Violent Crime and Female Victimization: Evidence from Metropolitan Regions in South Korea

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Abstract

In the economics of crime literature, victimization by crime has received less attention than the supply side of crime. This paper accounts for the relationship between violent crime and female victimization. We show that violent crime increases with the *overall female exposure* and the *female proportion in the victim-target group*. Potential interactions between these female characteristics and income inequality critically influence the incidence of violent crime. Empirically, we introduce proxies for female characteristics that better reflect our hypotheses—for example, young unmarried female-headed households (for exposure to crime) and new job gains among females (for economic status). Using a panel of South Korean metropolitan regions, 2000 to 2011, we find that a certain limited change in these female characteristics could account for as much as 16% of the number of violent crime.

Keywords: law and economics, women risk, labor markets of women, economic change of women, income inequality

JEL classification: K42, K14, D63

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I. INTRODUCTION

According to the recent survey on social safety by Statistics Korea (2012), crime is the most threatening factor in South Korea—even more than national security. Females expressed stronger concern for crime as only 6.8% of female respondents were 'feeling safe' from the fear of crime.

In fact, the annual incidence of violent crime in 2000s, on average, was 2.6 times higher than over the previous three decades.[1] More surprisingly, the percentage of female victims of violent crime reached a record high of about 90% in 2013. This peculiarity concerning *female victimization* is also confirmed through the international data. Based on the United Nations Office on Drugs and Crime (2014), Korea was ranked 5th among the 207 countries surveyed in terms of the percentage of female homicide victims in 2012 or later.[2]

Since Becker (1968), many studies have investigated socioeconomic determinants of violent crime, with particular focus on the deterrence hypothesis. However, "*victimization has not yet received the attention from economic scholars that it deserves*" (Entorf 2015, 391). This paper examines female victimization from an economic perspective, and investigates whether female characteristics (or activities) can contribute to the increase in violent crimes.

We provide a simple theoretical account of the relationship between violent crime and female victimization. Because females are less capable of protecting themselves, the expected costs of committing crimes against female victims are lower compared to male victims. We claim, as the first hypothesis, that violent crime increases (and so does female victimization) as the '*overall female exposure*' or the '*female proportion in the victim-target group*' increases. We also show, as the second hypothesis, that these changing female characteristics can affect the marginal effect of income inequality on violent crime—a point largely neglected in the previous research.

[1] The *Annual Crime Reports* by the Supreme Prosecutors' Office of Korea.
[2] The female victimization has also become a major social problem in other countries such as German, U.K., Canada, Central Americas (e.g. El Salvador, Guatemala, Mexico), and Australia.

In order to test the hypotheses, we estimate the violent crime supply function using various proxies for the female victimization. Due to limited work on this issue, it is difficult to find appropriate proxies. We show, however, that female employment rate (of a certain age) and young unmarried female-headed households—as proxy variables for exposure—and relative female wages and new job gains among females—as proxy variables for economic status—substantially influence the incidence of violent crime. We expect that these proxies, if confirmed through estimation, can be beneficially used to give warning signals for making counter-measure policies.

Using a panel of metropolitan regions in South Korea, 2000 to 2011, we find that the magnitudes of the relationship between violent crime and female victimization (exposure and economic status) are fairly significant. For instance, the number of violent crimes would increase by 4,630 (in 2011 population) if the share of young unmarried female-headed households and the share of new job gains among females increase by a 1 percentage point, respectively. The 4,630 violent crimes correspond to about 16% of the number of violent crimes committed in 2011, which gives important implications for criminal justice policy.

The paper is organized as follows. Section 2 outlines the recent trends of violent crime and female victimization in Korea. We then explain the (interactive) relationships among female victimization, violent crime, and income inequality. In Section 3, we explain the data sources, define the variables to be used, and examine their descriptive statistics. In Section 4, we estimate the supply function of violent crime and test the main hypotheses. Finally, Section 5 concludes and discusses policy implications.

2. VIOLENT CRIME AND FEMALE VICTIMIZATION

2.1 A Rapid Increase in Female Victimization

Korea has experienced a steady increase in the reported number of total crimes (i.e., customary and regulatory crimes) over the last four decades. Since 2000, in particular, customary crimes rapidly increased (see Figure 1). This trend is also characterized by a surge in violent (heinous) crime (C^v)—a subset of customary crimes including homicide, robbery, rape, and arson—which is perceived to be most threatening.[3] For example, C^v increased at an annual growth rate of 4.8% for the 2000–2011 period, higher than regulatory and other categories of customary crimes. The average growth rate of C^v even reached 8.8% for the 2008–2011 period.

More importantly, the surge in C^v was accompanied by an increase in female victimization. Statistics Korea and the Ministry of Gender Equity and Family recently reported that only 6.8% of female respondents expressed 'feeling safe' from the fear of crime. Accordingly, the share of female victims of violent crimes was reported to be as high as 84.6% in 2011 and about 90% in 2013—a large increase from 73.0% in 1995.

This peculiarity regarding female victimization is confirmed by the United Nations Office on Drugs and Crime (UNODC). According to *Global Study on Homicide 2013* by the UNODC (2014), the percentage of female homicide victims in Korea (52.5%) was higher than the Organization for Economic Co-operation and Development (OECD) average by about 18 percentage points.[4] Korea was thus ranked 3rd among OECD countries and 5th among the 207

[3] McCollister et al. (2010, 25) estimated the social costs of various crimes using the U.S. data and found that violent crimes incur the highest costs.

[4] The *Global Study on Homicide*, based on the United Nations Office on Drugs and Crime Homicide Statistics dataset, covers 219 countries and territories since 2012. Also, a recent report by the Violence Policy Center (2015) reveals that, in the U.S. in 2013, 1,615 females were murdered by males in single victim/single offender incidents that were submitted to the Federal Bureau of Investigation's (FBI) for its *Supplementary Homicide Report*. In particular, the U.S. Department of Justice confirmed that women are significantly more likely to be the victims of violent crimes committed by intimate partners.

countries for the female homicide victims. Note that homicide is a violent crime with the least reporting bias problem (Fajnzylber et al. 2000, 219).

This paper proposes that female socioeconomic characteristics have significantly contributed to this adverse phenomenon. Until recently, victimization has received scant attention in the economics of crime literature.[5] The existing economic studies of victimization mainly focused on how potential victim's behaviors affect their victimization risk (e.g., Glaeser and Sacerdote 1999; Levitt 1999; Fajnzylber et al. 2000; Gaviria and Pagés 2002). Only a few studies have examined the effect of female-related variables on the supply of crime—in association with the offender's incentives (e.g., Raphael and Winter-Ebmer 2001; Saridakis 2004; Aizer 2010). Our paper thus takes a more conventional approach to crime supply in order to explain the relationship between the crime rate and female victimization.

[Figure 1 here]

2.2 A Simple Model of Violent Crime and Female Victimization

Our model builds on previous studies of crime supply: Becker (1968) and Ehrlich (1973) for deterrence framework, and Bourguignon (2000) and Fajnzylber et al. (2002b) for the link between income inequality, moral values, and crime.

We consider an individual i who either earns income, w_i, in the (legal) labor market or receives monetary benefits, x, through criminal activities.[6] A potential offender incurs the total

[5] In criminology and sociology, victimization studies were launched in full force with the advent of major theories such as lifestyle-exposure theory (Hindelang et al. 1978) and routine activity theory (Cohen and Felson 1979) in the late 1970s. Cohen et al. (1981) subsequently merged the two in the 'opportunity theory'. After about a decade, the opportunity theory became the *modus operandi* for the current major theories of victimization (Meier and Miethe 1993). Cohen et al. (1981) argued that exposure to crime (defined as the physical visibility and accessibility of persons or objects to potential offenders at any given time or place) is indicative of one's vulnerability to crime. They claim that the factors of target attractiveness include income, protective environment, and the capacity of people to resist attack.

[6] x can be interpreted as the monetary equivalent gain from crime reflecting an *average* income of the target group.

cost, c, associated with planning and executing the crime, which, among other things, depends on the potential victim's capacity to protect him/herself. The criminal is arrested (and convicted) with probability p, and pays a penalty f (i.e., a monetary equivalent of punishment). We assume that f is proportional to the initial income w_i (Bourguignon 2000). A rational individual i thus commits a violent crime (C^v) if the expected net benefit of committing a crime is greater than μ, a pecuniary value that the agent assigns to his moral standard.

Assuming a logarithmic utility function, we can write the individual i's decision as

$$(1) \qquad NB_i = (1-p)\cdot \ln(w_i + x) + p\cdot \ln(w_i - f) - c - \ln w_i \geq \mu.$$

In (1), μ can be interpreted as the moral cost of committing a violent crime, indicating social disapproval of deviation from the law. As the level of moral costs decreases, the social pressure to abide by the laws decreases. Let $\underline{w}$ denote a threshold level of income that distinguishes potential criminals ($w_i \leq \underline{w}$) from others—that is, for all $w_i \leq \underline{w}$, $NB_i \geq \mu$. Noting that NB_i is decreasing in w_i for all levels of w_i, equation (1) indicates that $\underline{w}$ is a function:

$$(2) \qquad \underline{w} = \underline{w}(\underset{-}{c}, \underset{-}{\mu}, \underset{+}{x}, \underset{-}{f}, \underset{-}{p}).$$

From equations (1) and (2), individual i's supply of C^v can be shown as $C^v = C^v(c, \mu, x, f, p)$, where each factor affects i's decision to commit an offense (Becker 1968; Benson et al. 1994; Ehrlich 2010). Specifically, C^v can be written as a probability that a potential criminal finds that his labor income is below $\underline{w}$:

$$(3) \qquad C^v = \Pr\left(w_i \leq \underline{w}\right).$$

For simplicity, assume that w_i is uniformly distributed on $[\bar{w} - d/2, \bar{w} + d/2]$, where $\bar{w}$ is the average value, and $\bar{w} > d/2$. C^v in (3) can be rewritten as:

$$C^v = 1/2 + 1/d \times (\underline{w} - \bar{w}). \quad (4)$$

In equation (4), as $\underline{w}$ increases, a potential offender is more likely to commit violent crime. Equations (2) and (4) give the following comparative static derivatives with respect to c, μ, and x:

$$\partial C^v / \partial c < 0, \ \partial C^v / \partial \mu < 0, \ \partial C^v / \partial x > 0. \quad (5)$$

Extended social activities by females such as working more night shifts indicate an increase in the 'female exposure to crime (FEM_EXPO)' over time. In general, females have lower protection capacity against crime than males for the same level of exposure (Hurwitz and Smithey 1998; Faris and Felmlee 2014). This increase in vulnerability lowers the expected cost of committing crimes, c. Thus, as shown in (5), an exogenous increase in FEM_EXPO should increase C^v, other things equal. In addition, females in the target group have a higher likelihood of being victimized.[7]

Economic status of females is another important determinant of female victimization. As female workers begin to achieve a higher economic status (through new or better paying jobs), potential offenders perceive that overall c for the potential target group has reduced (because females now replace male workers who were previously in the target group). Thus, the higher 'female proportion in the target group (FEM_STATUS)' increases the supply of C^v as shown in (5). Thus, we have the following conjectures:

[7] Intuitively, potential criminals are more likely to encounter female workers because females in the target group are more exposed.

(6) $\partial C^v / \partial \text{FEM\_EXPO} > 0$ and $\partial C^v / \partial \text{FEM\_STATUS} > 0$.

Intuitively, rational offenders who maximize the expected net benefits take into account the expected cost of crime, which tends to fall as female exposure and economic status increase over time. Thus, the supply of violent crime eventually increases, and so does female victimization because females are more exposed and represent a larger proportion of the target group. Note that this hypothesis holds even if criminals do not know the gender of their victims in advance. These results are overall similar to the predictions made in the criminology literature.

Potential Interaction between Female Victimization and Income Inequality

Income inequality (INQ) in Korea has significantly increased since the 1997 Asian financial crisis.[8] INQ is claimed to be closely associated with violent crime (C^v). Existing claims concerning the relationship between INQ and C^v are two-fold. First, a higher INQ creates the 'envy effect,' that is, people perceive that the distribution of income has become more unfair, thus reducing the moral cost of breaking the law, μ.[9] Second, the rising INQ potentially increases the (financial) gain from crime x. Potential criminals find that their returns to crime increase because wealthy victims have become wealthier (Fajnzylber et al. 2002b; Glaeser 2005). These two sources of association imply that $\partial C^v / \partial \text{INQ} > 0$.

So far, we have separately examined how female characteristics and income inequality affect

[8] Before 1997, Korea's income distribution was considered one of the most equitable among the OECD member countries. By 2011, however, the income gap between the richest and the poorest 10% of the population (i.e., the S90/S10 ratio) was 10.7 in Korea, ranked as the 9th highest among 33 member countries (OECD 2013, 4). The World Economic Forum (*Global Risks 2014*) defines the widening income inequality into ten global risks of highest concern in 2014, declaring that income disparity is among the most worrying of issues in the 10 years following the financial crisis of 2007–2008.

[9] Today, the notion of moral insensitivity seems to be a dominant factor in understanding the nexus between INQ and C^v. Although one cannot explain the envy effect explicitly, the existing literature has either assumed the existence of the envy effect or simply suggested the envy effect as an *ex-post* explanation for the empirical results obtained. Refer to Witt et al. (1988, 266), Fajnzylber et al. (2002b, 1328), or Sachsida et al. (2010, 95).

violent crime. Our analysis further implies that the effects of female victimization and INQ on C^v can be interrelated—because female characteristics (relevant for victimization) are associated with changes in INQ. Both can affect each other, and such interrelationship is two-fold.

First, a change in INQ affects female characteristics tied to victimization. It was shown earlier that a worsening INQ increases C^v. Suppose that the government at least partly responds to the increasing inequality by promoting female employment, for example, as Korean government has done (OECD 2014, 2015).[10] Consequently, an increase in the exposure of females to crime (or an increased proportion of females in the target group) will result in a further *increase* in C^v. Second, changes in female characteristics relevant to victimization can influence INQ. The aforementioned public policy efforts such as promoting female employment and narrowing wage gaps are expected to reduce income inequality. For example, the increased female employment lowers inequality, causing a *decrease* in C^v. Thus, this second effect would dampen the initial crime increase.[11]

In summary, not only the change in inequality but also the potential interaction between female characteristics and inequality appear to be important in determining the incidence of violent crimes. The effect of increasing inequality on C^v is definite as shown above. However, no unambiguous conclusion on the net effect of the interaction on C^v can be drawn due to the

[10] In fact, this recommendation came from various studies on labor markets or income distribution such as Blau and Kahn (1992) and Altonji and Blank (1999). They emphasized the importance of gender inequality in varying aspects.

[11] A simple illustration that represents these conjectures of conflicting forces can be made in terms of our model. FEM includes the characteristics of female exposure and economic status. Suppose that $\mathrm{INQ} = \mathrm{g(FEM)}$ and $\mathrm{FEM} = \mathrm{h(INQ)}$ where $\partial \mathrm{INQ}/\partial \mathrm{FEM} = \partial \mathrm{g}/\partial \mathrm{FEM} < 0$ and $\partial \mathrm{FEM}/\partial \mathrm{INQ} = \partial \mathrm{h}/\partial \mathrm{INQ} > 0$. Also, assume that $C^v = C^v\big(\mathrm{g(FEM)}, \mathrm{h(INQ)}\big)$ for demonstrating convenience. Then, with the simplified feature of $\mathrm{dFEM} = (\partial \mathrm{FEM}/\partial \mathrm{INQ}) \times \mathrm{dINQ}$, the total derivative of C^v with respect to INQ is as follows: $(\partial C^v/\partial \mathrm{INQ}) + [2 \times (\partial C^v/\partial \mathrm{FEM}) + (\partial C^v/\partial \mathrm{INQ} \times \partial \mathrm{INQ}/\partial \mathrm{FEM})] \times (\partial \mathrm{FEM}/\partial \mathrm{INQ})$. The first term indicates the marginal effect of income inequality. The second term represents the conflicting effects of INQ on C^v via FEM. The first component in the bracket increases C^v, while the second component decreases C^v by lowering INQ. Perhaps, these conjectures may be pertinent more for a longer-term effect of INQ. Nonetheless, as they are potentially important, we will attempt to empirically determine the sign of the conflicting forces by including an interaction term. We are grateful to a commentator for helping us to address this issue more clearly.

conflicting forces. Only empirical investigation will provide a clue on this issue.

3. DATA AND EMPIRICAL MODEL

We use a panel of 12 metropolitan regions in South Korea from 2000 to 2011. Data sources include the *Annual Crime Reports* (for crime rates and deterrence variables), and the Korean Statistical Information Service (http://kosis.kr) and the Ministry of Employment and Labor (http://laborstat.molab.go.kr) (for population, socioeconomic variables, and female characteristics). In addition, data on the number of prosecutions were collected from all district prosecutors' offices. To calculate the probability of prosecution, we grouped 58 district (and branch) offices into 12 metropolitan regions.[12] Finally, we used 'Korean Labor and Income Panel Study (KLIPS)' conducted by the Korea Labor Institute to calculate the 'Gini coefficient (GINI)' across 12 metropolitan regions.

The baseline equation for the supply function of violent crime (C^v) is given by:

$$CR^v_t = \beta_0 + \beta_1 P_{a_t} + \beta_2 P_{p_t} + \mathbf{X}'_t \boldsymbol{\gamma} + \mathbf{FEM}'_t \boldsymbol{\delta} + u_i + \varepsilon_t ,$$

where subscripts i and t indicate the 12 metropolitan regions and 12 years, respectively. The dependent variable is the crime rate of C^v (CR^v), defined as the annual number of violent crimes per 100,000 population. The mean of CR^v is 41.9 and the standard deviation for the entire sample is 9.3. The explanatory variables include the deterrence variables (P_a and P_p), various proxies for female victimization (FEM), and other control variables (X). Parameter u_i is the area fixed effects, and ε_t represents the error term.

Table 1 presents definitions and descriptive statistics of the variables used in this study. For

[12] The grouping reflects the availability of other regional data and the homogeneity in the office sizes.

the explanatory variables, we first consider two deterrence variables. The probability of arrest, P_a, is expected to have a negative impact on violent crime. In this paper, we focus on the probability of prosecution, P_p, because (1) P_p has fairly strong deterrence against customary crime in Korea (Kim and Kim 2015) and (2) P_p has decreased substantially since 2000 (with an average of annual growth rate of −1.4%). Also, we observe non–trivial variations in P_p.

We also considered socioeconomic and demographic variables, as listed in the second panel in Table 1. Since the early 1970s, many studies have found a positive effect on CR^v of certain age groups in a predominantly male population (Freeman 1996). Because we do not know such age groups in the male population *a priori*, we use the percentage of the male population aged 40–49 (Population_Male). The *Annual Crime Reports* (2012) show that males aged between 40 and 50 dominate participation in crimes in Korea. It is also well known that participation in the legal labor market reduces the propensity to commit crime, thus making the unemployment rates a popular proxy. Since the 2000s, the unemployment rate among a certain group has been extensively explored in search of a variable representing a more crime-prone group (see Mustard 2010).[13] In this regard, we use the unemployment rate among non-college educated people (UNEMP_Low Edu) to capture the unemployed with low education. In addition, the wage rate or salary income is often used as alternative proxy for the labor market participation. Related studies also employed disaggregated statistics in labor market (e.g., Cornwell and Trumbull 1994; Doyle et al. 1999). In the similar spirit, we use the monthly wages in the construction industry (WAGE).

In addition, we include two variables to control for family environment. Family disruption,

[13] For example, Raphael and Winter-Ebmer (2001), Gould et al. (2002), and Lin (2008) argued that the overall unemployment rate may not help identify the marginal criminal. Thus, researchers attempted to identify crime-prone groups such as younger, male, or lower-educated classes (Tauchen 2010).

usually measured by the divorce rates or the share of female-headed households, indicates the instability of family structure (Liu et al. 2013). Divorce can increase CR^v through family conflicts or by resulting in economic hardship. This hypothesis has been verified in many studies from Sampson (1986) to a recent study by Cáceres-Delpiano and Giolito (2012). We use the number of divorces per 100,000 population (DIVORCE). While the mean DIVORCE is not high (45.4), inter-regional differences have increased particularly since 2007. Moreover, Glaeser et al. (1996), Levitt (1998), and Kelly (2000) reported that CR^v is higher when the head of the household is female.[14] We use the number of female heads (aged 55 to 69) per 1,000 households (FEMHEAD) because the size of this group shows relatively high variations across regions.

Two additional variables are considered. First, alcohol consumption has appeared in the literature that estimates the crime supply function. The underlying presumption is that consuming criminogenic (or crime-related) commodities is highly related to the incidence of crime (Cook and Moore 1993, 152; Lin 2008, 419). Saridakis (2004, 217), in particular, emphasized that alcohol consumption is an important predictor of violent crime that should not be omitted. Markowitz (2005, 22) also suggested that excessive alcohol consumption is associated with more aggressive and violent behavior. We use alcohol expenditure per capita (Alcohol_Spending).

Second, income inequality (INQ) is another important determinant of crime both theoretically and empirically. Earlier research on the nexus between crime and inequality, however, focused on property crime because both INQ and property crime are considered as economic phenomena. Since 2000s, however, INQ has been widely understood as an important factor of

[14] Gottfredson and Hirschi (1990) argued that weak family structures with low self-control in children could be a source for criminal behaviors. DIVORCE and FEMHEAD have similar effects on CR^v, but FEMHEAD may capture other characteristics since it can be an outcome of being a widow or single (except for being a divorcee).

C^v.[15] In this paper, the degree of INQ is measured by the GINI index that has been popular in the literature. The average GINI for the 12 years is 0.392.

Finally, in the third panel of Table 1, we include six female characteristics variables to capture our theoretical conjecture on female victimization in Section 2. In earlier studies, female-related proxies were mainly used to explain lifestyle-exposure and routine activities hypotheses (Hindelang et al. 1978; Cohen and Felson 1979; Cohen et al. 1981). Chapman (1976), for instance, found that the female labor participation rate has a significantly positive effect on crime. In the economics literature, a relatively small number of studies employed these proxies in order to capture the effect of gender composition (see Witt and Witte 2000; Raphael and Winter-Ebmer 2001; Saridakis 2004; Aizer 2010).

Regarding overall female exposure, extended social activities by female labors indicate an increase in female exposure to crime over time. We adopt the female labor force participation rate (EXPOSURE1) and the female employment rate (EXPOSURE2)[16]—popular proxies in criminology (e.g., Blanco and Vila 2008; Xie et al. 2012) as well as a relative small number of economic analyses (e.g., Witt and Witte 2000; Raphael and Winter-Ebmer 2001). Both EXPOSURE1 and EXPOSURE2 slowly but steadily increased after 2000,[17] indicating an increase in female exposure.

[15] Nonetheless, existing empirical investigations have produced mixed results. For example, Fajnzylber et al. (2002a, 2002b), Lerderman et al. (2002), and Saridakis (2004) confirmed a positive relationship, while estimates were statistically insignificant in Doyle et al. (1999), Neumayer (2005), and Haddad and Moghadam (2011). Chintrakahn and Herzer (2012) even found a negative relationship.

[16] It is also called the employment-to-population ratio which is, according to Paul Ashworth, one of the best measures of labor market conditions.
(http://money.cnn.com/2012/10/18/news/economy/other-unemployment-rate/index.html)

[17] Two variables increased with the same average annual growth rate of 0.2% for our sample period. In estimation, the coefficient of EXPOSURE2 had a correct sign but was insignificant. We then speculated that the effect of EXPOSURE2 might vary depending on age groups. First, the distribution of female victims of C^v was heterogeneous across age groups. Moreover, based on *Women's Lives through Statistics* in 2015 by Statistics Korea and the Ministry of Gender Equity and Family, the time spent outside, for example, for income-generating work and for commuting was greatest for the 30s followed by the 40s and the 50s. Thus, we decided to focus on these age groups for EXPOSURE2. This is equivalent to effectively identifying a *victim-prone group*, similar to identifying *crime-prone groups* for potential criminals in the economics of crime literature.

According to the Population and Housing Census by Statistics Korea, the number of one-person households has rapidly increased since 2000. One-person households constituted 23.9% of the total households in 2010, an increase by 8.4 percentage points from 2000.[18] One-person female households have also increased rapidly, especially among the age groups of 25 to 29 and 70 and over.

Criminological literature such as Hindelang et al. (1978), Sampson and Wooldredge (1987), and Meier and Miethe (1993) have revealed that living alone increases the risk of exposure to crime due to the tendency to engage in more public activity, leading to an increase in (violent) victimization.[19] Because data on one-person households of unmarried females—an excellent proxy to reflect this proposition in criminology—are not available for each area, we instead use the female heads of the unmarried households. We focus on the age group of 25 to 29 because we expect that females in this group live alone and are very active. Thus, our third proxy of exposure (EXPOSURE3) is young unmarried female-headed households as a share of the total female-headed households.

We now consider the economic status of females, another crucial determinant of female victimization. As female workers achieve higher economic status, for instance through better paying jobs, potential offenders perceive that the average cost of committing crime against the target group has reduced as explained in Section 2. The earlier literature often used the female unemployment rate (Raphael and Winter-Ebmer 2001; Ochsen 2010; Cook et al. 2013) and (relative) female wage (Vieraitis and Williams 2002; Blanco and Villa 2008; Aizer 2010) as

[18] That figure is estimated to be close to one in every four households in 2015. This does not appear to be a unique phenomenon of Korea. For example, according to the U.S. Census Bureau, the number of one-person households is increasing. In 1970, only 17% of American households were considered one-person and this figure grew steadily over the past four decades, reaching 25.5% by 2000. In 2012, it increased further to 27.4%. Also, according to Euromonitor International, this phenomenon is most distinct in Northern European countries such as Sweden (47%) and Norway (40%).

[19] According to a survey of 570 female one-person households by the City of Seoul in 2012, the fear of crime (e.g., sex assault and rape) was the most difficult problem for 77% of the respondents.

proxies for the economic status of females. Similarly, we use the female unemployment rate (STATUS1) and the ratio of female monthly wages to all workers' monthly wages (STATUS2).[20]

In Section 2, we conjectured that females with jobs tend to *replace* male workers who were previously in the target group *ceteris paribus*. As a new proxy in the literature, we employ the proportion of job gains among females to the working-age (15+) female population (STATUS3).[21] If our new proxies for female exposure and economic status, EXPOSURE3 and STATUS3, explain the incidence of violent crime, C^v, they can also be expected to play an important role in interaction with INQ.

[Table 1 here]

4. EMPIRICAL RESULTS

We now empirically investigate our main conjecture on the relationship between violent crime and female victimization. As a baseline estimation, **BASE1** of Table 2 simply includes the probability of prosecution (P_p) and the probability of arrest (P_a).[22] The coefficients on P_a and P_p are negative and statistically significant, and the estimates are fairly robust throughout the specifications. In Section 3, P_p was expected to play an important role. The estimates show that prosecution indeed represents a stronger deterrence of violent crime than arrest, consistent with Trumbull (1989, 430), Mustard (2003, 209), and Entorf and Spengler (2015, 187).[23]

[20] Due to unavailability of STATUS2 after 2010, we applied an extrapolation for years 2010 and 2011.
[21] Since the data of job gains among females were unavailable across regions, we approximated it by calculating annual differences in total female workers at all-size establishments. The differences would reflect the new employment across regions and, thus, the differences in the female's economic status.
[22] To the best of our knowledge, this is the first attempt to include P_p in the studies of the nexus between violent crime and female victimization.
[23] A possible reason for the greater deterrence of P_p is that the sample average of P_p is only about the half of P_a.

BASE2 of Table 2 adds the traditional socioeconomic variables.[24] Social variables such as DIVORCE and FEMHEAD have expected signs with statistical significance, and they are robust throughout the specifications. Among the economic variables, the coefficient on UNEMP_Low Edu is positive and statistically significant, while WAGE is not significantly associated with violent crime. In line with the literature, the coefficient on Alcohol_Spending is positive and statistically significant.[25] We also added GINI in **BASE2** to investigate the nexus between C^V and INQ. GINI has a positive impact but an insignificant one. This result is consistent with Soares (2004) who concluded from a review of 16 studies that the effects of INQ and crime rates vary from positive and to insignificant.

More importantly for our purpose, we test for the effect of female victimization associated with the female exposure and economic status. Our economic model suggested that extended social activities by females indicate an increase in female exposure to crime over time. **FEM_E** in Table 2 show the results of overall female exposure. The coefficient of female labor force participation rate (EXPOSURE1) in **FEM_E1** is negative but statistically insignificant. In **FEM_E2**, however, the coefficient of female employment rate (EXPOSURE2) is positive and significant at the 1% level.

As explained in Section 3, victimization risk is the highest for the young, the singles, and those who frequently go out at night and leave their homes empty (Sampson and Wooldredge

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We suspect that the law of diminishing marginal returns would hold in the production of deterrence. We have not undertaken the same task, but our general sense is that public prosecutors and their inputs, among different law enforcers in the entire criminal justice system, may play the most dominant role in explaining the variation of crime rates in Korea as recently suggested by Entorf and Spengler (2015) for the case of Germany. On average, the total number of prosecutors, who have the exclusive authority over public prosecution in Korea, is only about 1,260 nationwide for a country that has a population of nearly 50 million.

[24] Because violent crimes are growing during the sample period, part of the estimates may be an upward trend in violent crimes. To deal with the potential bias, we included a dummy variable that is 1 for the years 2005, 2007 to 2010—a period of surge in violent crimes.

[25] For instance, Saridakis (2004, 204) argued that alcohol consumption should not be omitted from any violent crime specification when modeling violent offences.

1987, 371). In **FEM_E3**, the coefficient of young unmarried female-headed households (EXPOSURE3) has a positive sign with statistical significance. Thus EXPOSURE3 appears to be a new proxy that clearly reflects, in terms of female vulnerability, our theoretical account of link between female exposure and violent crime.

For the nexus between economic status of females and violent crime, the existing literature has often used the female unemployment rate and the relative female wage. Unemployed females should be less attractive targets of crime other things equal. The coefficient estimate of STATUS1 in **FEM_S1** is insignificant. However, as suggested by Blanco and Villa (2008) and Aizer (2010), the relative female wage (STATUS2) in **FEM_S2** has a positive sign with statistical significance.

In Section 3, we explained that our new proxy, STATUS3, better reflects the claim that female labors, through job gains, substitute for male workers who were previously in the potential target group. A greater ratio of females within the target group would be associated with a decrease in the overall cost of crime, thus leading to an increase in violent crime. The coefficient of STATUS3 in **FEM_S3** is positive and statistically significant at the 1% level.

Finally, **FEM_E2_S2** and **FEM_E3_S3** in Table 2 include both female exposure and economic status. The sizes of coefficient estimates remain qualitatively similar, and estimation results of the two specifications were robust. This confirms our hypotheses regarding the nexus of violent crime and female victimization. The marginal impact analysis based on **FEM_E3_S3** reveals that 2,050 more violent crimes (in 2011 population) would result in when EXPOSURE3 and STATUS3 increase by a 1 percentage point and by a 0.72 percentage point (i.e., one standard deviation), respectively. Note that the marginal impact in **FEM_E3_S3** is greater than the marginal impact (i.e., 1,330 more violent crimes) based on **FEM_E2_S2**, which is a more

conventional specification in the literature. We now turn to the hypothesis that female victimization aggravates the adverse effect of income inequality.[26]

[Table 2 here]

4.1 Interaction between Female Victimization and Income Inequality

In this subsection, we test second hypothesis regarding the interactive effects on C^v of female victimization and INQ. As explained in Section 2, the net effect of the interaction on CR^v was expected to be indefinite. We use specifications in **FEM_E2_S2** and **FEM_E3_S3** in Table 2.

NTERACT1 and **NTERACT2** in Table 3 report the results of estimating the interactive effects for EXPOSURE2 and STATUS2, respectively. For instance, **NTERACT1** adds GINI * EXPOSURE2 in order to examine effect by higher exposure.[27] The coefficient of GINI * EXPOSURE2 has a relatively large positive value (7.76). In **NTERACT2**, however, the coefficient of GINI * STATUS2 was positive but insignificant.

NTERACT3 includes both GINI × EXPOSURE2 and GINI × STATUS2 (there is no multicollinearity between the two interactive variables). Only the coefficient on GINI ×

[26] As the customary practice in the literature, we conducted the endogeneity test for deterrence variables (P_a and P_p) in the two final specifications (i.e., **FEM_E2_S2** and **FEM_E3_S3**). Following Kim and Kim (2015), in terms of the instrumental variables for P_a, we used 'police manpower per 100,000' and 'one-year lagged P_a'. For P_p, 'the number of prosecutors per 100,000' and 'one-year lagged P_p' were used. The Durbin–Wu–Hausman (DWH) tests confirmed exogeneity for P_a and P_p. Furthermore, we also tested potential endogeneity for the female characteristics. CR^v rose over the period 2000-2011, and the values of female characteristics (i.e., female exposure and economic status) overall increased, too. This co-movement indicated a potential problem of omitted variables. In terms of instrumental variables for the six female-related variables, we used, for each variable, the 'one-year lagged value' and the 'first-differenced value' (Doyle et al. 1999; Fajnzylber et al. 2002a). The DWH statistics (χ^2) ranged from 0.23 to 1.51, confirming exogeneity of the six variables. Detailed test results are available upon request.

[27] There is severe multicollinearity between GINI and the interaction term (correlation coefficient = 0.873). To overcome this purely 'statistical problem,' we monotonically transformed EXPOSURE2 to a discrete variable which takes a value of 1 if its value is within the top 20% in the sample. The correlation coefficient was then 0.143 so that the multicollinearity problem disappeared. This method was used for **NTERACT2** where the original correlation coefficient was as high as 0.927, and also applied for STATUS2, EXPOSURE3, and STATUS3.

EXPOSURE2 is positive and significant. **NTERACT4** and **NTERACT5** show the estimation results of the interactive effects using our new proxies, EXPOSURE3 and STATUS3, respectively. Similar to **NTERACT1** and **NTERACT2**, we obtain a significant result only for GINI ∗ EXPOSURE3. **NTERACT6** includes both EXPOSURE3 and STATUS3, and the results are similar to **NTERACT3**.

Therefore, the conflicting effects generally appear to be in force. Nonetheless, an aggravation of the CR^v-increasing effect of income inequality via increased female exposure has been partially confirmed. Although experimental in nature, our work suggests that female victimization might play a catalytic role in terms of the nexus between C^v and INQ. Based on estimation results in **NTERACT6**, the marginal impact analysis reveals that 4,130 more violent crime (in 2011 population) would result in when EXPOSURE3 and STATUS3 increase by a 1 percentage point and by a 0.72 percentage point (one standard deviation), respectively. In fact, 4,130 violent crimes correspond to about 14% of the actual number of violent crimes in 2011.

[Table 3 here]

5. CONCLUSION

Despite its importance in criminal justice policy, the victimization phenomenon has received far less attention than the supply side of crime in the economics literature. Since 2000, violent crime in Korea has increased more rapidly than any other category of customary crimes. More importantly, the surge in violent crime was accompanied by a record high rate of female victimization.

This paper has investigated the relationship between violent crime and female victimization. In general, females are less capable of protecting themselves, which lowers the expected cost of

committing crimes against them relative to men. We claimed that the 'overall female exposure' and the 'female proportion in the target group' have a worsening effect on violent crime, leading to an increase in female victimization. Furthermore, we theoretically show that the effects of female victimization and income inequality on violent crime can be interrelated as female characteristics relevant for victimization are associated with changes in inequality. Nonetheless, no unambiguous signing on the net effect of the interaction was derived because both factors affect each other in the conflicting fashion.

We used a panel of metropolitan regions in Korea from 2000 to 2011. In particular, we employed new proxies of female characteristics, in addition to those commonly used in the literature, that would better reflect our hypotheses—for example, young unmarried female-headed households (for female exposure) and new job gains among females (for economic status).

Estimation results are overall fairly encouraging. First, we found that the deterrence hypothesis holds. In particular, prosecution represents stronger deterrence of violent crime in all specifications. Second, we obtained expected estimates for key control variables such as economic conditions, social variables (e.g., divorce and female-headed household), and alcohol expenditure.

Most importantly, we found evidence for our two main hypotheses. Regarding the first hypothesis, our estimation shows that 1,860 more violent crimes (in 2011 population) would occur when young unmarried female-headed household and job gains among females increase by a 1 percentage point and by a 0.72 percentage point, respectively. This number corresponds to about 6.4% of the actual number of violent crimes in 2011. In addition, we partially confirmed the weak interaction of female victimization and income inequality in affecting the crime rates.

The marginal impact analysis indicates that, in terms of female exposure, the interactive effect accounted for approximately 7.8% of the actual number of violent crimes that occurred in 2011, given the average of the Gini coefficient. (Thus, the two–prone effects of the female characteristics suggest a total marginal effect of 14.2%.) This is the first attempt to empirically examine the interactive effects of female victimization and income inequality on violent crime.

Our findings have implications for the policies designed to prevent female victimization. In Korea, for instance, the National Police Agency recently designated a safety zone so that women can return home safely late at night. Another example is the extended use of the Crime Prevention through Environmental Design (CPTED) which has been adopted in developed countries such as U.S., U.K., Australia, and Netherlands.[28] The effectiveness of both safety zones and CPTED can be enhanced by thoroughly examining the overall regional safety environment including the proportion of female victims, the occupational characteristics, and crime rates and patterns.[29] Furthermore, Samans et al. (2015) reported that women's labor force participation in Korea is among the lowest in advanced economies. To the extent that Korean government has recently pledged to raise female's overall economic activities, our study suggests that policy makers should also design a set of policies to counteract a likely increase in female victimization.

[28] CPTED is a multi-disciplinary approach to deterring criminal behavior through environmental design for cities and architecture. The basic idea of CPTED is to use interdisciplinary knowledge and creativity to build surroundings in ways that reduce the fear from, and prevent the incidence of, crimes (Cozens 2008; Willman 2011).

[29] A series of criminological literature suggests that voting is an important indicator for reducing female victimization as it leads to political avenues to improve female safety (Lee 2008; Xie et al. 2012). Although the degree of effectiveness regarding this argument may be subject to empirical verification in Korea, more serious research on this area also seems to be of benefit to derive efficient policies in the longer-term.

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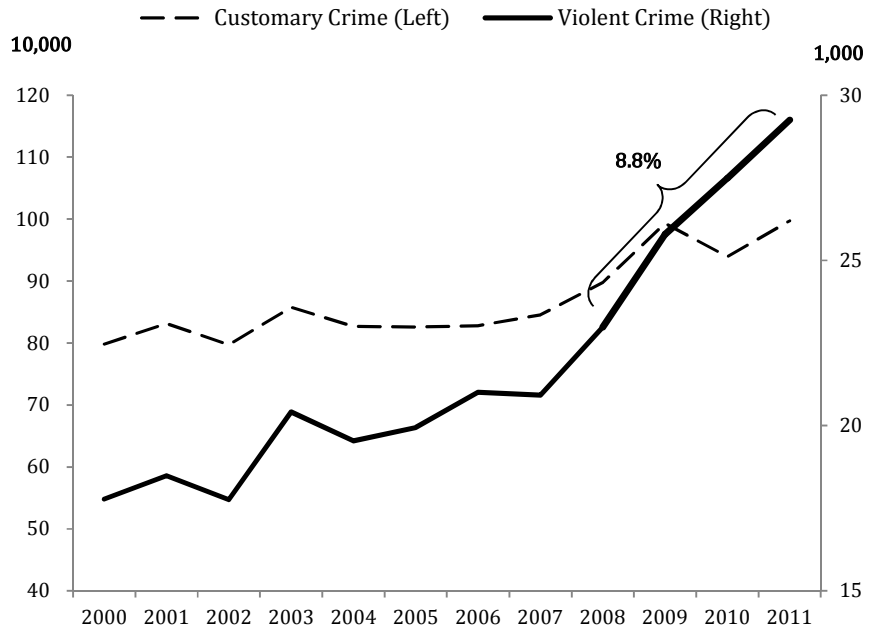
Figure 1

Frequency of Customary and Violent Crime



Source: *Annual Crime Reports,* The Supreme Prosecutors' Office of Korea

Table 1

Definition of Variables and Descriptive Statistics

Variables	Description	Mean (S.D.)
Crime and Deterrence Variables		
CR^v	Reported violent crimes per 100,000 population	41.9 (9.3)
P_a	Probability of arrest for violent crime (%)	91.0 (6.5)
P_p	Probability of prosecution for violent crime (%)	50.5 (7.1)
Socioeconomic Variables		
Population_Male	Percentage of the male population aged 40 to 49 (%)	8.6 (0.7)
UNEMP_Low Edu	Unemployment rate for non-college educated people (%)	3.3 (1.1)
WAGE	Monthly wages in the construction industry (KRW)	1,410.3 (210.3)
DIVORCE	Number of divorces per 100,000 population	45.4 (8.7)
FEMHEAD	Number of female-headed (aged 55 to 69) per 1,000 households	50.7 (10.7)
Alcohol_Spending	Alcohol and tobacco expenditure per capita (KRW)	258.6 (23.2)
GINI	Gini coefficient	0.392 (0.037)
Female Characteristics Variables		
EXPOSURE1	Female labor force participation rate (%): i.e., proportion of female labor force (employed & unemployed) to the working-age (15 +) female population	49.0 (2.4)
EXPOSURE2	Female employment rate (%): i.e., proportion of female employment (aged 30 to 59) to the working-age (15 +) female population	48.9 (2.5)
EXPOSURE3	Proportion of young unmarried female-headed households (aged 25 to 29) to the total female-headed households (%)	5.5 (1.9)
STATUS1	Female unemployment rate (%)	2.9 (0.9)
STATUS2	Average ratio of female's to all workers' monthly wages (%)	71.2 (4.2)
STATUS3	Proportion of female's new job gains to the working-age (15+) female population (%)	0.85 (0.72)

Table 2

Supply Function of Violent Crime: With Focus on Female Characteristics

	BASE1	**BASE2**	**FEM_E1**	**FEM_E2**	**FEM_E3**	**FEM_S1**	**FEM_S2**	**FEM_S3**	**FEM_E2_S2**	**FEM_E3_S3**
P_a	-0.2702**	-0.2737***	-0.2742***	-0.2296**	-0.2774***	-0.2759***	-0.2798***	-0.2232**	-0.2412***	-0.2351**
	(0.1130)	(0.0930)	(0.0933)	(0.0914)	(0.0897)	(0.0935)	(0.0900)	(0.0912)	(0.0893)	(0.0901)
P_p	-0.4760***	-0.4041***	-0.3950***	-0.3787***	-0.2852**	-0.4035***	-0.2882**	-0.3834***	-0.2818**	-0.2818**
	(0.0892)	(0.1280)	(0.1308)	(0.1244)	(0.1290)	(0.1284)	(0.1296)	(0.1251)	(0.1267)	(0.1268)
Population_Male		0.3048	0.0975	2.0217	0.7545	0.2951	2.7706	1.9163	0.8891	1.1428
		(1.9480)	(2.0341)	(1.9768)	(1.884)	(1.9550)	(2.1398)	(2.0713)	(2.2173)	(2.0330)
DIVORCE		0.3335***	0.3289***	0.3061***	0.2696***	0.3352***	0.3082***	0.2791***	0.2880***	0.2319***
		(0.0593)	(0.0608)	(0.0583)	(0.0606)	(0.0597)	(0.0580)	(0.0613)	(0.0572)	(0.0619)
FEMHEAD		0.4283**	0.4383**	0.4217**	0.5648**	0.4262**	0.5663***	0.4765**	0.5424***	0.5889***
		(0.2042)	(0.2067)	(0.1980)	(0.2016)	(0.2050)	(0.2028)	(0.2000)	(0.1985)	(0.1985)
UNEMP_Low Edu		2.1372**	2.1746**	2.6231**	2.6696**	2.5389*	2.5463**	2.2324**	2.9092***	2.6865***
		(1.0436)	(1.0522)	(1.0254)	(1.0205)	(1.4902)	(1.0190)	(1.0185)	(1.0063)	(1.0035)
WAGE		-0.0041	-0.0038	-0.0070	-0.0083	-0.0040	-0.0016	-0.0035	-0.0044	-0.0073
		(0.0056)	(0.0056)	(0.0055)	(0.0055)	(0.0056)	(0.0054)	(0.0054)	(0.0054)	(0.0054)
Alcohol_Spending		0.1135**	0.1141**	0.0869*	0.0605	0.1113**	0.0568	0.1252***	0.0415	0.0764
		(0.0449)	(0.0451)	(0.0444)	(0.0464)	(0.0454)	(0.0473)	(0.0440)	(0.0466)	(0.0462)
GINI		5.3176	4.4308	14.0390	2.7454	5.9053	1.0569	10.2319	9.1084	7.1274
		(16.7573)	(16.9880)	(16.5187)	(16.1848)	(16.8878)	(16.2792)	(16.4457)	(16.2243)	(16.0314)
EXPOSURE1			-0.1800							
			(0.4881)							
EXPOSURE2				1.6763***					1.4390**	
				(0.5682)					(0.5615)	
EXPOSURE3					3.0811**					2.7215***
					(0.9689)					(0.9658)
STATUS1						-0.5966				
						(1.5747)				
STATUS2							1.3667***		1.1855***	
							(0.4497)		(0.4453)	
STATUS3								2.1949***		1.8231**
								(0.8153)		(0.8038)
Adjusted R^2	48.6%	66.7%	66.5%	68.5%	69.0%	66.4%	68.8%	68.3%	70.1%	70.0%

Notes: · ***, **, and * represent statistical significance at the 1%, 5%, and 10%, respectively. Standard errors in parentheses. Constant term is included in all regressions and year dummy is included in all regressions except **BASE1**, but are not shown for brevity. The Adjusted R^2 was calculated from the LSDV estimation.

Table 3

Interaction between Income Inequality and Female Victimization

	NTERACT1	NTERACT2	NTERACT3	NTERACT4	NTERACT5	NTERACT6
P_a	-0.2404*** (0.0886)	-0.2407*** (0.0898)	-0.2401*** (0.0891)	-0.2130** (0.0901)	-0.2264** (0.0909)	-0.2023** (0.0909)
P_p	-0.2848** (0.1257)	-0.2840** (0.1294)	-0.2864** (0.1284)	-0.2583** (0.1263)	-0.2810** (0.1270)	-0.2566** (0.1264)
Population_Male	1.0002 (2.2001)	0.8778 (2.2295)	0.9924 (2.2124)	1.4099 (2.0192)	1.6114 (2.1208)	1.9580 (2.1072)
DIVORCE	0.2884*** (0.0568)	0.2888*** (0.0580)	0.2890*** (0.0575)	0.1687** (0.0705)	0.2305*** (0.0620)	0.1651** (0.0707)
FEMHEAD	0.5094** (0.1978)	0.5419*** (0.1994)	0.5090** (0.1987)	0.5855*** (0.1967)	0.6263*** (0.2044)	0.6285*** (0.2023)
UNEMP_Low Edu	2.9683*** (0.9987)	2.9038*** (1.0120)	2.9646*** (1.0044)	2.2924** (1.0175)	2.5730** (1.0153)	2.1489** (1.0301)
WAGE	-0.0049 (0.0054)	-0.0045 (0.0055)	-0.0049 (0.0055)	-0.0073 (0.0054)	-0.0077 (0.0055)	-0.0078 (0.0054)
Alcohol_Spending	0.0538 (0.0468)	0.0419 (0.0470)	0.0541 (0.0471)	0.0809* (0.0458)	0.0723 (0.0465)	0.0764* (0.0461)
GINI	8.4289 (16.0964)	9.2790 (16.3878)	8.5461 (16.2602)	9.8125 (15.9493)	7.7407 (16.0753)	10.6062 (15.9835)
EXPOSURE2	1.0533* (0.6000)	1.4376** (0.5640)	1.0526* (0.6026)			
STATUS2	1.1022** (0.4443)	1.1539** (0.5551)	1.0806* (0.5522)			
EXPOSURE3				2.4020** (0.9728)	2.8306*** (0.9772)	2.5171** (0.9815)
STATUS3				1.8849** (0.7970)	1.5618* (0.8703)	1.5862* (0.8615)
GINI × EXPOSURE	7.7575* (4.4878)		7.7522* (4.5074)	7.6169* (4.1984)		7.8655* (4.2100)
GINI × STATUS		0.3771 (3.9185)	0.2582 (3.8873)		4.3143 (5.4616)	4.9661 (5.4165)
Adjusted R^2	70.6%	69.9%	70.4%	70.6%	69.9%	70.5%

Notes: ***, **, and * represent statistical significance at the 1%, 5%, and 10%, respectively. Standard errors are in parentheses. Constant term and year dummy are included in all regressions, but are not shown for brevity. The Adjusted R^2 was calculated from the LSDV estimation.