than pristine approach of using UCR county-level crime data, for the potentially problematic reasons discussed by Maltz and Targonski (2002) and Pridemore (2005), was determined to be the most appropriate method available. The aforementioned justification for examining county-level effects of armed violent crime on concealed carry applications and permits is coupled with the availability of such data. Due to legislation safeguarding concealed carry permit-holder information, county-level data

are perhaps the most fine-grained source of administrative insight available in the state of Florida.

We acknowledge that the use of Florida as a state to conduct concealed carry–related research has been called into question. Although the present study is not directed toward the potential impacts of shall-issue laws, Black and Nagin (1998) contended that estimates of shall-issue law effects are extremely sensitive to the inclusion of Florida to the extent that models including Florida, or of Florida itself, produce systematic prediction errors while others have found Florida to negatively skew crime estimates related to concealed carry laws (Kovandzic & Marvell, 2003). The present research utilized Florida given its availability of data as well as the state's culture surrounding firearm prevalence, violent crime rates, and that the state currently has the most active concealed carry permits per capita in the United States.

Moreover, Florida's "stand-your-ground" law allows legal gun carriers to use firearms in self-defense when they believe they are in danger of death or serious bodily harm. Stand-your-ground laws remove an individual's duty to retreat, even if a safe route of retreat or escape is available, from any place a person has a lawful right to be. The present research is not concerned with the plausible link between stand-your-ground laws and violent crime, but such laws do possibly create a sense of legislative empowerment for individuals to seek protective mechanisms in the form of a concealed firearm. Citizens living in states that legally require people to retreat, as opposed to stand-your-ground, may feel a concealed carry weapon will be less effective in the face of a violent offender given a more stringent legal threshold for the justification of using the firearm for self-protection. Floridians may perceive the state's stand-your-ground laws as a mechanism to enhance the effectiveness of a concealed firearm as a legitimate means of self-protective behavior.

In conclusion, the present study has demonstrated a significant relationship between firearm crime and subsequent applications and issuance of concealed carry gun permits. This finding was consistent across two temporal periods and net other informative covariates. Scholars should seek to build upon these findings to further explore the nexus between the levels of violence in crime incidents, individual fear of crime, and a desire to pursue self-protection in the form of concealed gun carrying.

Appendix

Table A1. Correlation Matrix for Variables From 2005-2012.

	CCW Applications	CCW Permits	Violent Crime With Firearm	Violent Crime Without Firearm	Unemployment	Per Capita Income	Percentage White	Percentage Republican	Population Per Square Mile	Sworn Officers Per 100k	Hunting Licenses Per 100k
CCW applications	1										
CCW permits	.951	1									
Violent crime with firearm	.463	.424	1								
Violent crime without firearm	.067	.061	.522	1							
Unemployment	.247	.209	-.004	-.182	1						
Per capita income	.357	.361	.084	-.014	.061	1					
Percentage White	-.416	-.425	-.483	-.340	-.135	.074	1				
Percentage Republican	.104	.091	-.076	-.184	.062	.545	.400	1			
Population per square mile	.654	.671	.413	.128	.041	.353	-.206	.145	1		
Sworn officers per 100k	-.060	-.058	-.010	.099	.080	-.015	.003	-.133	-.082	1	
Hunting licenses per 100k	-.410	-.415	-.222	-.003	-.107	-.439	.247	-.409	-.406	.184	1

Note: CCW = concealed carry weapon.

Table A2. Correlation Matrix for Variables From 1997-2012.

	CCW Applications	CCW Permits	Violent Crime With Firearm	Violent Crime Without Firearm	Unemployment	Per Capita Income	Percentage White	Percentage Republican	Population Per Square Mile	Sworn Officers Per 100k
CCW applications	1									
CCW permits	.921	1								
Violent crime with firearm	.305	.366	1							
Violent crime without firearm	.010	.091	.649	1						
Unemployment	.297	.219	-.007	-.166	1					
Per capita income	.438	.427	-.026	-.083	.148	1				
Percentage White	-.383	-.406	-.359	-.205	-.205	-.049	1			
Percentage Republican	.159	.173	-.027	-.043	.013	.575	.309	1		
Population per square mile	.555	.634	.355	.191	-.004	.350	-.157	.246	1	
Sworn officers per 100k	-.030	-.016	.032	.140	.093	.075	-.050	-.052	-.045	1

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Declaration of Conflicting Interests

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Notes

1. CCW permits are applied for and issued at the state level. However, the county-level data used in this research reflects where the applicant/permit holder permanently resides within the state of Florida. By Florida law, this is the most granular level at which CCW applicant/permit holder data are made available.
2. These counties were Calhoun, Franklin, Gilchrist, Glades, Gulf, Hamilton, Holmes, Jefferson, Lafayette, Liberty, Okeechobee, and Suwannee.
3. Coefficients and standard errors of these diagnostic models are not presented given space considerations, but can be provided by the authors upon request.
4. Given substantial academic debate regarding model specification and concealed carry research, linear regression models were employed for robustness and confirmatory purposes. Linear regression estimation used Driscoll–Kraay standard errors to account for both autocorrelation and cross-sectional dependence, thereby allaying concerns about "clustering" (Driscoll & Kraay, 1998). Results pertaining to these confirmatory models are not reported for space considerations, but can be provided by the authors upon request. Linear regression models confirmed findings of the negative binomial models. Crimes committed with a firearm had a significant positive effect on both concealed carry applications and permits across each model tested. Control variable effects were sporadic across the confirmatory models; however, there did appear to be a trend of support for positive socioeconomic (unemployment and income) and negative population density effects. A higher proportion of Whites in a county was only a significant predictor in the 1996-2012 permit models. A sporting culture (hunting licenses) was only a significant predictor of permits, not applications. Police service levels have a positive effect on concealed carry applications and permits across each model tested. Additional models were specified with all violent crime included. These additional models confirmed the findings of the models presented. The coefficient for the "all violent crime" variable in the 2005-2012 model was .00016, and for the 1997-2012 model, the coefficient was .0000178. Full model reports can be provided upon request.

5. As a robustness check, we provided two bivariate correlation matrices in the appendix. The first correlation matrix includes data from 2005 to 2012 and the second includes data from 1997 to 2012. None of the independent variable bivariate correlations are higher than .70, a key threshold for inclusion in a multivariate regression (see Tabachnick & Fidell, 2001).

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Author Biographies

Jeremy G. Carter, PhD, is an assistant professor within the School of Public and Environmental Affairs at Indiana University–Purdue University Indianapolis and earned his PhD from the School of Criminal Justice at Michigan State University. His research areas include policing, policy evaluation, and justice technologies. His research has appeared in outlets such as *Criminal Justice and Behavior, Journal of Criminal Justice, Homicide Studies, Evaluation Review, Police Quarterly, Policing and Society, Journal of Crime and Justice, Criminal Justice Policy Review, Security Journal*, and *Police Practice and Research*.

Michael Binder, PhD, is an assistant professor in the Department of Political Science and Public Administration at the University of North Florida and a visiting scholar at Stanford University's Hoover Institution. He received his doctorate in political science from the University of California, San Diego, in 2010. His research interests include voter decision making, direct democracy, American politics, and public opinion. He is a regular contributor to various media outlets and his research has been published in *Political Research Quarterly, American Review of Politics*, the *California Journal of Public Policy*, and the *California Western Law Review*. He is also the director of the Public Opinion Research Laboratory at the University of North Florida.