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Causes of Crime: Insights from Institutional and Gender-based Analysis and Mapping

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Abstract
Crime deterrence has remained a policy priority for most countries. Despite the existence of policies and empirical work in this area, a gap in institutional interlinkages on deterrence, and the exploration of the gender angle to crime, exists. Consequently, a regression analysis of causes of crime was undertaken to fill the gap and advice policy. The analysis entailed using the two-step System GMM estimator and six-year panel data of cumulative and gender-disaggregated offences covering 47 Kenyan spatial units. A mapping of crimes preceded the regression analysis to elucidate crime's spatial and gender dynamics. The regression results revealed that crime persists in an environment characterized by a declining likelihood of apprehension and sub-optimal conviction rates. Institutional inefficiencies that prolong the celerity of punishment signal potential offenders to victimize. Enhanced public investments in policing and a higher propensity to earn lawful income reduce crime. Results also pointed to skewed opportunities for earning legal income for female persons. Further, the deterrent effect of heightened policing significantly impacts potential female offenders more than their male counterparts. To reduce crime, crucial institutional and gender-specific interventions have been proposed.
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1. Background

1.1 Introduction

Diverse disciplines, scholars, and policymakers have viewed crime differently. For instance, crime is the behaviour judged by the State to violate the prevailing norms that underpin society's moral code (Bun, Kelaher & Sarafidis, 2020). Despite the differences, the underlying concurrence is that crime is an undesirable phenomenon that harms society. For instance, crime undermines the rule of law and increases public expenditure for justice sector institutions. Rising crime destabilizes the security of property rights and investment decisions as investors spurn crime-prone areas. Subsequently, the ability of a nation to allocate resources optimally is adversely affected, undermining economic growth. Crime also adversely affects individual victims, with effects varying across gender. According to Piquero and Weisburd (2010), pain, suffering, and low quality of life are burdens of crime to the victims. Further, crime may cause trauma, give rise to precautionary expenditures, and instil avoidance behaviour in individuals.

The occurrence and persistence of crime, therefore, require to be mitigated. Since crime is undesirable, governments have arrogated, through various laws, the responsibility of mitigating the occurrence and perpetuation of crime. The mitigation strategies seek to reduce crime and its adverse effects on societal well-being. Some of the crucial strategies governments use include, among others, having a system of laws to deter crime and, whenever a crime occurs, investigating, apprehending, and punishing the perpetrators. Nonetheless, a crucial mitigation focus is continuous policy improvement, especially on gender-specific policy prescriptions, to enhance safety and observance of the rule of law.

In most instances, the desirable safety threshold is not always realized. Across many countries, varying levels of crime persist, with perpetrators being of either gender. Also, policy and knowledge gaps exist, especially the gender angle to deterrence. For instance, despite the crime control measures being in place over time in Kenya (Republic of Kenya, 2007, 2013 & 2018), the crime level has persistently remained high (Kenya National Bureau of Statistics (KNBS), 2022; National Crime Research Centre (NCRC), 2021). The crime level has also varied by gender (KNBS, 2022). The persistence of crime begs the question of whether there could be unexplored factors, especially the institutional and gender-based factors, which still cause offending despite mitigation measures being in place.

A regression analysis of the potential causes of crime was undertaken to answer this question and advice policy. Three supply of offenses functions, two of them being specific to male and female occasioned offenses, were estimated using a two-step system generalized methods of moments (GMM) estimator utilizing panel data of cumulative and gender-disaggregated offenses. Crime mapping across the Kenyan geographical areas preceded the regression analysis to elucidate crime's spatial and gender dynamics. The scope of the study is Kenya, a developing country with 47 counties. Each county faces unique and shared characteristics predisposing it to different types and levels of crime.

1.2 Intersection of Crime, Economic Setting and Institutions

The study is primarily anchored on an economic framework. In the economics of crime framework, individuals decide whether to engage their labour or time in legal or illegal income-generating activities by comparing crime's potential benefits and costs. The benefits and costs of crime vary depending on several factors. These benefits may vary from acquiring the basic survival needs to higher-order benefits, including non-monetary ones. For instance, in 1551, Thomas More linked the need for human survival, a social-economic phenomenon, and punishment, by asserting that '*Neither is there any punishment so horrible, that it can keep people with no other craft to get their living, from stealing…Provision should have been made for them to have some means to get their living so that no man should be driven to this extreme necessity, first to steal and then to die'.*

Crime studies using an economic framework can be traced back to the 18th century (Posner, 2004) with Cesare Beccaria's *Dei delitti e delle pene* in 1764 and Jeremy Bentham's *Introduction to the Principles of Morals and Legislation* in 1780. However, the most influential work is traced from the seminal paper by Becker titled '*Crime and Punishment: An Economic Approach',* published in 1968. In Becker's paper, the centrality of the argument was that individuals, considered rational, decide to commit crime after weighing the potential benefits and costs of crime. Crime is then committed once the benefits outweigh the costs (Becker, 1968).

In any society, crime imposes a burden on individuals, businesses and government institutions. The burden of crime is the real resource costs associated with producing, combating and punishing crime, and the opportunity costs of these activities. To an individual, the opportunity cost of crime consists of the net benefit of the forgone legal activity while planning, performing, and concealing the criminal act (Eide, Rubin & Shepherd, 2006). To society, the opportunity cost consists of additional benefits and welfare forgone that could have accrued if crime control resources were optimally invested in alternative income-generating ventures.

Crime imposes high operational costs on businesses, affects consumption patterns, and reduces production time. Jaitman (2019) asserts that crime generates distortions in allocating private and public resources and engenders economic and social costs that hinder economic growth. Sub-optimal economic growth may also, in reverse, exacerbate crime due to reduced government expenditure from a dwindling tax base.

The intersection of institutions and crime is anchored on the societal response to crime. The response to crime covers the prevailing laws, regulations, and structures. According to North, Wallis and Weingast (2009), institutions are fundamental in controlling crime by shaping the incentives of individuals who commit a crime. The actions of citizens and their proximate settings are constrained by, and are reflective of, the prevailing institutional order (Messner, 2014). To conceptualize the role of institutions in crime deterrence, certainty, severity, and celerity of punishment are crucial concepts. Certainty refers to the probability of legal sanctions upon commission of a crime, severity is the onerousness of the sanction imposed, while celerity is the lapse in time between the commission of a crime and its punishment (Nagin, 2013).

It is against the occurrence of crime that public institutions react through deterrence measures. Among the institutions are the police, prosecution, courts, prisons, and probation departments, commonly referred to as the criminal justice system institutions that administer justice. These institutions spend their resources on investigating, apprehending, prosecuting, punishing, and incarcerating individuals who commit crimes. To avert crime, a government policymaker decides on the level of resources to commit in preventing individuals from engaging their labour or time in illegal activities (Fu & Wolpin, 2018). The policymakers operate within institutional processes and procedures that bring diverse dynamics to crime prevention. Positive institutional interactions enhance efficient administration of justice and aid in avoiding convicting accused persons for crimes not committed or acquitting criminals who are guilty of offending.

Hence, supporting the institutions involved in crime deterrence is critical. Police clear-up cases through investigation, arrest, and handing over for prosecution (Lee & McCrary, 2017). The prosecutors then seek to maximize guilty verdicts in courts (van Tulder & van der Torre, 1999). In some countries, prosecutors apply discretionary powers to determine which cases to dispose off before trial by either dismissal of the charges or by imposing certain obligations on suspects in exchange for laying the file aside (Entorf & Spengler, 2015). Courts, through the application of laws and adduced evidence, resolve disputes. Prisons then play the role of incapacitation by isolating convicted persons from physical access to offending opportunities. The prisons also focus on rehabilitation programs to reorient prisoners' mindsets and skills to undertake legal work upon release and control recidivism.

1.3 Crime Mapping and Prevalence by Gender

Kenya comprises 47 counties with varying populations, economic endowments, infrastructural growth, and climatic conditions. In these counties, different levels and magnitude of crime exist, with perpetrators varying across gender. To mitigate crime, the Government has invested in criminal justice institutions across the country. Figure 1 shows the intensity of overall serious crimes across Kenyan Counties.

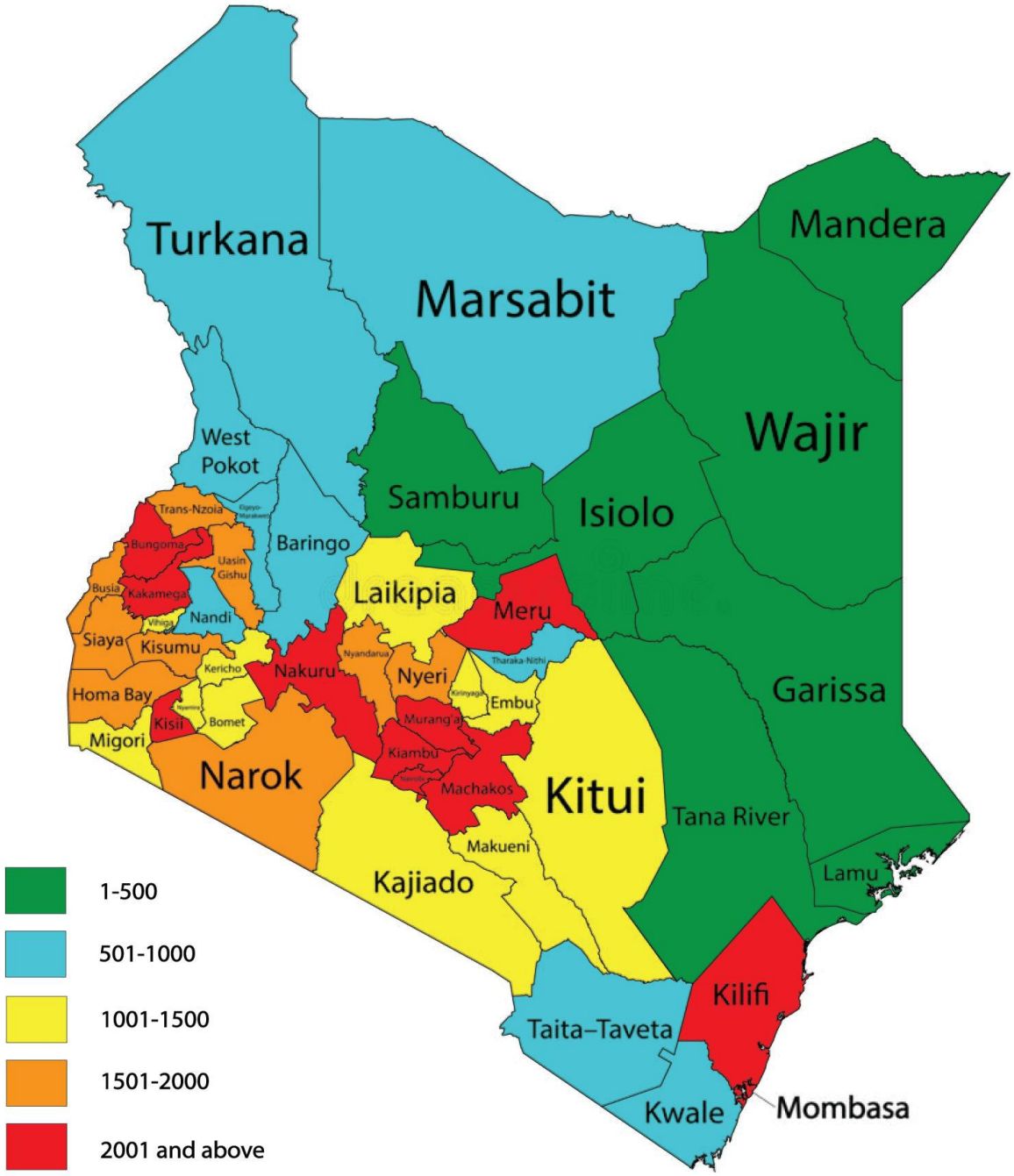

Figure 1: Overall serious crimes (Average for the period 2015-2020)

Source: Author's analysis using crime data sourced from the KNBS

From Figure 1, 11 counties had the highest incidents of victimization. The counties had an annual average of above 2000 serious crimes for the period 2015-2020. These counties are; Kilifi, Mombasa, Nairobi, Kiambu, Machakos, Murang'a, Meru, Nakuru, Kisii, Kakamega and Bungoma. The counties would therefore require strengthened deterrence measures. Another nine counties had an annual average of 1501 to 2000 offences over the same period. These are; Narok, Nyeri, Nyandarua, Homabay, Siaya, Kisumu, Busia, Trans-Nzoia and Uasin-Gishu. These counties would also require heightened measures to reduce the escalation of crimes.

The counties marked green had annual crimes averaging between 1 and 500. These counties are predominantly characterized by a lower population, perhaps a pointer to their relatively low crime level. Despite the low level of crime in these counties, some have experienced severe crimes like terrorism resulting in loss of life and adverse effects on maintaining law and order (National Police Service (NPS), 2020). Therefore, the low numbers of crime incidents may not necessarily imply limited adverse effects, as the impact of crime would also be primarily influenced by its nature and magnitude.

Concerning crime prevalence by nature of the offense, out of the 81,272 crimes reported to the police in

2021, robbery, theft, and stealing were the majority at 30 per cent (KNBS, 2022). They were followed by other offences against persons, comprising of assault, disturbances, and affray, at 28 per cent. Further, offences against morality stood at 10 per cent, homicides at 4 per cent, and the rest of crimes at 28 per cent. The offences against morality comprise rape, defilement, rape, sodomy, abduction, bigamy, indecent assault, and bestiality. On the other hand, homicides include murder, manslaughter, infanticide, causing death by dangerous driving, suicide, procuring abortion, and concealing a birth. The annual average prevalence for these crimes was more or less the same between 2015 and 2021(KNBS, 2022).

In comparison with the overall level of crime, crimes perpetrated by female persons is lower. For every 100 serious crimes committed, 20 were committed by female persons between 2015 and 2020 (KNBS, *various editions*). Over the same period, the average population for female persons stood at 50 per cent of the total. Hence, women commit fewer offences than their male counterparts. Figure 2 shows the level of offending by female persons in counties.

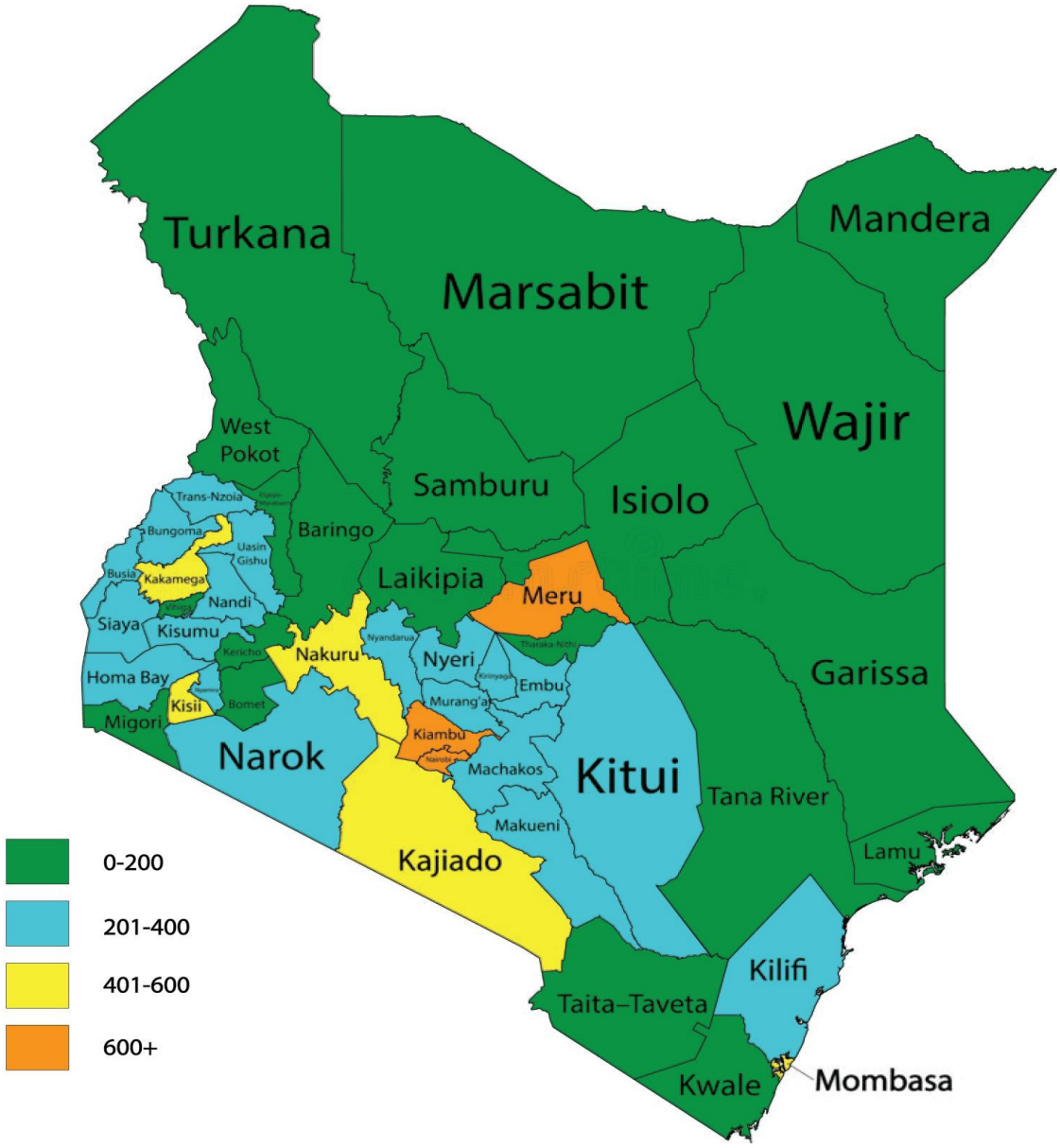

Figure 2: Serious crimes by female persons (Average for the period 2015-2020)

Source: Author's analysis using crime data sourced from the KNBS

In Figure 2, Nairobi, Kiambu, and Meru Counties had the highest number of serious crimes committed by women, averaging above 600 annually. The three counties are followed by Kajiado, Nakuru, Kisii, Mombasa, and Kakamega counties, with average annual crimes by female persons ranging between 401 and 600. Most counties had an annual average of between 201 and 401 crimes. These are; Kilifi, Kitui, Makueni, Machakos, Embu, Murang'a, Nyeri, Kirinyaga, Nyandarua, Narok, Homabay, Nyamira, Kisumu, Siaya, Nandi, Busia,

Bungoma, Trans-Nzoia and Uasin-Gishu. A number of counties, majorly characterized by low population, had low annual serious crimes by women at less than 200. In areas characterized by high female offending, the strategies should not mimic those applied to deal with crimes by male persons.

Regarding the most prevalent crime, out of the 25,721 robberies, breakings, and theft committed in the year 2021, 16 per cent were committed by female persons (KNBS, 2022). Of the 2,726 homicides and 22,912 other offences against persons committed over the same period, 14 and 23 per cent were perpetrated by female persons, respectively. Further, only 4 per cent of the 8,449 offences against morality were committed by female persons in 2021 (KNBS, 2022). The low percentage affirms that the perpetrators of rape, defilement, rape, sodomy, abduction, bigamy, indecent assault, and bestiality, are predominantly male. Therefore, strategies to reduce the offences against molarity should heavily target potential male perpetrators for the highest impact. The level of offending by male persons is mapped for each county in Figure 3.

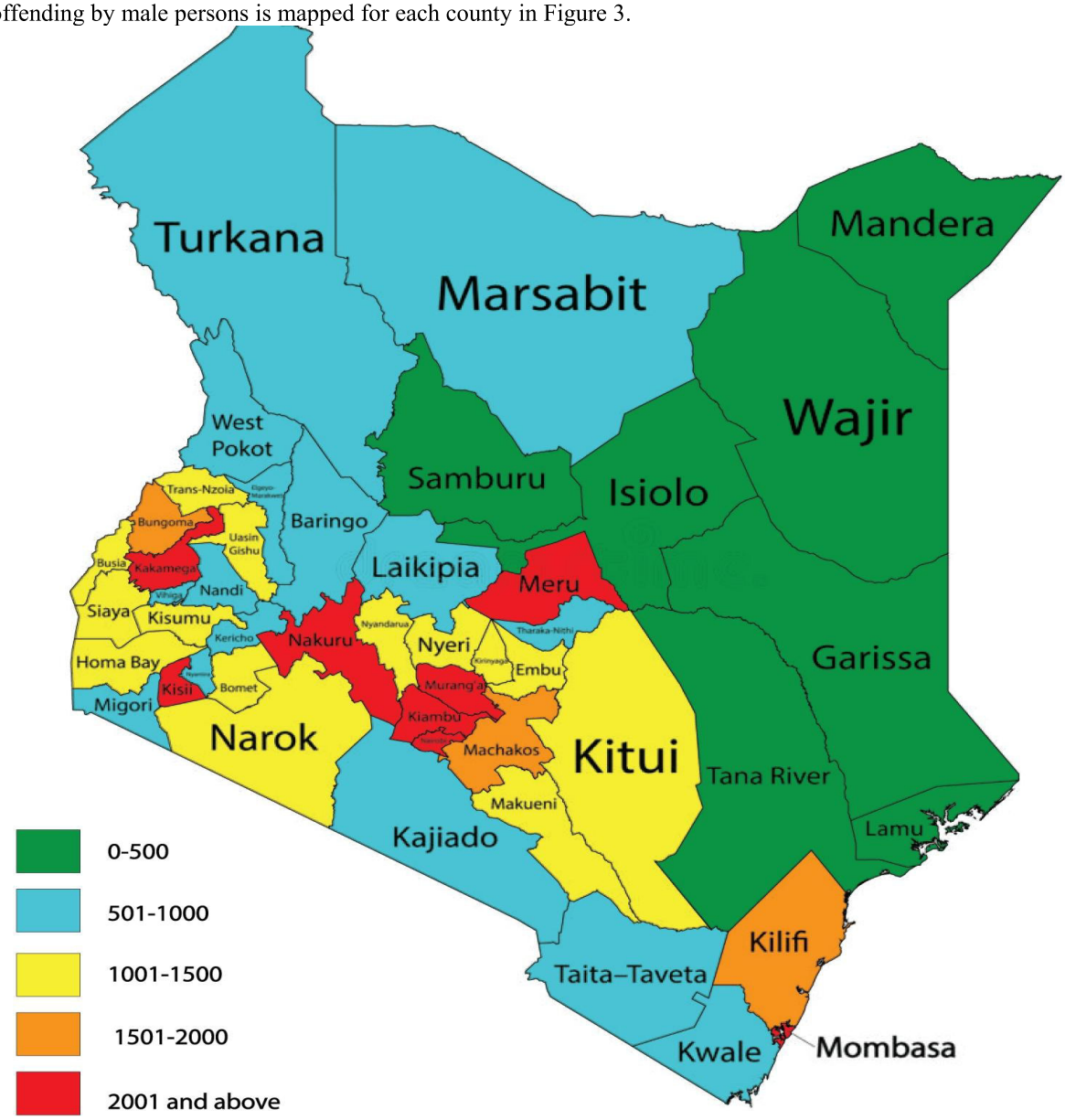

Figure 3: Serious crimes by male persons (Average for the period 2015-2020)

Source: Author's analysis using crime data sourced from the KNBS

A total of eight counties registered the highest number of serious crimes perpetrated by male persons, at 2,001 and above for the period 2015-2020. These counties are Nairobi, Mombasa, Kiambu, Murang'a, Nakuru, Meru, Kisii, and Kakamega. The average offences for Kilifi, Machakos, and Bungoma counties ranged between 1501 and 2001. Over the same period, Lamu, Tana River, Garissa, Wajir, Mandera, Isiolo, and Samburu counties recorded an average of between 1 and 500 crimes. Though these counties had the least crimes, they have experienced terrorism, regarded as a very serious crime, over some years (NPS, 2020).

In 2021, out of the 81,272 crimes, robberies, breakings, and theft committed by male persons stood at 84 per cent, homicides at 86 per cent, while other offences against persons were at 77 per cent (KNBS, 2022). Further, out of the 8,449 crimes against morality, a total of 8079 or 96 per cent were committed by male persons. Between 2017 and 2021, predominant crimes were perpetrated by male persons. Therefore, deterrence measures for such crimes should significantly target the potential male offenders to bear maximum effects. Hence, exploration of the nature and magnitude of the crimes is crucial to allow for tailor-made mitigation measures.

2. Empirical Literature on Causes of Crime

The empirical literature on causes of crime is vast. This study focused on the most recent literature and with a considerable bearing on research objectives. Bun, Kelaher and Sarafidis (2020) estimated the drivers of crime in Australia's New South Wales. The study established that criminal activity is highly responsive to arrest and conviction but less responsive to the prospect and severity of imprisonment. Further, the results showed that increasing the risk of apprehension and conviction exhibits a much more significant effect in reducing crime than raising the expected severity of punishment. Also, Lee and McCrary (2017) established that for juvenile offenders in the USA, the longer the expected incarceration length, the less the offending. Elsewhere, Entorf and Spengler (2015) found out that crime is deterred by the certainty of conviction, with increased imprisonment length only reducing violent crimes. In England and Wales, Bandyopadhyay, Bhattacharya and Sensarma (2015) showed that a higher detection rate reduces crime. Durlauf and Nagin (2011) advocated for less deterrent effects of increasing the severity of punishment but considerable effects of increasing the certainty of punishment.

Oyelade (2019) found that low gross domestic product per capita increased crime in Nigeria. Also, an increase in urban and rural populations, and male and female unemployment, yielded more crime. In Ireland, Brosnan (2018) established that income per capita positively impacted theft and fraud. Additionally, relative income positively impacts crimes against property, with unemployment positively affecting theft. The study also established that previous crimes positively impacted current crime. Elsewhere in European Union countries and Turkey, Kizilgol and Selim (2017) linked higher GDP per capita, inflation, unemployment rate, and urban overpopulation to more crime, while an increase in police and high school enrolment reduced crime. By examining the socioeconomic causes of crime in Spain, Buonanno and Montolio (2008) established that GDP and education growth negatively affected the crime rate. Also, their results showed that lagged crime and percentage of males aged 15-29 positively impacted serious property crimes and total crimes.

Fu and Wolpin (2018) undertook a structural estimation of the Becker-Ehrlich equilibrium model of crime covering US metropolitan areas. The findings were that the crime is higher in areas with a young and less educated population but lower where the police force is concentrated. Further in the USA, Caetano and Maheshri (2018) established that serious crimes like robberies, burglaries, and auto thefts yield more crimes, while light crimes do not cause an increase in severe crimes. In the United Kingdom, Draca and Machin (2015) established that changes in crime types positively correlate with changes in retail prices. Han, Bandyopadhyay and Bhattacharya (2013) also examined the determinants of property and violent crimes in England and Wales from 1992 to 2008. From the findings, the previous level of crime affected current crime while higher detection and imprisonment lowered crime. Additional results showed that a higher detection rate lowers property and violent crimes, with a higher prison population reducing property crime.

In summary, there is convergence in most empirical work that certainty of punishment and not the severity of punishment has a higher propensity to reduce crime. Even when imprisonment is only for a short period, scholars have opined that the imminent threat of imprisonment triggers offenders to pay fines, a phenomenon known as the miracle of cells. Although empirical literature showed that the causes of crime vary across geographical regions, there was convergence in most findings. Further, most results complement the crime theory explained in Section 3.

However, policy and knowledge gap still exists on factors causing crime. *First*, institutional dynamics have not been adequately investigated. Although various aspects of criminal justice institutions have been studied, rigorous empirical work to produce a holistic model is limited. However, Entorf and Spengler (2015) and van Tulder and van der Torre (1999) made great strides in analyzing the crime function from the multi-institutional approach. *Second*, most models of crime omit celerity of punishment, a cross-institutional efficiency measure of deterrence, as a theoretical component. *Third*, although Piquero and Weisburd (2010) emphasized spatial criminology, there is need for wider information on the nexus between spatial dynamics and crime. *Fourth*, empirical analysis of crime by gender is limited. To fill these gaps, this study emphasized institutional and gender dynamics in empirical analysis. In Section 1.3, this study explored some aspects of crime mapping by gender.

3. Research Methodology

3.1 Theoretical Basis

The theoretical foundation for the study was drawn from multiple models, with the starting point being Gary

Becker's paper, *Crime and Punishment: An Economic Approach,* of 1968. Becker (1968) developed the rational individual utility model, where an individual decides in a single period, whether or not to commit a crime. Becker's model was refined through the introduction of dynamism, notably by Ehrlich (1973 & 1996), Block and Heineke (1975), Zhang (1997), Grogger (1998), and van Tulder and van der Torre (1999). Other papers, notably Buechel, Feess and Muehlheusser (2020), Bun et al. (2020), Caetano and Maheshri (2018), Entorf and Spengler (2015), Fu and Wolpin (2018) and Nagin (2013) also inspired the theoretical insight. The theoretical emphasis is on models with multi-institution decision-making, with a decision from one institution impacting decisions about crime from other institutions.

At the point of commission of a crime, the theoretical relationships are generally anchored on the crime's general demand and supply dynamics. The potential victims' precautionary measures impact demand. With weak precautions, the crime demand would increase, and the number of crimes would subsequently rise. As crime rises, potential victims result in enhanced precautionary measures lowering the expected return to crime. Regarding the supply of crime, the offender's choices determine the extent of offending. The criminal justice system's operations influence the choices and, therefore, the supply of crime. Hence, the supply of offences model captures the intricacies of the offenders' and policy makers' decision-making problems.

Offender's Decision-Making Problem

To a potential criminal, the optimization problem is setting out to commit a crime against a potential victim, gain illegal income and avoid apprehension. To explicate this problem, consider location units of a given country denoted by C such that $c=1,...,C$, with each c having a continuum of inhabitants (I) possessing a linear utility over wealth and correlated with age, gender, and education. The legal output of location c is produced by the percentage of inhabitants assumed to be working in the legal sector (μI), available capital resources, and technology. The inhabitants of location c are assumed to obey the von Neumann-Morgenstern axioms for individual behavior under risk. The axioms are regarded by many scholars as reasonable, or at least as a fruitful hypothesis (Eide, 2004). The inhabitants are endowed with the willingness to earn legal income through the pursuit of lawful income-earning means and the propensity to commit a crime and earn illegal income. Further, the inhabitants are faced with a probability of victimization subject to their own precautions, precautions of others, and the effectiveness of justice institutions. If victimized, they would lose a fraction of their income to offenders.

Drawing from Becker (1968), an individual residing in location c would choose to commit a crime if their benefits or expected utility to commit that crime exceeded their costs. The individual, whom Becker argued to be rational, compares the utility they would gain from committing a crime and the associated risks of detection, apprehension, and punishment, with the utility they would gain in pursuing legal activities. Becker's model is given as follows;

$$EU = pU(Y - S) + (1 - p)U(Y) \quad \ldots (1)$$

where U is the individual's von Neumann-Morgenstern utility function, EU is the individual's expected utility from committing an offense or victimizing. The notation p is a broad and exogenously determined probability of being caught, prosecuted, and punished, while (1- p) is the probability of not being caught, prosecuted, and punished. The probability (p) is further decomposed into the probability of apprehension (P^a), probability of prosecution conditional on apprehension (P^p), and probability of conviction conditional on apprehension and prosecution (P^c). From Equation (1), the illegal income from an offense is denoted by Y, while the sanction or monetary equivalent of the punishment upon apprehension or the disutility of punishment is given by S. The sanction S can be unpacked into the severity of sanctions (S^S) and the timing of sanction (S^T). *The timing of punishment, or celerity of punishment, is viewed from* the time a crime is committed to the offender's punishment.

The cost of committing a crime denoted as $pU(Y-S)$, is a function of the offender's probability of apprehension, prosecution and punishment p, illegal income Y, and sanction S. The potential offenders are assumed to be either fully informed about the justice sector institutions' enforcement efforts or form unbiased beliefs in case of uncertainty (Buechel, Feess & Muehlheusser, 2020). The benefits of committing a crime, given as $(1-p)U(Y))$, is a function of the offender's probability of not being caught, prosecuted, and punished (1-p), and illegal income Y. The individual will commit the offense if *the EU* is positive, and this occurs when;

$$(1 - p)U(Y) > pU(Y - S) \quad \ldots (2)$$

From Equation (2), the supply of crime function is postulated as;

$$Crime = f(Y, p^a, p^p, p^c, S^s, S^t, X) \quad \ldots (3)$$

where X represents a vector of other factors that may cause crime.

Policymakers' Decision Making Problem

The optimization problem for criminals triggers a decision-making problem for the policymakers involved in the role of administering justice and maintenance of the rule of law. The role is spearheaded by justice sector institutions that seek to minimise offending, subject to their resource and technological constraints. The decision-making problem draws from the need to avert the commission of a crime, or once a crime is committed, to

timeously and successfully investigate, apprehend, prosecute and punish the offender. The policymaker's decision influences the resources devoted to detection, apprehension, prosecution, punishment, and incarceration. The policymaker act as a Stackelberg leader by choosing the size of their police, prosecution, court, and prison officials to maximize the expected value of an objective function. To finance policing, prosecution, punishment, and incarceration, justice sector institutions are constrained by the volume of government revenue, which affects the magnitude of the available production inputs. Each policymaker makes decisions by choosing the best alternative that their constraints allow. The level of crime is thus dependent on among others, the volume of resources and technology justice sector institutions devote to maintaining the rule of law and administering justice. This implies a constrained optimization problem that minimizes social costs.

In the upstream of the criminal justice system, an arrest production function associated with police is given as follows;

$$Arrests = f(Number\ of\ crimes, Inputs\ to\ the\ police, Technology) \quad \ldots (4)$$

In Equation (4), apprehensions are influenced by the number of crimes, varying and fixed inputs, and technology adopted. Once police execute arrests, they strive to clear and process them downstream to other justice sector institutions. Drawing from van Tulder and van der Torre (1999), the utility of police is maximized by the number of clear-ups accomplished.

In the midstream of the criminal justice system, arrested persons are prosecuted in courts, with convictions expected to be maximized. The output by the prosecutor depends on criminal cases handled conditional on police clearances, inputs to the prosecutor, and technology. This is conceptualized as follows;

$$Prosecutions = f(Cleared\ arrests\ by\ police,\ Inputs\ to\ prosecution,\ Technology) \quad \ldots (5)$$

Courts at the downstream seek to maximize case resolutions. Some of the dominant modes of resolution are acquittals, convictions, dismissal of proceedings, and withdrawals. The number of criminal cases resolved depends on criminal cases filed in courts conditional to police and prosecution clearances, inputs to courts, other case types, and technology.

$$Resolutions = f(Criminal\ cases\ filed, Inputs\ to\ courts, Civil\ cases\ filed, Technology) \quad \ldots (6)$$

Equation (6) introduces an additional variable, civil cases filed, which compete for time and other court resources with criminal cases. Therefore, updating Equation (3) using Equations (4), (5), and (6), yields an augmented crime function as follows;

$$Crime = f(\mathrm{Y}, p^a, p^p, p^c, S^s, S^t, I_{JS}, T_{JS}, W_{JS}, \mathrm{X}) \quad \ldots (7)$$

The notations $I_{JS}, T_{JS}, and\ W_{JS}$, represents inputs, technology and workload of the justice system (*JS*) institutions, respectively. The other notations in Equation (7) are as previously described.

3.2 Empirical Models Specification

The study strived to incorporate most, if not all of the variables in Equation (7) derived from theory including others from empirical literature. However, the availability of aggregate data, especially panel in nature, was a challenge. Subsequently, the general crime function used for estimation was specified as;

$$Crime = f(Prob^A, Prob^C, Eff^C, Cel^P, Inv^P, Income^L, Pop^Y) \quad \ldots (8)$$

In Equation (8), crime is a function of the probability of apprehension *(Prob^A)*, probability of conviction (*Prob^C*), efficiency of courts *(Eff^C)*, celerity of punishment *(Cel^P)*, public investment to deter crime *(Inv^P)*, opportunities to earn legal income *(Income^L)*, and proportion of the young population (*Pop^Y*) in a geographical location. Given the need to investigate the gender angle to crime, the existence of unobserved heterogeneity, and the panel nature of study data, three dynamic models were specified as follows;

$$Crime_{ct} = \beta_0 + \beta_1 Crime_{ct-1} + \beta_2 Prob^A_{ct} + \beta_3 Prob^C_{ct} + \beta_4 Eff^C_{ct} + \beta_5 Cel^P_{ct} + \beta_6 Inv^p_{ct} + \beta_7 Income^L_{ct} + \beta_8 Pop^Y_{ct} + \gamma_c + \varphi_t + \mu_{ct} \quad \ldots (9)$$

$$Crime^M_{ct} = \delta_0 + \delta_1 Crime^M_{ct-1} + \delta_2 Prob^A_{ct} + \delta_3 Prob^C_{ct} + \delta_4 Eff^C_{ct} + \delta_5 Cel^P_{ct} + \delta_6 Inv^P_{ct} + \delta_7 Income^L_{ct} + \delta_8 Pop^{YM}_{ct} + \gamma^M_c + \varphi^M_t + \mu^M_{ct} \quad \ldots (10)$$

$$Crime^F_{ct} = \alpha_0 + \alpha_1 Crime^F_{ct-1} + \alpha_2 Prob^A_{ct} + \alpha_3 Prob^C_{ct} + \alpha_4 Eff^C_{ct} + \alpha_5 Cel^P_{ct} + \alpha_6 Inv^P_{ct} + \alpha_7 Income^L_{ct} + \alpha_8 Pop^{YF}_{ct} + \gamma^F_c + \varphi^F_t + \mu^F_{ct} \quad \ldots (11)$$

Equation (9) is the model of total crimes in county *c* at time *t* ($Crime_{ct}$) as the dependent variable. The dependent variable for Equation (10) is crimes committed by male persons in county *c* at time *t* ($Crime^M_{ct}$), while that in Equation (11) is crimes by female persons in county *c* at time *t* ($Crime^F_{ct}$). Other variables in the three models are overall lagged crimes in county *c* at time *t* ($Crime_{ct-1}$), lagged crimes by male persons ($Crime^M_{ct-1}$), lagged crimes by female persons ($Crime^F_{ct-1}$), young male population (Pop^{YM}_{ct}), and young female population (Pop^{YF}_{ct}). The previous level of offending was used to capture the models' dynamic nature and the crime's persistence over time. In the three models, the notations β_i, δ_i, and α_i, $i=1,\ldots,8$, represent the parameters to be

estimated, while μ_{ct} , μ_{ct}^{M} and μ_{ct}^{F} are idiosyncratic error terms which are uncorrelated with the independent variables in the three models, respectively.

The subscripts c and t represent the counties (c =1,2,…47) and the time period (t = 1,2,…,6), respectively. The dichotomous variable (γ_c) captures the unobserved counties' specific differences or characteristics. For instance, some counties could have very hardworking police, prosecution, and court officers, something unobserved to a researcher, yielding higher detection, conviction, and resolution rates. Further, the dichotomous variable φ_t was used to capture the unobserved time characteristics. For instance, the justice system institutions, individually or collectively, could have exerted more effort to curb crime in a particular year than in other years, again a phenomenon unobserved to a researcher.

3.3 Estimation and Data Analysis

3.3.1 Identification

Various bottlenecks characterize empirical estimation of the crime function. The study invoked reasonable restrictions to avoid identification failure during empirical analysis to avert the bottlenecks. According to Lewbel (2019), econometric identification, which precedes estimation, inference, and testing, requires having model parameters uniquely determined from the observable population that generates the data.

First, the construct of the policy maker's decision problem given by Equations (4), (5), and (6) implies a potential endogeneity problem in Equation (7) that combines the three equations. Hence, resolving the identification problem resulting from the endogenous determination of any two variables was essential. This is manifested as simultaneous equation bias, with Brosnan (2018) asserting a two-way relationship between crime and some of its determinants. Since the actions of the criminal justice institutions are generally geared towards reducing crime, the actions may increase as crime rises (Yezer, 2015). The identification problem may arise in estimating the supply of offences because areas with higher crime rates may have a higher police presence (Jaitman, 2019). While rigorous sanctions may reduce crime, a rise in crime may yield more sanctions or interventions by justice sector institutions.

Second, challenges exist in the measurement of crime data. For instance, measurement errors in one variable from a given institution are related to errors in a variable of another institution (Yezer, 2015). When the probability of arrest is calculated using the number of arrests divided by the number of crimes, ratio bias may arise, yielding an artificial negative correlation between the two variables (Dills, Miron & Summers, 2010). This challenge is closely related to the aggregation bias occasioned by summing up crime offences. The bias may make enforcement policies' causal effect on crime challenging to identify (Bun et al., 2020). Also, crime data primarily records reported crimes rather than actual occurrences. This renders the reported offences to be less than the actual crimes. However, the actual number of victimless crimes remains unknown because there are no victims to inform the police, and again, police do not observe all offenders perpetrating a crime. Further, some counting rules are biased toward severe offences only (Brosnan, 2018).

Third, there is the likelihood of omitted variables bias emanating from the unobserved heterogeneity or unavailable data. It is hard to specify a complete model that includes all deterrence variables prescribed by economic theory (Bun et al., 2020). For instance, data for a few variables in Equation (7) could not be sourced for inclusion in Equation (8). Mustard (2003) showed that excluding conviction rates from a model may lead to omitted variables bias. Also, most available data sources often lack information on available choices and emphasize the choices made (Eide, Rubin and Shepherd, 2006).

Fourth, past crime values can influence the independent variables in Equations (9), (10), and (11). According to Bun and Sarafidis (2015), past crime values may still affect independent variables since relationships usually involve dynamic adjustment processes. Han, Bandyopadhyay and Bhattacharya (2013) argue that crime is correlated over time due to recidivism caused by, among other things, recessions affecting the crime over successive periods and peer effects. Lagged specifications are also appropriate to reduce endogeneity arising from reverse causality (Bandyopadhyay et al., 2015).

Since the study aimed at estimating the causation of variables in Equations (9), (10), and (11) and not the correlation, proper identification before estimation was undertaken. Hence, the study adopted an identification strategy that allowed endogeneity or weak exogeneity between crime and its potential determinants, controlled for omitted variables and measurement errors, and captured dynamic relationships by including lagged crime.

3.3.2 Estimation Method

Though several estimators are used in estimating dynamic panel data models, the study used two-step System GMM estimator, attributed to Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998), to allow appropriate identification. The estimator was desirable due to the dynamic nature of Equations (9) (10) & (11), few panel periods, and unobserved heterogeneity. The GMM estimator works well in a dynamic model with endogenous relationships, few periods, and unobserved heterogeneity (Hayakawa, 2016; Kiviet, 2020; Kripfganz & Schwarz, 2015; Marang'a, Kimalu & Ochieng, 2020; Roodman, 2009). The estimator avoids full specification of the error's serial correlation (Bun et al., 2020; Bun & Sarafidis, 2015) and uses the

orthogonality conditions to allow for efficient estimation in the presence of heteroskedasticity of the unknown form (Baum, Schaffer & Stillman, 2003). Further, the two-step GMM estimator allowed for Windmeijer's (2005) finite-sample correction to the reported standard errors, rendering the errors not downward biased.

Estimating Equations (9), (10), and (11) entailed the use of STATA statistical software and the application of the crucial System GMM estimation steps proposed by Kiviet (2020) and Roodman (2009). The Harris-Tzavalis test was used to determine the unit root to ensure that the regression did not use non-stationary series. Variance Inflation Factors (VIF) were generated to shed light on multicollinearity among the regressors. The Hansen test of over-identifying restrictions was used to determine the overall validity of instruments for the System GMM estimator. Arrellano and Bond (1991) test was applied to determine the presence of serial correlation in the first-differenced errors. After estimation, the Wald Chi-square test was used to determine the joint significance of the coefficients. Measures of variables were converted into log form, and subsequently, the coefficients were explained as elasticities.

3.4 Measurement of Variables and Research Hypotheses

The measurement of the variables and their hypothesized signs are given in Table 1.

Table 1: Variables, measurement and hypothesized sign

Variable	Measurement of the Variable	Hypothesized Sign
Crime	Number of crimes reported to the police	N/A
Probability of apprehension	Ratio of police to population	-
Probability of conviction	Ratio of convicted murder cases* to registered murder cases	-
Court efficiency	Ratio of resolved cases to filed cases**	-
Celerity of punishment	Ratio of case backlog*** to total backlog	+
Public investment to deter crime	Ratio of police stations to total stations	-
Opportunities to earn legal income	Ratio of county revenue**** to population	-
Lagged crime	Number of previous period reported crimes	+
Young person population	Number of persons aged between 18 and 35 years	+

**Data on convictions of all criminal cases was not available. However, the proxy measure was deemed appropriate as it depicts the justice sector's performance on the trial of serious crimes like murder.*

***The calculation of court efficiency entailed incorporating data for all case types, criminal and civil, as these cases compete for court resources and time.*

****In Kenya, a case is classified as backlog if it remains unresolved one year after being filed in a court. Since criminal and civil cases compete for court time and resources, the calculation of case backlog entailed using all case types. A higher case backlog depicts low case processing speed.*

*****Calculated by summing the equitable share to Counties from the National Government, conditional grants, and local county revenue.*

3.5 Data Type and Sources

The study used secondary panel data from 2015 -2020, covering all the 47 Kenyan counties. Data on crime, apprehension, probability of conviction, opportunities to earn legal income, and public investment to deter crime was sourced from several Economic Survey Reports published by the KNBS. Data on the population and the number of young persons were calculated using the baseline statistics obtained from the Population and Housing Census Report of 2019 (*Volumes I, II & III*) published by KNBS. Data on court efficiency and celerity of punishment was sourced from various editions of the annual State of the Judiciary and Administration of Justice Reports. Data on public investment to deter crime was sourced from the Kenya Gazette of 14th February 2020 (Republic of Kenya, 2020) and mapped per county to calculate the ratios.

4. Results and Discussions

4.1 Descriptive Statistics, Correlation and Multicollinearity Analysis

Before estimation, descriptive statistics were generated to create a deeper understanding of the data. The average annual crimes per county were 1,567. The minimum number of reported crimes was 50, with the maximum being 8,429. The deviation from the average stood at 1,310, a pointer to a considerable variation in the number of crimes among counties, a phenomenon also witnessed for the crimes committed by male and female persons. The mean for crimes committed by male and female offenders was 1,259 and 309, respectively. Both predominantly urban, Nairobi and Kiambu counties had the highest crimes by male and female persons. The least offences were recorded in Mandera and Isiolo counties. The summary statistics for the other variables are given in Appendix 1.

Correlation analysis among the variables was undertaken to inform their potential association. Appendix 2

shows a relatively high and low correlation amongst some variables. A correlation of 85 per cent between the current and previous level of the crime showed their potential association. The celerity of punishment correlated 69 per cent with crime, indicating that the time-lapse between offending and punishment relates with crime. A correlation of 58 per cent between public investments to deter crime and the level of offending depicted their potential association. Further, opportunities for earning legal income had a negative correlation of 52 per cent with crime. Other variables had a low correlation amongst them. Raw correlation between crime and deterrence variables is often weak due to reverse causality (Dills et al., 2010). The VIFs were used to ascertain the extent of multicollinearity among the independent variables. Since the average VIF was 4.18 <10, multicollinearity was not a significant challenge. Appendix 3 gives other details on multicollinearity for the specific regressors.

4.2 Diagnostic Tests

The Harris-Tzavalis test was used in determining the unit root to ensure that the regression did not use non-stationary series. From Appendix 4, the test statistics for the variables had a p-value of less than 0.01. Hence, the null hypothesis of the presence of unit root was rejected implying that the series were stationary. Consequently, estimation was undertaken without the likelihood of generating spurious results.

After estimation, the Wald Chi-square test was used to determine whether the coefficients for the System GMM model were jointly different from zero. From Appendices 5, 6, and 7, the Wald chi2 statistic of 36,875.53, 43,063.67, and 12,992.54 for the general, male persons-based crimes model and the female gender-based crimes model, respectively, had a p-value of 0.000. Therefore, the parameters in each of the model were jointly different from zero.

In regard to serial correlation, Arrellano and Bond (1991) test for zero autocorrelation in first-differenced errors was undertaken. Although serial correlation is more of a challenge when long panels instead of short panels are involved, undertaking the test is suitable for linear GMM regressions on panels where lags are used as instruments (Roodman, 2009). From Appendices 5, 6, and 7, the p-value of the Arellano-Bond test for AR (2) in the first differences was greater than 0.1 for the three study models. Hence, no serial correlation was not a challenge.

The Hansen test of over-identifying restrictions was used to ascertain the overall validity of instruments for the system-GMM estimator. In Appendices 5, 6 and 7, test result of 41.77 for the general model, 43.05 for model having crimes by male persons, and 43.50 for the model having offences by female persons, had a p-value > 0.1. Hence, the null hypothesis of binding restrictions could not be rejected in all the three models and therefore the instruments used were valid. Further, the diagnostic test results for the difference-in-Hansen test of homogeneity of instruments had a p-value > 0.1 in all the three models, implying that the instruments subsets in all the models were also valid.

4.3 Empirical Results and Discussions

The study sought to determine the causes of crime, exploring the role of justice sector institutions and the gender angle to crime. The analysis entailed regression of three distinct models, the first using the aggregate crime data, the second using the offences by male persons, and the third using offences by female persons. The estimation was undertaken using a two-step System GMM estimator. In total, 77 system-generated instruments were used in each model for the difference and level equations, applying Windmeijer (2005) corrected robust standard errors. Table 2 provides the regression results.

Table 2: Regression results on causes of crime

Variable	Value of the Coefficient	Value of the Coefficient	Value of the Coefficient
Dependent Variable	*Total crimes*	*Crimes by male persons*	*Crimes by female persons*
Probability of apprehension	-1.4469**(-2.00)	-0.4342(-1.32)	-2.8661***(-2.66)
Probability of conviction	-0.0720**(-1.97)	-0.0686**(-2.05)	-0.0744(-1.00)
Court efficiency	-0.3192 (-1.03)	-0.1035(-0.24)	-0.7303(-1.06)
Celerity of punishment	0.1921**(2.05)	0.2436***(2.85)	0.2128*(1.89)
Public investment to deter crime	-1.27646*(-1.84)	-0.3294(-1.05)	-2.5890***(2.61)
Opportunities to earn legal income	-0.4982**(-2.30)	-0.3964*(-1.88)	-0.7580(-1.54)
Lagged crime (All gender)	0.2349**(2.25)		
Population (All young persons)	1.3213**(1.99)		
Lagged crime by male persons		0.2665***(2.71)	
Population (Young male persons)		0.3944(1.28)	
Lagged crime by female persons			0.1524 (1.25)
Population (Young female persons)			2.4381**(2,40)
Standard errors: Windmeijer-corrected robust errors			
Wald chi2 (10)	*36,875.53****	*43,063.67****	*12992.54****

*Key: *** p<0.01, ** p<0.05 & * p<0.1 indicates significance levels at 1%, 5% & 10 % respectively, while ( ) are z statistics.*

Source: Author's analysis.

Effect of Probability of Apprehension on Crime

An increase in the probability of apprehension was found to have a deterrent effect on crime. A per cent increase in the probability of apprehension would reduce crime by 1.4 per cent, *ceteris paribus*. The finding indicates that high police presence and visibility deters potential offenders, as it is construed as a higher likelihood of being apprehended. The empirical finding supports the theory that the probability of arrest is inversely related to crime. Potential offenders, therefore, abscond or postpone offending by perceiving a higher risk of apprehension upon observing heightened police presence. To a reasonable extent, it seems that the potential offenders in Kenya are aware of government enforcement efforts and make a decision to offend based on this awareness. The finding is similar to that by Nagin (2013), who established that individuals were sensitive to the probability of apprehension changes. The results also support the assertion by Chalfin and McCrary (2017) that the investments in police are effective due to the deterrence effect, and Bun et al. (2020), that crime is highly responsive to arrest.

The deterrence effect of a higher likelihood of apprehension differs across gender. In the regression analysis using the female offender's data, a percentage increase in the probability of apprehension would reduce offending by female persons by 2.6 per cent, holding other factors constant. Despite having the hypothesized negative sign, the coefficient for the probability of apprehension was not statistically significant in the regression that had offences committed by male persons. It would therefore be desirable that the deterrence policy prescriptions be tailor-made to address crime prevalence by a specific gender in a given location.

Effect of Conviction Rate on Crime

A higher conviction rate was found to reduce crime. Specifically, a percentage rise in conviction rate would reduce crime by 0.10 units, *ceteris paribus*. The result affirms the theoretical postulation that realization of more convictions, which of course entails within and inter-institutional interlinkages, would reduce crime. According to Jaitman (2019), the certainty of punishment is a crucial component of a dynamic theoretical model of crime with a higher probability of legal sanctions given the commission of a crime, expected to lower the level of offending. Entorf and Spengler (2015), Durlauf and Nagin (2011), and Hawken and Kleiman (2009) also established that certainty of punishment deters crime. Therefore, the enhanced intra and inter institutional efficiency in realizing more convictions would deter criminals.

The coefficient of conviction rate of -0.10 in the regression model with male-person offences as the dependent variable was statistically significant. Although the coefficient for the conviction rate was negative as hypothesized when crime by female persons was used as the dependent variable, it was not statistically significant. The finding points that most female persons may be having limited information about the nature of punishment imposed at the downstream by courts compared to their male counterparts.

Effect of Celerity of Punishment on Crime

A reduction in celerity of punishment, measured using the magnitude of the case backlog, was found to increase the supply of offences. Specifically, a percentage decrease in celerity of punishment would reduce crime by 0.19 per cent. The empirical work by Jacob (2011), and Chalfin and McCrary (2017), had similar finding. The decrease depicts that potential criminals could be evaluating the time-lapse between offending and conviction in

their decision-making. Since case backlog manifests inefficiency across the justice system, criminals could be taking advantage of this inefficiency. It is likely that potential criminals may be preferring to experience immediate crime rewards in comparison to postponed costs. Therefore, reducing the time lapse between an offender's commission of a crime and subsequent punishment would lower crime.

The results were also significant and had appropriate signs when male and female person-based crimes were used as the dependent variables in the regression. A percentage increase in celerity of punishment would increase the potential offending by male and female persons by 0.24 and 0.21 per cent, respectively. Hence, male and female offenders who heavily discount the future will be more likely to engage in crime. However, results showed that it is more of reduced celerity of punishment and not the court efficiency, which bears the highest impact on the level of offending. The coefficient of court efficiency had the hypothesized negative sign in the three models but was not statistically significant.

Effect of Public Investment in Policing on Crime

An increase in public investment towards policing was found to reduce crime. A percentage increase in public spending targeting an increase in police stations would reduce crime by 1.28 per cent. The finding reinforced the theory that once a policymaker increases and optimizes resources devoted to law enforcement, the supply of offences would decline. The deterrence effect of the increase in the number of police stations also had an impact on potential female offenders, with a one per cent increase found to reduce crimes by female persons by 2.6 per cent. However, potential male offenders were found not to be deterred by the increase of police stations, though the coefficient had the hypothesized negative sign.

Effect of Opportunities to Earn Legal Income on Crime

The availability of avenues for earning legal income was found to reduce crime. A percentage increase in the opportunity to earn legal income would reduce crime by approximately 0.50 per cent, holding other factors constant. The result shows that rising income in Kenya does not translate into increased targets by criminals but rather more opportunities to earn legal income and a decent life. The finding affirms the rational utility theory of crime postulation that potential criminals will be less likely to commit a crime if opportunities for earning legal income increase. Also, the finding resonates with the assertion by Chalfin and McCrary (2017) that the utility associated with abstaining from crime is principally a function of income earned in the legal labour market. In Nigeria, Oyelade (2019) also linked low income to increased crime.

In reference to the gender-based crime analysis, an increase in opportunities for earning legal income had a negative and significant effect on crime by male persons. However, the coefficient was not statistically significant though it had the hypothesized negative sign when causes of crimes committed by female persons were analysed. Perhaps, the county spending is skewed toward projects that predominantly create more income-earning opportunities for the male and not for the female persons.

Effect of Previous Level of Offending on Current Crime

The previous level of crime was found to positively affect current crime. If crime control measures were to remain constant, a percentage rise in current crime would give rise to 0.23 per cent crime in the subsequent period. Hence, failure to reduce crime today poses a threat in the future. Hence, the finding is a pointer to, among other things, the potential existence of recidivism in Kenya. According to Han et al. (2013), crime is correlated over time due to recidivism. Once individuals observe the circumstances and events post the commission of a crime and conclude that government agencies are lax or inefficient, they may decide to commit crimes. If detection, arrest and punishment of past crimes were grossly compromised, individuals will perceive the current benefits of committing a crime to be higher and engage in crime. The finding resonated with Brosnan (2018), who established that the previous level of crime in Ireland positively affected the current crime, and Buonanno and Montolio (2008), who demonstrated that lagged crime influenced the current crime in Spain.

Regarding the previous level of crime by male persons, the coefficient had the expected positive sign and was statistically significant. However, female offenders' previous level of crime did not affect their current offending. Perhaps this indicates that female persons commit crimes primarily due to instantaneous or spontaneous reasons, or rehabilitation efforts in women's prisons are effective in reducing recidivism amongst them. Therefore, crafting gender specific interventions, over and above the general interventions, would be ideal in reducing gender specific offences.

Effect of Young Population on Crime

The study results showed that young people are associated with a 1.32 per cent rise in crime. The finding revealed that younger persons have a lower opportunity cost of committing a crime. On average, they have lower earnings than their older counterparts, and if caught, they have less to lose when it comes to foregone earnings (Han et al., 2013). Therefore, strategies targeting the youthful population would be pivotal in crime reduction, especially on gainful engagement that would increase their current opportunity cost of committing a crime. Previous empirical work also suggests that crime is more likely to be carried out by younger people in the population (Fu & Wolpin, 2018; Han et al., 2013; NCRC, 2021).

In the model of crime by male persons, the coefficient for the young male population was not statistically

significant, though it had the expected positive sign. Hence, offending by male persons is not predominantly among young male persons but is spread across the population. However, an increase in the young female population was found to increase crime committed by female offenders. Holding other factors constant, a per cent rise in the young female population would increase crime by 2.44 per cent. Therefore, interventions targeting potential young female offenders would reduce crime among them, but targeting both the young and old population would be most ideal in controlling crime among male persons.

5. Conclusions and Recommendations

5.1 Conclusions

The study aimed at determining the causes of crime, emphasizing gender and institutional dynamics. Regression analysis involving two-step System GMM estimation on three distinct models was undertaken to realize this objective. In the first model, the dependent variable was the overall crime level. The second model had crimes by male persons, while in the third model, crime level by female persons was the dependent variable. The findings from the overall crime model showed that a rise in the probability of apprehension, conviction rate, public investment in policing, and opportunities to earn legal income would reduce crime. Longer celerity of punishment was found to increase crime. Further, the higher the proportion of the young population and previous offending, the higher the crime.

The results revealed different dynamics when the male and female persons-based crime was used as the dependent variable in the regression. An increase in the probability of apprehension would reduce crime by female offenders but does not deter potential male offenders. A rise in conviction rate deters male persons from committing crime, not female persons. While an increase in the young female population was found to increase offences by female persons, an increase in the young male population did not lead to more crime by young male persons.

The deterrence effect of having more police stations had the propensity to reduce offences by female persons than male counterparts. Increasing opportunities for earning legal income would reduce offending by male persons. However, the coefficient for opportunities to earn legal income in the regression model having offences by female persons as the dependent variable was not statistically significant. The results also revealed that previous crimes by male persons impacted their current crimes. However, this was not the scenario when previous crimes by female persons were analysed. Further, the longer the celerity of punishment, the higher the crime by both male and female persons.

5.2 Recommendations

Overall Recommendations

Increasing the probability of apprehending criminals was found to lower crime. Therefore, increased investment in police programs that directly enhance the apprehension of offenders is critical for deterrence since such programs would render opportunities for crime to be risky. Enforcement through increasing the police presence would create disutility of committing a crime, and once a crime is committed, create a higher likelihood of apprehension. Once potential offenders observe and interpret a higher risk of apprehension, they postpone or withhold offending. To increase the probability of arrests, the deployment of the police should aim at increasing the policing intensity and responsiveness. The strategies for increasing the number of arrests ought to reach a point where their marginal benefits equal marginal costs.

Since a higher conviction rate reduces crime, a concerted effort by criminal justice institutions is crucial to lowering case dismissals by courts. Proper and adequate gathering of evidence upstream by the police, appropriate and adequate processing and presentation of cases by the prosecution, and adducing of water-tight evidence would increase convictions relative to cases prosecuted. These actions could be coupled with intensified sharing of information by the justice sector institutions to understand the dynamics and expectations of the partnering institutions. Focusing on areas of delay targeting specific institutional inefficiencies that would affect the system's functioning would be ideal. This can be coupled with undertaking joint training and capacity-building programs.

Ensuring crime is timely punished in the foreseeable future would reduce its envisaged benefits due to the higher likelihood of immediate retribution. The recommendation is informed by the finding that reducing celerity of punishment lowers crime. The midstream pre-trial diversion techniques through the prosecution office would reduce the time lapse between apprehension and punishment. Institutional specific and joint strategies should be pursued to reduce the time between offending, investigation, apprehension, prosecution, and eventual punishment. Since justice sector institutions majorly converge downstream in courts, the courts ought to take a lead role in coordinating efforts to reduce the celerity of punishment. For instance, crime reduction measures at the court level would yield better results if they were heavily anchored on accelerating the time to disposition of cases. Therefore, prioritizing extensive case backlog reduction in courts would be ideal in shortening the time to disposition.

The study results showed that the more the opportunities for earning legal income, the less the crime. Therefore, controlling crime requires policymakers to, among other things, prioritize programs that would yield more chances for making a lawful income for individuals. Strengthening the economy to provide legal-work opportunities would nurture a society characterized by less offending due to increased legal revenue. More income to the counties, either from the national government or through enhanced local resource mobilisation, would dissuade potential criminals from offending. The National Treasury, county governments, and other partners should spearhead resource mobilization.

The young population was found to be more predisposed to committing a crime. Therefore, having social support schemes targeting young people would be ideal. The schemes could cover skill-building to enhance youth employability, improve their capacities for gainful employment in the labour market, boost their potential earnings in the legal sector, and dissuade them from offending. Therefore, enhancing social interventions, especially for the young and unemployed population, could reduce crime by providing legal income, thus reducing the propensity to fund their needs with illegal income.

Since the previous level of crime impacted the present crime, there is a need for proper re-integration of the previous offenders to avoid predisposing them to opportunities for recidivism. Section 3.2 indicates that some of the required justice system data was unavailable. Hence, there is a need to increase the scope of the published crime data, including a rejuvenated collection of non-aggregated primary data and by gender.

Recommendations on Specific Gender Issues

It would be desirable that policy prescriptions to reduce crime be tailor-made to address crime prevalence by a specific gender. Since the results pointed out that most female persons commit crimes spontaneously and not as a habit, crafting particular interventions to mitigate the predisposing factors to such behaviour would reduce their offending. Also, creating awareness of the likely punishment to be imposed upon the commission of a crime would deter potential female offenders from committing crimes. Further, intensified police presence in areas with more potential female offenders would prevent crime. The duty-bearing institutions should have a renewed focus in counties or locations with high female offending. In areas with higher male offenders, strategies surpassing increasing police presence would enhance deterrence.

Increasing the physical presence of the police, perhaps by having police mingle or live among the citizens, should be pursued to lower crime among women. The study results showed that having more opportunities where potential male offenders could earn legal income at the county level would be beneficial. There is a need to explore project implementation methodology, especially the potential benefits to a specific gender. Also, programs targeting the likely young female offenders would be ideal. Due to the different vulnerabilities of potential offenders and victims, counties could target programs whose execution would create more income-earning opportunities for vulnerable persons. Specifically, programmes and projects beneficial to different gender should be initiated or supported.

Suggestions for Future Research

Future studies could dig into the police strategies to establish the most effective ones, where, how, and when. Exploring the costs and benefits associated with the collective justice system strategies would be desirable, including examining their potential impact on either gender. Further, optimal resource requirements for the justice sector institutions that would guarantee efficiency in service delivery ought to be determined.

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Appendices

Appendix 1: Summary Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Crimes by male persons	282	1,259	1,000	45	6,891
Crimes by female persons	282	309	340	4	2,175
Total crimes	282	1,567	1,310	50	8,429
Young male population	282	143,797	139,254	20,354	985,675
Young female population	282	154,370	149,090	17,883	1,047,878
Total young population	282	298,166	39,515	287,651	2,033,553
Celerity of punishment	188	0.0213	0.0444	0.0002	0.2893
Public investment to control crime	282	0.0213	0.0134	0.0059	0.0793
Conviction rate	280	0.2949	0.3357	0.0000	2.3333
Probability of apprehension	282	0.00005	0.00002	0.000009	0.0001
Court efficiency	188	0.8858	0.1278	0.5160	1.5673
Opportunities for legal income	282	0.0080	0.0034	0.0028	0.0246

Appendix 2: Correlation amongst variables

	Crimes	Lagged crimes	Total population	Celerity of punishment	Public investment to control crime	Conviction rate	Probability of apprehension	Opportunities for legal income	Court efficiency
Crimes	1								
Lagged crimes	0.8469	1							
Total young population	0.8082	0.8162	1						
Celerity of punishment	0.6878	0.6833	0.8838	1					
Public investment to control crime	0.576	0.5863	0.416	0.1747	1				
Conviction rate	-0.0463	-0.0451	-0.0417	0.0417	-0.0499	1			
Probability of apprehension	-0.1811	-0.1798	-0.3599	-0.3	0.3595	0.016	1		
Opportunities for legal income	-0.5162	-0.4985	-0.4501	-0.2998	-0.481	-0.0666	0.1889	1	
Court efficiency	0.1074	0.073	0.0076	0.0394	0.0416	-0.048	0.1058	-0.1243	1

Appendix 3: Variance inflation factor (VIF)

Variable	VIF
Total young population	11.37
Celerity of punishment	7.38
Public investment to control crime	3.87
Probability of apprehension	2.62
Opportunities for legal income	1.86
Court efficiency	1.06
Conviction rate	1.06
Mean VIF	4.18

Appendix 4: Unit test results

Variable	**Harris-Tzavalis test**
Crimes by male persons	-0.2776***
Crimes by female persons	-0.2941***
Total crimes	-0.2133***
Young male population	-0.5774***
Young female population	-0.1915***
Total young population	-0.1915***
Celerity of punishment	-0.1949***
Public investment to control crime	0.0000***
Conviction rate	-
Probability of apprehension	-0.9024***
Court efficiency	-0.1149 ***
Opportunities for legal income	-0.7130***

*Key: ***p-value less than 0.01*

Appendix 5: Diagnostic test results for two-step System GMM regression: Overall crimes model

Test Type	**Statistic**	**p-value**	**Conclusion**
Wald chi2	36,875.53	0.000	Model variables are jointly significant
Hansen test of over-identifying restrictions	41.77	0.995	Instruments set is valid
Difference-in-Hansen test of over-identifying restrictions	42.39	0.799	Instruments subset is valid
Arellano-Bond test for AR(2) in first differences	-1.63	0.110	No serial correlation in the specified error term

Appendix 6: Diagnostic test results for two-step System GMM regression: Crime by male person's model

Test Type	**Statistic**	**p-value**	**Conclusion**
Wald chi2	43,063.67	0.000	Model variables are jointly significant
Hansen test of over-identifying restrictions	43.05	0.992	Instruments set is valid
Difference-in-Hansen test of over-identifying restrictions	40.31	0.859	Instruments subset is valid
Arellano-Bond test for AR(2) in first differences	-1.56	0.119	No serial correlation in the specified error term

Appendix 7: Diagnostic test results for two-step System GMM regression: Crime by female person's model

Test Type	**Statistic**	**p-value**	**Conclusion**
Wald chi2	12,992.54	0.000	Model variables are jointly significant
Hansen test of over-identifying restrictions	43.50	0.991	Instruments set is valid
Difference-in-Hansen test of over-identifying restrictions	39.82	0.848	Instruments subset is valid
Arellano-Bond test for AR(2) in first differences	-1.21	0.225	No serial correlation in the specified error term