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DOCTORAL THESIS

Doctor of Philosophy (PhD)

CRIME RATE AND ECONOMIC GROWTH

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THESIS APPROVAL PAGE

DECLARATION

I hereby declare that this doctoral thesis titled as “Crime Rate and Economic Growth” has been written by myself in accordance with the academic rules and ethical conduct. I also declare that all materials benefited in this thesis consist of the mentioned resources in the reference list. I verify all these with my honor.

Ezgi ADIYAMAN

……/……/2022

ABSTRACT

Doctoral Thesis

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Crime rate and Economic Growth

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This thesis offers three chapters on the link between economic growth and crime rates. Chapter 1 seeks to investigate convergence of homicide rates in EU. Focusing on modernization theory, the chapter also investigates conditional convergence by using income per capita and unemployment rates as control variables. The findings based on GMM regressions demonstrate substantial evidence of homicide rate convergence within the EU. Chapter 2 explores the existence of Homicide Kuznets Curve (HKC) in new EU member countries by using FMOLS, DOLS, and PMG methods. Using modernization and civilization theories, the chapter also attempts to theoretically explain the existence of Kuznets curve in homicide rates of new EU member countries. Finally, Chapter 3 examines how high and increasing inflation affects crime rates. To address this question, this essay investigates inflation-crime rates nexus for Turkey, using a large dataset from 26 subregions over the period 2006-2020. The results of the system GMM approach reveal the positive impact of inflation on homicide and robbery in Turkey, while inflation has no statistically significant impact on theft rates. Findings also suggest that GDP per capita is a quantitatively important factor. Hence, the results are consistent with the modernization theory.

Keywords: Crime Rate; Economic Growth; Panel Data Models

ÖZET

Doktora Tezi

Suç Oranı ve Ekonomik Büyüme

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Dokuz Eylül Üniversitesi

Sosyal Bilimler Enstitüsü

İngilizce İktisat Anabilim Dalı

İngilizce İktisat Programı

Bu tez, ekonomik büyüme ve suç oranları arasındaki bağlantı üzerine üç bölüm sunmaktadır. 1. Bölüm, AB'deki cinayet oranlarındaki yakınsamayı incelemeyi amaçlamaktadır. Modernleşme teorisine odaklanan bu bölüm, kontrol değişkenleri olarak kişi başına gelir ve işsizlik oranlarını kullanarak koşullu yakınsamayı da inceler. GMM regresyonlarına dayanan bulgular, AB üyesi ülkelerde cinayet oranlarının yakınsadığına dair önemli kanıtlar gösteriyor. Bölüm 2, FMOLS, DOLS ve PMG yöntemlerini kullanarak yeni AB üyesi ülkelerde Cinayet Kuznets Eğrisi'nin (HKC) varlığını araştırıyor. Modernleşme ve uygarlık teorilerini kullanarak, bölüm ayrıca yeni AB üyesi ülkelerin cinayet oranlarında Kuznets eğrisinin varlığını teorik olarak açıklamaya çalışır. Son olarak, Bölüm 3, yüksek ve artan enflasyonun suç oranlarını nasıl etkilediğini incelemektedir. Bu soruyu ele almak için bu makale, 2006-2020 dönemi boyunca 26 alt bölgeden geniş bir veri seti kullanarak Türkiye için enflasyon-suç oranları bağlantısını araştırıyor. Sistem GMM yaklaşımının sonuçları, Türkiye'de enflasyonun cinayet ve hırsızlık olaylarına olumlu etkisini ortaya koyarken, enflasyonun hırsızlık oranları üzerinde istatistiksel olarak anlamlı bir etkisinin olmadığını ortaya koymaktadır. Bulgular ayrıca kişi başına düşen GSYİH'nın nicel olarak önemli bir faktör olduğunu göstermektedir. Dolayısıyla, sonuçlar modernleşme teorisi ile tutarlıdır.

Anahtar Kelimeler: Suç Oranı; Ekonomik Büyüme, Panel Veri Modelleri

CRIME RATE AND ECONOMIC GROWTH

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CHAPTER TWO

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ABBREVIATIONS

ADF	Augmented Dickey Fuller
AFSJ	Area of Freedom, Security, and Justice
ARDL	Autoregressive Distributed Lag
CEE	Central and Eastern European
DOLS	Dynamic Ordinary Least Squares
EC	European Community
EIS	European Information System
EKC	Environmental Kuznets Curve
EU	European Union
EUROPOL	European Police Office
FMOLS	Fully Modified Ordinary Least Squares
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
HKC	Homicide Kuznets curve
IPS	Im, Pesaran, and Shin
JHA	Justice and Home Affairs
LLC	Levin, Lin, and Chu
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
PMG	Pooled Mean Group
PP	Phillips-Perron
TEU	Treaty on the European Union
TFEU	The Treaty on the functioning of the European Union
US	United States
WDI	World Development Indicators

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INTRODUCTION

Poverty is the mother of crime. —Marcus Aurelius (121-180 AD)

Crime causes harm to individuals and communities in a variety of ways. Individuals suffer financial and bodily injury as a result of crime, as well as post-traumatic stress disorders, strong rage, loneliness, despair, and other anxiety disorders. A high societal crime rate can disseminate fear of crime and a sense of insecurity, limiting economic and social activity. Furthermore, while national governments make promises to their citizens to decrease and prevent crime and violence, growing crime rates can cause people to lose faith in the government's and institutions' ability to maintain peaceful, secure, and safe societies.

How crime rates evolve over time has long fascinated both researchers and policy makers. Public and political discourse have often suggested that the world is more peaceful, safe, and secure than it was in the 1990s. Empirical research largely confirmed this claim, showing that crime rates have remarkable decreased since the mid-1990s.[1] However, Organization for Economic Cooperation and Development's (OECD) report on "*How was Life? Global Well-Being Since 1820"* published in 2014 suggests that world average homicide rates remarkably declined since the 1820s, whereas there are still substantial differences in homicide rates between poor and rich regions (Van Zanden et al., 2014).

As seen in Table 1, in the 1820s, homicide rates were higher in some regions with having lower Gross Domestic Product (GDP) per capita, namely Latin America and the Caribbean, Eastern Europe, and Sub-Saharan Africa. Homicide rates were lower in some regions with higher GDP per capita, such as Western Europe, and South and South-East Asia. For example, whereas homicide rates tended to decline in Latin America and the Caribbean, Eastern Europe and Sub-Saharan Africa, these regions remained at very high rates of 20.8, 19.3 and 11.8, respectively. In Western European countries, the already low homicide rates fell further, from 1.4 to 1.2. Homicide rates in South and South-East Asia, remained close to the world average.

[1] Please see Baumer et al. (2018), Dijk & Tseloni (2012), Tonry (2014), and Tseloni et al. (2010).

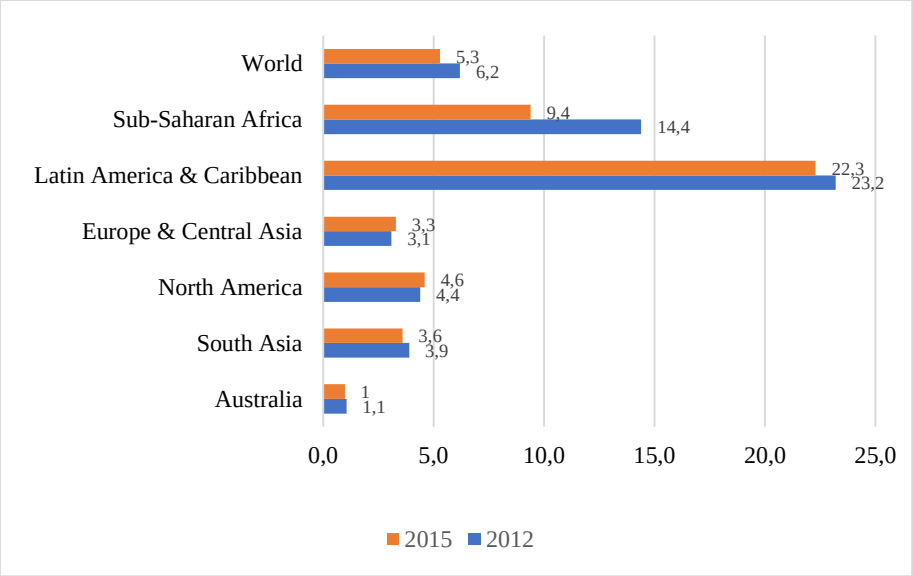
Table 1: Regional averages of homicide rates from 1820s to 2000s

	World	Western Europe (WE)	Eastern Europe (EE)	South and South-East Asia (SSEA)	Latin America and Caribbean (LA)	Sub-Sahara Africa (SSA)
1820s		3.5				
1900s		2.2				
1950s		1.1		2.8		
1960s		0.9		3.2	12.4	
1970s	9.4	1.1		4	11.9	
1980s	7.3	1.3	6.4	4.6	16.9	
1990s	7.6	1.4	13.6	5.1	21.3	
2000s	6.9	1.2	11.8	4.6	20.8	19.3

Source: Clio-Infra, www.clio-infra.eu.

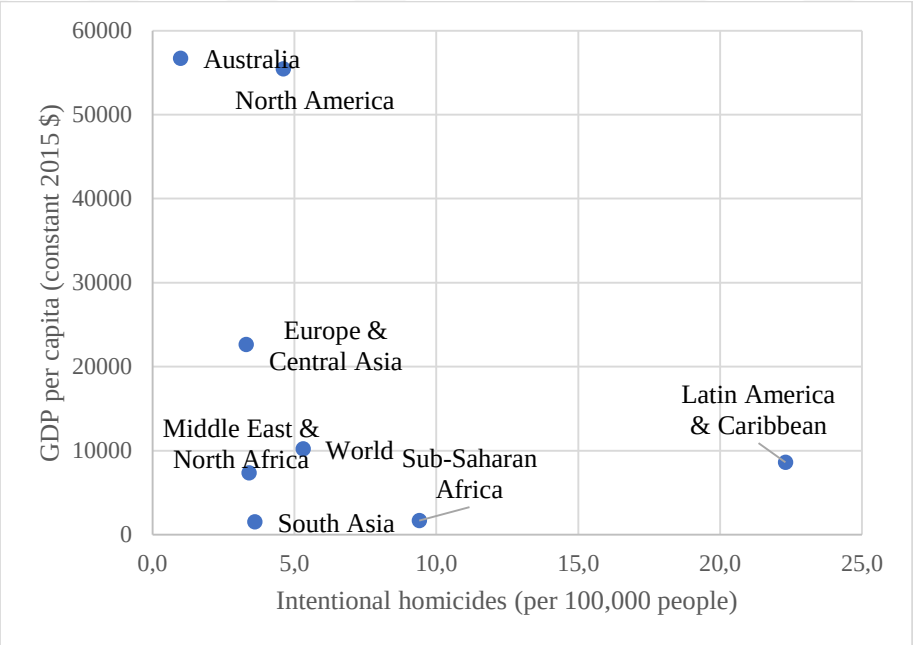
In the 2010s, while the world average homicide rate continued to decline, the regional differences remained. As seen in Figure 1 and Figure 2, in the 2010s, regions with higher per capita GDP such as Australia, Central Asia, Europe and North America, continued to have low homicide rates, while some regions with lower per capita GDP, such as Latin America and the Caribbean and Sub-Saharan Africa, continued to have high homicide rates. Hence, persistent regional differences in homicide rates raise a question of whether there is a relationship between economic development and homicide rates.

Figure 1: Intentional Homicide Rate in the 2010s



Source: The World Development Indicators (WDI) Database, World Bank

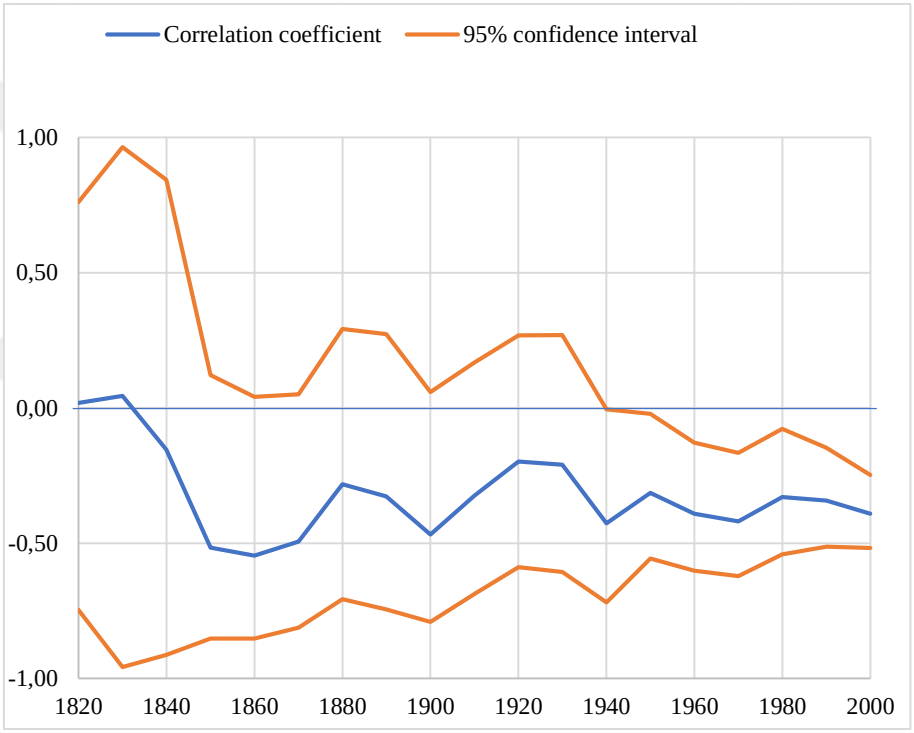
Figure 2: GDP Per Capita and Intentional Homicide Rate in 2015



Source: The World Development Indicators (WDI) Database, World Bank

Figure 3, which shows the correlation between homicide rates and GDP per capita across all available countries since the 1820s and provides more descriptive evidence on the negative correlation between GDP per capita and homicide rates.[2] According to Figure 3, even though the correlation coefficient between homicide rates and GDP per capita is not stable over time, homicide rates, in general, seems to be negatively associated with GDP per capita over the period between 1820s and the 2000s.

Figure 3: Correlation between Homicide Rates and GDP Per Capita between 1820s and 2000s



Sources: Clio-Infra, www.clio-infra.eu.

While descriptive evidence suggests a strong negative relationship between homicide rates and economic development, empirical researchers have reached no consensus on the existence and characteristics of this relationship. Many studies

[2] The historical correlation coefficient is based on the calculations of Clio Infra project. This correlation coefficient is calculated per decade in order to solve the problems caused by non-stationarity.

support a negative association between homicide rates and economic development, but there are some others documenting mixed results. The most comprehensive literature review on the relationship can be found in Koeppel et al. (2015) and LaFree (1999). LaFree (1999) surveyed early studies on the cross-country relationship between homicide rates and economic development, whereas Koeppel et al. (2015) cover the most recent literature. Nivette (2011), Pridemore (2002), Pridemore and Trent (2010), and Stamatel (2009) also provide broad literature reviews of cross-country studies on this relationship.

Most studies examining the cross-country relationship between homicide rates and economic development have relied on modernization and civilization theories (high modernization) in criminology literature. Modernization theory builds on Durkheim's (1951) evaluation of progress towards modern societies. According to the theory, rapid economic progress, along with modernization, industrialization, and urbanization might lead to an increase in crime and violence (Howard & Newman, 2000; La Free & Drass, 2002; Shelley, 1981).[3] Modernization theorists also argue that all societies progress through similar stages of development, and developing countries gradually adopt the characteristics of developed countries (Inkeles, 1983, 2010; Neuman & Berger, 1988; Shelley, 1981). In this regard, this theory predicts crime rate convergence between countries with similar developmental stages (Cook & Winfield, 2013; Kollias et al., 2018; LaFree, 2005; McDowall & Loftin, 2005, 2009). Civilization theory builds on Norbert Elias's assessment of the process of civilization and proposes that as countries attain higher levels of development, the behaviors of individuals will become more civilized, and thus there will be a gradual decline in crime and violence. Therefore, this theory is often called high modernization theory in the literature (Pinker, 2011).

There are number of cases supporting the proposition of the modernization theory that crime and violence may increase in the early stages of the development process. For example, many studies have argued that after the industrial revolution in the late 18th century, with rapid industrialization and urbanization homicide rates

[3] For example, social disorganization theory argues that crime tends to occur in areas where the mechanisms of social control are weak, whereas stain theory argues that poverty and social deprivation could enhance income inequality among individuals, which in turn increasing crime and violence.

substantially increased (McHale & Johnson, 1976; Shelley, 1981). In the early 1990s, a sharp increase in homicide rates was also recorded in Russia and Central and Eastern European (CEE) countries that have transitioned from communist economies to market economies (Ceccato, 2008; Ceccato & Haining, 2008; Gruszczyńska, 2004; Kim & Pridemore, 2005a, 2005b; Levay, 2000; Pridemore, 2002; Stamatel, 2009b, 2012, 2017; Zhang et al., 2008). Similarly, CEE countries that joined the European Union (EU) in 2004 and 2007 and transitioned to a single market experienced a rapid increase in their homicide rates (Andresen, 2011; Piatkowska et al., 2016).

Historical studies on crime provide support for the proposition of civilization theory that crime and violence may decrease in later stages of development. Gurr (1981), for example, shows the steady decline in homicide rates in British cities from the 13th to the 20th century. Eisner (2003) also shows long-term declines in homicide rates among West European countries. Other historical analyzes also support that homicide rates among industrialized West European countries declined from the early Middle Ages to the early 21st century (Johnson & Monkkonen, 1996a; Österberg, 1996; Spierenburg, 1996). Several empirical studies showing declines in crime rates in recent years also support for the civilization theory. Van Dijk et al. (2012) reported a series of studies that show that homicide rates have declined in Western developed countries since the 1990s. For example, Aebi and Linde (2012) found that homicide rates in 10 European countries tended to decline overall from 1990 to 2007 (see also Aebi & Linde, 2014). Frate and Mugellini (2012) showed that some non-Western nations also experienced a decline in crime rates over the period 1990-2007.

In recent years, modernization prediction on convergence of crime rates has attracted significant attention among empirical criminologists, but it seems that research on this subject is limited. While economic development was assumed to be a key factor for convergence, previous research had primarily focused on absolute convergence, which refers to the unconditional convergence of crime rates over time. To our knowledge, no study to date has investigated whether and how economic development affects in achieving convergence of crime rates.

With the increasing economic integration worldwide, investigating convergence of crime rates between countries, as well as the effect of economic development on crime convergence is important. This research is of vital importance,

especially for economic entities that aim to establish economic integration. However, because economic integration is a lengthy process with long-term consequences, not every economic entity is suitable for empirical analysis. As a result, country groups with a reputable history, legal frameworks, and high levels of cooperation among member countries are of particular interest.

The European Union (EU) is an especially interesting case study. Ensuring a secure, safe and peaceful area within the EU is one of the EU's founding objectives. Hence, diverging performances and increasing inequalities in security conditions weaken the commitment of an area of security in the EU, threaten the EU cohesion and put the entire European project at risk. The European policymakers and researchers therefore continuously monitor convergence in economic, social, and security conditions between member countries. In recent years, several studies have documented that convergence occurred in economic and social dimensions. However, studies have been so far have not investigated whether the EU member countries achieved convergence in terms of security conditions.

Chapter 1 seek to emphasize above-mentioned gap in criminology literature by investigating the existence of convergence of homicide rates between EU members (Adıyaman & Kasman, 2022). To address this, the chapter relies on the idea of β-convergence and utilizes the Generalized Method of Moments (GMM) methodology on data of member countries over the period 1990-2018. The chapter focuses on modernization theory, which was first derived from Durkheim (1951), to conceptually explain the convergence of the homicide rate. According to this theory, countries that are in similar developmental phases will likely have similar crime rates as they progress (LaFree & Drass, 2002; Shelley, 1981). Aside from absolute convergence, the chapter explores conditional homicide convergence by accounting the income and unemployment. The conditional homicide convergence analysis is to show whether the EU economic integration has an effect on the homicide rate convergence of the member states.

Chapter 1 enhances to the literature in two different ways. First, as mentioned earlier, while a growing number of studies aim at providing support for the proposition of modernization theory that countries with similar development stages achieve convergence of homicide rates, previous work has not investigated the impact of

economic development on homicide rate convergence. Chapter 1 aims to fill this gap by using GDP per capita and unemployment rates as control variables in the conditional convergence analysis. As far as we know, this study is the first in the literature that analyzes how economic development affects crime convergence. Second, while there is a growing literature on crime convergence, no studies have yet examined whether there is convergence among EU member states. This study, as far as we know, is the first study that addresses the existence of the homicide convergence in the EU (Adıyaman & Kasman, 2022). The EU pursues various policies, programs, strategies to achieve convergence and strengthens cooperation between its institutions and member states. Section 1.2 provides a comprehensive and up-to-date picture of the EU's crime-fighting and prevention policy framework. As one of the main establishment purposes of the EU is to ensure a security area in the EU, divergence in homicide rates may spread the feeling of social injustice and unfairness among citizens and undermine the overall trust in the EU project.

The investigation of the relationship between homicide rates and economic development is particularly important for new EU member countries. The EU's objective is to foster peace, its values, and the well-being of its citizens by providing freedom, security, and justice without internal borders, while also taking reasonable measures at its external borders to monitor and control asylum and immigration, as well as to prevent and combat crime. Therefore, new member countries expect to achieve higher levels of income as well as lower crime and violence. These expectations seem to have been realized to a considerable extent as new member economies have enjoyed steady growth over the past nearly 20 years, while their homicide rates have fallen remarkably.

While we expect a general decreasing trend in homicide rates in new EU member countries, the extant research suggests that homicide rates increased in new EU member countries in the early stages of EU accession and decreased in the later stages (Andresen, 2011; Piatkowska et al., 2016). In contrast to these claims, existing research has only concentrated on a linear relationship between homicide rates and economic development in new EU member countries, and it has revealed a negative relationship between homicide rates and economic development. Hence, to the best of

our knowledge, no studies have investigated whether crime and economic development has a reverse U-shape relationship.

Chapter 2 explores the existence of a homicide Kuznets curve in new EU member countries that is empirically investigating an inverse U-shaped link between homicide rates and income per capita while controlling unemployment rate and urbanization. To contextualize this analysis, this chapter uses modernization and civilization theories, as well as the concept of Kuznets curve. As modernization and civilization theories are typically measured by levels of urbanization, and economic development, unemployment rate and urbanization are used as control variables. To evaluate this analysis, the chapter uses advanced panel data techniques. The results yield concrete evidence for the emergence of the homicide Kuznets curve in new EU countries. However, the estimates of the impact of unemployment and urbanization produce inconclusive results.

Chapter 2 aims at contributing to the literature in two ways. First, this chapter for the first time uses modernization and civilization theories to explain the existence of the homicide Kuznets curve in new EU member countries and contributes to the literature from the theoretical side. Only few studies have examined for the existence of the Kuznets curve for crime rates. An assessment of the literature shows that the study of Buonanno et al. (2017) is very close to this present work. This study relied on motivation and opportunity theories to explain the existence of the crime Kuznets curve in the United States. These theories are by no means trivial, but they are micro-level theories that focus on a small group of offenders or on an individual crime. They attempt to explain why some people commit crimes more frequently than others do. Macro theories of criminal behavior focus on crime globally or within a society and explain how the relationship between homicide rates and economic growth has changed over time. For this reason, the macro-level modernization and civilization theories used in this chapter, which predict a positive and negative relationship between economic development and crime rates, respectively, potentially better explain the emergence of the reversed U-shaped relationship across countries.

Second, an investigation of the homicide Kuznets Curve for the EU is not only important for the homicide research in new EU member countries, but also from a policy perspective, as the EU makes commitments to new EU member countries to

promote their economic prosperity as well as improve security conditions. The homicide Kuznets curve in new EU member countries also implies that economic integration leads to an increase in homicide rates in the first years of accession and a decline in the later stages.

Since the-1980s, the macro-level research on the crime-economic development nexus has heavily focused on the impact on GDP per capita, urbanization, and unemployment rate on crime rates. Inflation is also very closely related to economic development and can lead to deterioration in society by reducing purchasing power and deteriorating living standards, and thus could some effects on crime rates. Some studies have recently been established to investigate the relationship between crime and inflation, but research in this field is limited in two distinct ways. First, existing research suggested different explanations for the effect of inflation on crime; nevertheless, these explanations were either loosely related to theoretical literature on crime causation or were difficult to generalize to all societies. It has been argued that inflation is likely to increase crime by creating uncertainty that undermines consumer confidence (Rosenfeld, 2009; Rosenfeld & Levin, 2016; Rosenfeld & Vogel, 2021). Some have argued that increased inflation tends to disrupt trust in economic and political institutions, and lead to a rise in crime and violence (Fischer, 1999; LaFree, 2018; Roth, 2012). Thus, as existing research focused on single causes, event, or situation, they failed to provide a macro-level, general explanations for the inflation and crime nexus. Second, despite inflation is posited to surge crime, studies to date have focused primarily on countries with low or stable inflation. Existing studies have documented a positive impact of inflation on crime rates in the Unites States and Western Europe countries that experienced declining inflation rates since the-1990s. Some studies have found a positive impact of inflation on crime rates in developing countries, such as China (Cheong & Wu, 2015) India (Hazra & Cui, 2018), Nigeria (Adekoya & Abdul Razak, 2016), Pakistan (Ahad, 2016; Gillani et al., 2009) and Malaysia (Tang, 2009), but inflation rates have also been falling in these countries over the last three decades.

After the COVID-19 pandemic, the Ukraine-Russia war, and the sanctions imposed on Russia, inflation began to increase globally. Inflation is rising not only in developing countries, where poverty is more pervasive, wage growth is limited, and

fiscal support measures to alleviate the impact of rising prices on vulnerable groups are more restricted, but also in many developed countries. For instance, according to World Economic Situation and Prospects report published by the United Nations (UN) prices have risen by 6.2% in the United States, 4.2% in the United Kingdom, 10.7% in Brazil and 4.5% in India. Hence, the world economy is currently experiencing one of the peak inflation rates on record in the first two decades of the 21st century, and is expected to reach 8.8% in 2022, tripling from the 2.9% average recorded in the 2010-2020 period.[4] The United Nations Trade and Development body, UNCTAD, also warns that the global economy may be approaching a cost-of-living crisis. With the increasing inflationary pressures worldwide, assessing whether and how hyperinflation or dramatic increases in inflation affect the crime rates is very important and requires further empirical attention.

Chapter 3 seeks to fill these gaps in the literature by using modernization theory while exploring the impact of inflation on crime rates in Turkey for the period 2006-2020. Using the system GMM on a large panel dataset covering 26 sub-regions from 2006 to 2020, the chapter first investigates whether inflation affects total number of prison admissions for homicide, robbery, and theft. It examines whether GDP per capita and unemployment rates moderates or accelerates the criminogenic effects of inflation. Assessing how high and increasing inflation affects crime in Turkey is important for several reasons. First, while many advanced economies and emerging markets enjoyed low and steady inflation rate since the 2000s, Turkey has been experiencing high and increasing inflation. This is also noteworthy because Turkey's central bank has a price stability target and uses different tools to stabilize inflation. Investigating the inflation-crime nexus for Turkey will show the effect of the current monetary policy on living and security conditions. Hence, examining the effect of inflation on crime rates in Turkey would help advance criminological research as well as a broader understanding of the impact of high and rising inflation on crime.

[4] World Economic Situation and Prospects: June 2022 Briefing, No. 161. https://www.un.org/development/desa/dpad/publication/world-economic-situation-and-prospects-june-2022-briefing-no-161/

CHAPTER ONE

CONVERGENCE IN HOMICIDE RATES ACROSS THE EUROPEAN UNION MEMBER COUNTRIES[5]

1.1. INTRODUCTION

. The European Union primarily aims to ensure an area of security without internal borders for its citizens. In recent years, the EU has made significant progress toward establishing a secure region after the introduction of the European Security Agenda in 2015 and "Security Union" idea. The main purpose of the Security Union is to encourage convergence in the security dimensions of the member countries and to reduce the differences between their security development levels. Even though a series of communications emphasized the progress towards an "Effective and Genuine Security Union", the EU has recently set the Security Union as its primary goal in the new Security Strategy for 2020-2025 (Adıyaman & Kasman, 2022).

While it is unclear whether the EU has achieved its key objective of establishing a security area, EU attempts should provide signs of convergence among member states in terms of physical security. Several studies have documented that EU member states have achieved better security conditions since the mid-1990s (Adıyaman & Kasman, 2022; Dijk & Tseloni, 2012; Farrell et al., 2011; Frate & Mugellini, 2012; Stamatel, 2017; Tonry, 2014; Tseloni et al., 2010). Table 1.1 shows that between 1990 and 2018, homicide rates diminished in the EU, whereas there are some exemptions. Major decreases in homicides were also seen in many Eastern European countries, including Croatia, Czechia, Hungary, Slovenia, and Estonia, which had very severe homicide rates in the nineties. While there has been an improvement in homicide rates throughout the Union, whether EU member countries

[5] Our own published work, Adıyaman & Kasman (2022) “Convergence in Homicide Rates Across the European Union Countries: Toward an Effective and Genuine Security Union” has been incorporated in Chapter 1.

have achieved convergence in terms of their homicide rates remains as an important question.

The goal of this chapter is to assess and determine whether homicide convergence exists in the EU. [6] To address this question, the chapter relies on the notion of β-convergence and utilizes the GMM econometric techniques on panel level data from 26 EU member countries from 1990 to 2018.[7] In particular, this investigation will be useful for European policymakers in fostering collaboration and creating effective crime-fighting policies. Moreover, homicide convergence will implicitly show the success of the ability to meet the pledge of a security area in the EU and thus will reinforce trust in the EU project.

To ascertain whether EU economic integration affects the convergence of homicide rates among member states, conditional convergence is estimated in addition to absolute convergence. In the literature on cross-country comparative criminology, there are two major theories: modernization and conflict, both of which are related to economic development and its impact on the process of convergence. According to the modernization theory, grounded on Durkheim's (1951) theory of anomie, countries that are going through the same developmental steps will eventually have same crime rates (LaFree & Drass, 2002; Shelley, 1981). Conflict theory, on the other hand, expects divergence in crime rates as countries' development processes tend to differ (Greenberg, 1980). Thus, this chapter uses GDP per capita and unemployment rate as control variables, assesses whether and how economic integration affects the process of homicide convergence within the EU.[8] In this sense, such conditional convergence analysis would be very important to European policymakers, as both economic and social development must go hand in hand. If EU economic integration is associated by disparities in homicide rates, EU citizens may become less supportive of the European project.

[6] Luxemburg is removed because of data limitations.

[7] Barro and Sala-i-Martin (1992) proposed β-convergence

[8] These are the widely studied macroeonomic factors (please see Allen, 1996; Baumer et al., 2018; Blau & Blau, 1982; Bushway & Reuter, 2011; Cantor & Land, 1985, 2001; Carlson & Michalowski, 1997; Fajnzylber et al., 1998, 2000, 2002; Gillani et al., 2009; Gould et al., 2002; Hale & Sabbagh, 1991; Howard & Newman, 2000; Kelly, 2000; Messner, 1982; Messner & Rosenfeld, 2009; Soares, 2004).

Table 1.1: Homicides in the EU between 1990 and 2018[9]

Countries	Homicide growth	Homicides (per 100,000 people)	
	1990-2018	1990	2018
Austria	-0.60%	1.15	0.97
Belgium	1.88%	1.04	1.69
Bulgaria	-2.33%	2.57	1.3
Croatia	-5.53%	2.87	0.58
Cyprus	2.27%	0.65	1.26
Czechia	-4.87%	2	0.62
Denmark	0.81%	0.8	1.01
Estonia	-4.38%	7.54	2.12
Finland	-2.15%	3.04	1.63
France	-2.38%	2.39	1.2
Germany	-1.54%	1.48	0.95
Greece	-0.28%	1.02	0.94
Hungary	0.89%	1.94	2.49
Ireland	2.03%	0.48	0.87
Italy	-5.89%	3.14	0.57
Latvia	-3.04%	9.88	4.36
Lithuania	-0.22%	4.87	4.57
Malta	1.53%	1.1	1.59
Netherlands	-1.49%	0.9	0.59
Poland	-3.09%	1.79	0.73
Portugal	-2.36%	1.57	0.79
Romania	-3.35%	3.39	1.28
Slovakia	-1.56%	1.76	1.14
Slovenia	-4.99%	2.04	0.48
Spain	-2.37%	1.23	0.62
Sweden	-0.08%	1.11	1.08

Source: The World Development Indicators (WDI) Database, World Bank.

[9] This table is incorporated from our published work, Adıyaman & Kasman (2022)

Although there is substantial study on modernization theories, few studies have studied crime rate convergence behavior at cross-country dimension. The majority of past research has concentrated on the convergence of crime rates within an individual country (Chang & Choi, 2016; Çiftçi & Akkoç, 2019; Cook & Winfield, 2013; Fondevila & Massa, 2018; McDowall & Loftin, 2005, 2009; Winsberg, 1993).

There is little evidence of crime rate convergence across countries. Only two studies, as far as we are aware, explicitly evaluated at the cross-country convergence of crime rates. LaFree (2005) analyzed the convergence of homicides within and across industrialized and developing economies from 1956 to 2000 by using time series econometric methods on homicide data on developed and developing countries. This analysis confirmed the existence of homicide convergence among developed countries but found no evidence on the existence of convergence between developed and developing countries. Kollias et al. (2018) examined total crime rate convergence patterns in 16 European countries from 1972 to 2012 and reported the presence of overall crime rate convergence.

Kollias et al. (2018)'s research for European nations is noteworthy due to its similarities to the current study, but this study is different from Kollias et al. (2018) in several ways. Unlike Kollias et al. (2018), who analyzed convergence among European nations which includes non-EU members such as Norway and the United Kingdom, this study focused mainly on EU member countries and hence would be of interest to EU policymakers. In addition, the sample spans the years 1990 to 2018, when significant security regulations were implemented. Moreover, instead of using overall crime statistics, this research is based on homicide data, which are often considered to be the most reliable crime data in a cross-country settings (Bennett & Lynch, 1990; Gartner, 1990; LaFree, 2005; Pratt & Godsey, 2003).

Three substantial contributions to the related literature are made by this study. To begin, as far as we know, this study is the first to investigate into the convergence of homicide rates throughout the EU. Second, unlike previous studies that only used absolute (unconditional) convergence to analyze crime convergence, this study focuses also on conditional convergence process of homicide rates in the EU. Through conditional convergence analysis, the impact of EU economic integration on the

process of homicide convergence will be proved empirically. Lastly, the current study contributes methodologically to the crime convergence literature. Whereas existing studies have used pooled Ordinary Least Squares (OLS) and within-group estimators to evaluate crime rate convergence, this study adopts GMM methodology, employs Difference GMM and the System GMM estimators. For three key reasons, GMM estimators are ideal for estimating convergence models. Initially, GMM estimators are likely to yield consistent and efficient results in regressions where the independent variables do not appear to be strictly exogenous. Second, the endogeneity problem that occurs when the previous period of dependent variables are included is eliminated with GMM estimations. Finally, they are well suited to dynamic panel data models when time periods are limited and cross-section units are large.

Chapter 1 is divided into the following sections. Section 1.2 describes the crime fighting and prevention policy framework of the EU. Section 1.3 introduces related literature on crime convergence. Section 1.4 presents methodology and the data. Section 1.5 shows and discusses the estimation results. Section 1.6 outlines conclusion and policy implications.

1.2. THE EUROPEAN UNION CRIME FIGHTING AND PREVENTION POLICY FRAMEWORK

The concept of security convergence has been central to the European project since its creation. The roots of this policy area can be traced back to the main works of ad hoc groups concerned with intergovernmental cooperation on security issues, such as the Pompidou Group and the TREVI Group.[10] The early intergovernmental beginnings were loosely coordinated, narrow-scoped, and not formal as a treaty framework. This has revealed the necessity of legal institutional policy frameworks. The process of building a permanent European institutional framework, has started with the agreement of the Palma Document by the European Community (EC) in

[10] In 1975, European ministers of interior and justice had established TREVI group for intergovernmental cooperation to combat serious crime, terrorism and drug trafficking.

1989.[11] The Amsterdam Treaty allows the European Union to take more wide and resolute action for crime prevention and combat throughout the Union. Article 29 mentioned crime prevention in general, whether cross-border organized or otherwise, as one of the Union's measures for establishing an area of freedom, security, and justice.

The early framework of the Schengen Agreement in 1985 on the gradual abolition of border checks between France, Germany, and three Benelux countries, i.e., Belgium, the Netherlands, and Luxembourg, has been conceived as an important step toward the establishment of the Area of Freedom, Security, and Justice (AFSJ).[12] With the entrance into force of the Treaty of Maastricht in 1993, cooperation on Justice and Home Affairs (JHA) became a formal aspect of EU action for the first time. The Maastricht Treaty subjected JHA cooperation to the Council of Ministers' decision-making procedure, but it gave supranational institutions, such as the European Commission, the Court of Justice of the European Union, and the European Parliament, a limited role.

The EU has also created five-year work plans, such as the Tampere Programme, the Hague Programme, and the Stockholm Programme. These programs make it apparent that the goal is to provide citizens with a high level of security by preventing and combating crime. They aim to institutionalize police and judicial cooperation in criminal situations, so boosting internal security in both member states and the EU.[13] While the EU member states have had the principal responsibility to implement the political guidelines in the field of crime fighting and prevention, with

[11] Trevi Groups policy efforts in Palma Document to put emerging policies on policing, law, immigration and asylum, and legal systems that underpin the European state in the overall context. The tasks assigned to Trevi resulted in the Programme of Action, which spawned the European Information System (EIS) and the European Drugs Intelligence Unit. The 'Palma Document' (Madrid, June 1989); the 'Declaration of Trevi Group Ministers' (Paris, 15 December 1989); the 'Programme of Action' (Dublin, June 1990); and the Coordinators report on the progress on the Palma Document are the four major documents published on Trevi's work (Edinburgh, December 1992). (See Bunyan, 1993, for more information.

[12] Benelux is the customs union which is formed by Belgium, the Netherlands, and Luxembourg in 1948; became an economic union in 1960.

[13] The Treaty on European Union institutionalized cooperation for the first time by establishing police and judicial cooperation in criminal matters and stating it in the third pillar.

the entry into force of the Lisbon Treaty (Art. 84 TFEU), the EU has become partly liable for crime fighting and prevention.[14]

The EU has been taking more general and determined actions on crime fighting and prevention since 1996. These actions have sought to achieve the integration of crime fighting and prevention perspectives of member countries, which has led to quite a number of steps being taken towards making an area of freedom, security, and justice a reality.[15]In sum, the EU's initiatives in this area can be distinguished according to whether they are intended to (I) address the root causes of crime; (ii) strengthen national crime prevention policies; and (iii) improve cooperation and coordination between member states. Finally, these initiatives aim at establishing a comprehensive security framework both with member states and with other European countries, even with third countries.

The EU is also committed to strengthening police cooperation among all member states' competent authorities, involving police forces, customs authorities, and other competent authorities in the prevention, detection, and investigation of criminal offenses. Although some member states' police cooperation began in 1976, it gained legal legitimacy with the Treaty of Maastricht. This treaty also established the main tool for police cooperation, the European Police Office (EUROPOL), which originated as the Europol Drugs Unit. Cross-border police cooperation became a reality with the entry into force of the Treaty of Amsterdam, also known as the Schengen acquis. The Treaty of Lisbon (TFEU) significantly simplified the institutional framework of police cooperation, with measures now being adopted through ordinary legislative procedure (codecision) and subject to judicial review by the Court of Justice.[16]

[14] The Treaty of Lisbon, Article 84 states that "The European Parliament and the Council, acting in accordance with the ordinary legislative procedure, may establish measures to promote and support the action of Member States in the field of crime prevention, excluding any harmonization of the laws and regulations of the Member States."

[15] The Treaty of Lisbon amends the Treaty on European Union and the Treaty establishing the European Community. The Treaty of Lisbon modifies the EU's primary law in a variety of ways. The most significant change for our field of activity is that the pillar structure will be abandoned, which means that the third pillar (Police and Judicial Cooperation in Criminal Matters) will be integrated into the first community pillar. In other words, the Lisbon Treaty formally abolished the previous constitutional pillar structure in Justice and Home Affairs (JHA) policies and established an Area of Freedom, Security, and Justice (AFSJ).

[16] Article 87 of the Treaty of Lisbon (ex-Article 30 of the Treaty of the European Union).

Furthermore, in 2005, a small group of member countries signed the "Prüm Decisions" in order to strengthen intergovernmental cooperation between member state police and judicial authorities and to combat cross-border crime and terrorism more effectively.[17] These decisions include provisions and rule sets for automated information exchanges, the creation of national databases, and automated access to DNA profiles, dactyloscopy data, and national vehicle registration information.[18] The Prüm decisions were adopted by the European Council in 2008, and they were later transformed into a legal instrument binding all EU countries.

Additionally, since 1999, the European Council has approved multi-annual plans that serve as the strategic compass for the JHA of the EU. On April 28, 2015, the European Commission renewed internal security policy and adopted the European Agenda on Security to specify effective and sustainable actions to address security threats at the EU level from 2015 to 2020. In this regard, EU and member countries agreed to strengthen tools and policies for combating crime, as well as to improve coordination and closer cooperation between judicial and police authorities and other relevant authorities.[19]

1.3. RELATED LITERATURE

In recent years, the empirical criminology literature has paid increasing attention to the analysis of crime rate convergence. This literature has mostly investigated the behavior of convergence from the cross-sectional comparative perspective (Cook & Winfield, 2013; LaFree, 2005; McDowall & Loftin, 2005, 2009; Winsberg, 1993). However, there has been much recent interest in the analysis of crime rate convergence at country level (Fondevila & Massa, 2018).

The most prominent study that tests the modernization prediction of the cross-country crime convergence is that of LaFree (2005). In order to investigate the

[17] Council Decision 2008/615/JHA of June 23, 2008, on enhancing cross-border cooperation, particularly in combating terrorism and transnational crime (OJ L 210, 6.8.2008, pp. 1-11), retrieved from https://eur-lex.europa.eu/legalcontent/EN/TXT/?uri=LEGISSUM%3Ajl0005#keyterm_E0001.

[18] The decision is based on the Prüm Treaty, which Belgium, Germany, Spain, France, Luxembourg, the Netherlands, and Austria signed in 2005.

[19] The Treaty of Lisbon, Article 82 (ex Article 31 TEU)

dynamics of convergence both between and within the income groups, LaFree (2005) calculated "convergence scores" by using the homicide rates of 23 advanced and 11 developing countries over the period 1956–2000. During the second half of the twentieth century, LaFree (2005) found no significant evidence of crime convergence between developing countries and developed countries. However, findings revealed that only high-income countries tended to achieve homicide rate convergence during the same time period. LaFree (2005) therefore formulated an "elite convergence model", in which convergence behavior is only limited to industrialized, urbanized, high-income, and thereby elite countries. More recently, Kollias et al. (2018) using the modernization theory in their examination of convergence in police recorded crime rates among 16 European countries from 1972 to 2012, provided support for the achievement of convergence in overall crime rates across European countries.

Since cities, states, or regions of a country might reach the same steady-state crime levels in the long-run due in part to their developmental similarity, some researchers concentrate on convergence in crime rates within a single country through this theory (McDowall & Loftin, 2009; Winsberg, 1993). Some researchers also explain the cross-sectional convergence in crime rates within a single country through this theory. Using a comprehensive dataset for 50 U.S. states over the period 1950–2009, Cook and Watson (2013) and Cook and Winfield (2013) studied the dynamics of convergence in murder, rape, robbery, assault, burglary, larceny, and motor vehicle theft across U.S. states. However, the former obtained no statistically significant results for the existence of convergence in crime rates by using Barro-Baumol regressions and the probabilistic approach to the analysis of convergence, whereas the latter found significant coefficients by using β- and σ-convergence to measure convergence. More recently, Çiftçi and Akkoç (2019) considered the impact of developmental changes in their assessment of time series convergence behavior in four main types of crime, namely, violent, property, drug-related, and opposition to bankruptcy and enforcement law for 12 regions of Turkey over the period 1990–2016. They find no evidence of convergence behavior in crime rates, however.

Fondevila and Massa (2018) considered the modernization theory in their investigation of time series convergence behavior of robbery rates in Mexico in the

three developmental phases, 1997–2006, 2007–2011, and 2012–2018, which also coincided with the implementation of three major national security policies in Mexico. They demonstrated the presence of robbery convergence and improvements in national security policy have affected such convergence in Mexico.

1.4. METHODOLOGY AND DATA

1.4.1. Methodology

The following dynamic panel equation can be used to estimate convergence of homicide rates in the EU:

$$H_{it} = \beta \cdot \mathrm{H}_{i,t-1} + \alpha \cdot X_{it} + \mu_i + \delta_t + \upsilon_{it} \qquad (1.1)$$

where H_{it}, denotes the homicide rate, and $H_{i,t-1}$. is the previous period of the homicide rate and β is the coefficient of previous period of the homicide rate. Based on the idea of convergence, this coefficient would be between 0 and 1. Hence, $\beta^* = \beta - 1$ is presumed to be between -1 and 0. If $0 < \beta^* < 1$, this mainly suggests that the homicide rate growth would be faster in countries with lower initial rates of homicide. In this regard, if $\beta^* > 1$, it signifies the homicide rate divergence in the EU. If $\beta^* = 1$, it shows that disparities in homicide rates across member countries persist over time.

X_{it}, denotes the vector of control variables and α is the coefficients of X_{it}. It should be noted that X_{it}, and its coefficient α appears in the conditional convergence estimation.

μ_i is used to calculate country-specific effects and and δ_t is used to measure time-specific intercepts. υ_{it} can be denoted as the transitory error term. To reinforce the notion that there is no association between people with idiosyncratic disturbances, this study also uses time dummies to all regressions (Roodman, 2009a, 2009b).

The vector of control variables, X_{it}, includes per capita GDP and the unemployment rate. Greater income per capita and lower unemployment rates are

expected to reduce homicide rates while also hastening the process of homicide rate convergence.

This chapter employs the Difference GMM, developed by Arellano and Bond (1991), as well as the System GMM estimator, introduced by Blundell and Bond (1998). There are four primary reasons why GMM is employed in the EU's homicide convergence analysis. First, while the Ordinary Least Squares (OLS) estimator and within-groups estimators are widely used in the convergence literature, in the dynamic panel data models, these estimators may lead to biased and inconsistent estimations due to the addition of the previous periods of dependent variables into the model (Hoeffler, 2002; Hsiao, 2014; Nickell, 1981). In this aspect, GMM estimations would be a reliable methodology because they are unlikely to produce biased results with the inclusion of previous period of dependent variable (Arellano & Bover, 1995; Blundell & Bond, 1998, 2000; Windmeijer, 2005).

Second, the GMM tends to yield both consistent and efficient estimation results in the cases where explanatory factors do not seem to be strictly exogenous, and heteroscedasticity and autocorrelation are likely to occur across cross-sections (Roodman, 2009a). More precisely, the GMM estimators avoids endogeneity by making instruments of the lag dependent variable, or of another endogenous variable. However, Nickell (1981) and Roodman (2009a) noted that the instruments should not be correlated with the fixed effects.

Third, dynamic panel data sets with large cross-sectional units and small temporal dimensions are considered to be well-suited for GMM estimators (Blundell & Bond, 1998, 2000; Bond et al., 2001).

Finally, GMM estimators are ideally suited for empirical growth models that primarily include dynamic dependent variables and other explanatory variables that are very likely to be endogenous (Bond et al., 2001; Roodman, 2009b).

There are numerous arguments against the Difference GMM and the System GMM. It is well documented that the System GMM estimator would be more efficient than the Difference GMM estimator in several ways. The System GMM, in particular, allows for the addition of instruments, but the first differences of instruments should not be associated with the fixed effects (Roodman, 2009a). Furthermore, Blundell and

Bond (1998) proposes that when the series is near to be random walks, the System GMM may yield effective predictions, yet the Difference GMM estimations in these instances might be suffered from finite sample biases. Additionally, in the Difference GMM estimation, the coefficient of previous period of the response variable would be downward biased if time dimension is lacking and instruments seems to be weak (Blundell & Bond, 2000; Hoeffler, 2002).

In the GMM approach, the first-order autoregressive model can be written as:

$$y_{it} = \theta \cdot y_{i,t-1} + \gamma \cdot X_{it} + \mu_i + \delta_t + \upsilon_{it} \; for \; i = 1, \dots, N \; and t = 2, \dots, T$$
$$u_{it} = \mu_i + \delta_t + \upsilon_{it} \tag{1.2}$$

$y_{i,t-1}$ denotes the lag of dependent variable. X_{it} is the vector of explanatory variables. μ_i and δ_t are used to determine country-specific effects and time-specific intercepts, correspondingly. While υ_{it} shows the idiosyncratic shocks, u_{it} signifies the error term. To resolve the endogeneity problem brought on by the correlation between $y_{i,t-1}$ and u_{it}, the first action would be to change the variables by first-difference and reduce the variable μ_i from u_{it}.

$$\Delta y_{it} = \theta \cdot \Delta y_{i,t-1} + \gamma \cdot \Delta X_{it} + \Delta \phi_t + \Delta \upsilon_{it} \; for \; i = 1, \dots, N \; and \; t = 3, \dots, T \tag{1.3}$$

$$E(\upsilon_{it} \upsilon_{is}) = 0 \; for \; t \neq s \tag{1.4}$$

In this respect, transitory errors are regarded serially uncorrelated and independent across countries, as shown by Equation (1.4).

Besides, it should be note that the initial conditions should succeed that:

$$E(y_{i1} \upsilon_{it}) = 0 \; for \; t \geq 2 \tag{1.5}$$

According to these presumptions, it is expected that $y_{i,t-1}$ is predetermined with respect to υ_{it}.

Despite the removal of μ_i from the regression, $y_{i,t-1}$ might be endogenous, as $y_{i,t-1}$ in $\Delta y_{i,t-1}$ is linked with $v_{i,t-1}$ in Δv_{it}. To address the problem of endogeneity, As suggested by Arellano and Bond (1991), Equations (1.6) and (1.7) show moment restrictions:

$$E\left(y_{i,t-s}\Delta v_{it}\right) = 0 \; for \; t = 3, \dots, T \; and \; s \geq 2 \tag{1.6}$$

$$E\left(X_{i,t-s}\Delta v_{it}\right) = 0 \; for \; t = 3, \dots, T \; and \; s \geq 2 \tag{1.7}$$

Blundell and Bond (1998) suggest that if the explanatory factors remain persistent across time, the past values of these variables could be weak instruments to use for the first-differenced equation. Because of the weak correlation between the instruments and the endogenous variables in this case, the estimations are subject to finite sample bias.

Blundell and Bond (1998) suggest that a system be made up of two groups of equations. More precisely, in first differences the transformed equation is one group of equations for which the previous periods of y_{it} and X_{it} are employed as instruments. The original equation in levels is employed as an instrument in the other group of equations. Accordingly, Equations (1.8) and (1.9) demonstrate the additional moment constraints:

$$E\left[\Delta y_{i,t-1}(\mu_i + v_{it})\right] = 0 \; for \; t = 3, \dots, T \tag{1.8}$$

$$E\left[\Delta X_{i,t-1}(\mu_i + v_{it})\right] = 0 \; for \; t = 3, \dots, T \tag{1.9}$$

Four fundamental factors must be met to assure the consistency of GMM estimations: First, the error term should not have any serial correlation. In first-difference residuals, the Arellano-Bond (1991) test detects the first order serial correlation, specifying that sequential errors are highly correlated, as well as second-

order serial correlation, implying that the present error term is connected to the error term from two periods ago. The first-order autocorrelation in levels is analyzed using the second-order correlation in first differences, because this determines the correlation between $v_{i,t-1}$ in $\Delta v_{i,t-1}$ and $v_{i,t-2}$ in $\Delta v_{i,t-2}$. To determine whether the error term should not include serial correlation, the Arellano-Bond test for AR(2) for first differences should be considered (Roodman, 2009a). AR(2) provides test statistics for the null hypothesis that the first-differenced residuals do not have second-order serial correlation.

Second, to maintain instrument validity, it should be ensured that the instruments used in the estimations are not correlated with the errors. The Hansen (1982) test provides test statistics for the validity of over-identifying restrictions. The rejection of the null hypothesis implies that the instruments are valid.

Third, the additional moment restrictions suggested by Blundell and Bond (1998) are required to be valid. Difference-in-Hansen test reports the validity of additional instruments. Hence, the rejection of the difference-in-Hansen test signifies that additional instruments used in the estimation are valid.

Lastly, to avoid finite sample bias caused by overfitting, the number of instruments in a regression should not be higher than or equal to the number of groups (Roodman, 2009b).

1.4.2. Data

The panel data used for the empirical analysis, which spans the years 1990 to 2018, covers 26 countries that are members of the European Union.[20] Data on intentional homicides recorded for 100,000 individuals, GDP per capita at a constant 2010 US dollar in millions, and unemployment rate is retrieved from the World bank Databank.

[20] 26 member countries include Austria, Belgium, Bulgaria, Croatia, the Republic of Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden. However, due to data availability constraints, we exclude Luxembourg from the analysis.

Because GMM estimation technique requires small time periods and relatively large cross-sections, this chapter uses 2-year span data to overcome possible serial correlation. As a result, for each of the 26 EU member countries, 15 data points are obtained, e.g., 1990, 1992,.., 2018. All series are used in their natural logarithm to evaluate the results of homicide convergence. Table 1.2 shows the basic statistics for the series in the study.

Table 1.2: Descriptive Statistics

Variables	Num.Obs.	Mean	S.Dev.	Min	Max
Intentional Homicides	382	0.472	0.716	-1.243	2.937
Unemployment rate	390	2.089	0.482	0.095	3.255
GDP per capita	379	9.995	0.694	8.279	11.244

Num. Obs. represents total number of observations, and S. Dev. denotes the standard deviation.

1.5. EMPIRICAL RESULTS

Table 1.3 displays the GMM results from estimating Eq. (1) with data from 26 EU member countries from 1990 to 2018.[21] Columns 1-4 of Table 1.3 exhibit the results of one-step Difference GMM estimation, and columns 5-8 show the one-step System GMM estimation results. All estimates account for time effects. In all tables, the heteroscedasticity-consistent standard errors are displayed in parentheses. The first rows in both parts show $\hat{\beta}$, the estimates of the coefficient of the previous period of the homicide rate. Note that $0 < \hat{\beta} < 1$ describes the presence of convergence, $\hat{\beta} = 1$ signifies the persistence of the cross-country differences in homicide rates, and $\hat{\beta} > 1$ denotes homicide rates divergence. Additionally, it is anticipated that $\hat{\beta} - 1$ in

[21] In Stata (v.14), the command "xtabond2" is used for Difference GMM and System GMM estimates, and the instrument matrix is compressed using the Stata command "collapse," as indicated in Roodman (2009b).

absolute value, will rise when control variables are included in the model. This indicates that conditional convergence will be faster than absolute convergence.

Column (1) and column (5) in Table 1.3, display the findings from absolute (unconditional) convergence estimations by using the Difference and the System GMM, correspondingly. In both estimations, the estimated coefficients of previous period of homicide rate are statistically significantly and between 0 and 1, 0.794 and 0.835, respectively, indicating the presence of convergence. .[22] According to these findings, absolute convergence rates per year with the Difference GMM estimator are around 10.3% and 8.25% with the System GMM estimator. The System GMM estimate suggests a slower convergence rate than the Difference GMM estimation.[23]

In columns (2) and (3) of Table 1.3, the control variables are included one by one into the model to estimate using Difference GMM and System GMM, respectively. Columns (4) and (5) demonstrate the estimation results for two control variables (8). As predicted, conditional convergence regressions generate lower results than absolute convergence regressions. While the observed GDP per capita coefficients are negative, as predicted, and statistically significant, the calculated unemployment rate coefficients are frequently positive but negligible.

Columns (4) and (8) show that incorporating a control variable improves the conditional convergence rate even when unemployment is not always significant. The primary reason for this is that incorporating an explanatory variable improves the instrument set in GMM regressions significantly (Hoeffler, 2002). For example, in column (2), GDP per capita is used as a control variable; but, in column (4), the unemployment rate is included in the regression, and the estimation in (4) indicates a higher rate of conditional convergence, as evidenced by the results. Estimates (6) and exhibit comparable results (8).

[22] The homicide rate (observed for 1990,., 2018) is used as the dependent variable in all regressions, with the two-year lag of this variable added on the right-hand side. In this sense, the estimated annual rate of convergence equals the estimated coefficient on the previous period of dependent variable minus 1 divided by 2.

[23] Some empirical studies used Monte Carlo analysis to evaluate the convergence results of Arellano and Bond (1991) and Blundell and Bond (1998) (Bruno, 2005; Hauk & Wacziarg, 2009). They suggest that in some cases, Arellano and Bond (1991) substantially overestimate the convergence rate, whereas Blundell and Bond (1998) substantially underestimate it.

The results of the Arellano-Bond test for no second-order serial correlation in the error term, represented by AR (2), the Hansen test for instrument validity, and the Difference-in-Hansen test for the validity of extra moment conditions are shown in the final three rows of Table 1.3.

AR (2) statistics in all estimates show no evidence for second order serial correlation in disturbances. The Hansen test uses the over-identification limits' validity as a null hypothesis (Hansen, 1982). The Hansen null hypothesis would not be rejected in any estimation, suggesting that instruments are valid in both unconditional and conditional meanings. Furthermore, because the Difference-in Hansen null hypothesis is not rejected, the extra moment requirements are also valid. The number of cross sections and instruments are also depicted to validate the rule of thumb. Nonetheless, estimation findings show that the number of cross sections is not always considerably more than the number of instruments, a circumstance that partially meets the rule of thumb.

Table 1.3: GMM Estimates from a Panel of 2-Year Span Data.

	Difference GMM				System GMM			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Homicide rate (-1)	0.794*** (0.134)	0.420*** (0.186)	0.749*** (0.154)	0.400*** (0.191)	0.835*** (0.124)	0.569*** (0.182)	0.709*** (0.162)	0.564*** (0.187)
GDP per capita	-	-0.819** (0.353)	-	-0.861** (0.361)	-	-0.505* (0.279)	-	-0.514* (0.277)
Unemployment rate	-	-	0.273 (0.215)	-0.065 (0.108)	-	-	0.240 (0.234)	0.056 (0.108)
Number of Instruments	18	23	23	25	20	26	26	26
Number of Groups	26	26	26	26	26	26	26	26
Hansen	0.377	0.346	0.504	0.255	0.110	0.520	0.846	0.339
Difference in Hansen	-	0.867	-	-	0.048	0.603	0.867	0.705
AR (2)	0.233	0.296	0.281	0.174	0.241	0.147	0.296	0.154

***, ** and * signify the significance at 1%, 5% and 10% level, respectively.

1.6. CONCLUDING REMARKS AND POLICY IMPLICATIONS

The purpose of this chapter is to investigate whether homicide rates tend to converge over time in the EU. To that purpose, the chapter utilizes the GMM approach on a dataset encompassing 26 EU member nations from 1990 to 2018. This chapter investigates two forms of convergence: absolute (unconditional) and conditional on control factors, namely income per capita and unemployment. The findings show the existence of unconditional and conditional convergence of homicide rates in the EU over the period 1990-2018. The inclusion of control variables generally provides a faster rate of convergence, and which suggests that EU economic integration played an important role in homicide convergence across member countries.

The findings of this chapter indicate that actions aimed at achieving a true and effective Security Union benefit EU member nation by leading homicide rates to follow a pattern of convergence. As a result, regardless of whether the EU is able to create a Security Union, more collaboration and policy integration in the sphere of JHA can benefit all member nations.

Possible extensions to this study would be to look at the same issue using a larger data set, namely low-income countries, and rates for other forms of crime. These advancements, however, are contingent on the availability of the appropriate data.

CHAPTER TWO
AN EXPLORATION OF HOMICIDE KUZNETS CURVE IN NEW EU MEMBER COUNTRIES

2.1. INTRODUCTION

Ensuring economic well-being and improving security conditions are among the founding objectives of the European Union (EU). In this context, member states and their citizens join the EU in the hope of achieving higher economic growth and lower crime rates. These expectations of the countries of Central and Eastern Europe (CEE) that joined the EU in 2004 and 2007 have been largely met. Since their entry into the EU, these new member countries have witnessed steady growth and a significant drop in homicide rates. Although the decrease in homicide rates and the increase in income may propose a link between homicide rates and economic growth, this link can be complex and non-linear one. Whereas considerable research has been conducted on the linear link between economic growth and homicide rates across new EU member countries, no consideration has been given to the possible nonlinearity of this relationship.

This oversight is noteworthy for two reasons. First, most prior research on the relationship between homicide rates and economic development in new EU member countries has already claimed that homicide rates in new EU member countries initially increase and then decline in the early stages of accession. To our knowledge, only two studies on the relationship between homicide rates and economic development in new member states have been published: Andresen (2011) and Piatkowska et al. (2016). Andresen (2011) investigated how EU accession affected violent crime rates in Lithuania during the period 2001-2006. Andresen (2011) found that homicide rates in Lithuania increased during the early stages of EU membership, and that income was positively correlated with homicide rates. However, Andresen (2011) noted that the homicide rate started to decrease in the later stages of EU membership. Similarly, Piatkowska et al. (2016) examined the homicide rates in 10 new EU member states from CEE from the 1994 to 2017. They found that homicide rates increased in the first years of accession in new EU member countries, while they

decreased in the later years. However, they found a negative association between homicide rates and income over the period from 1994 to 2017. Hence, while both studies have suggested that after EU accession, homicide rates in new member countries first increased and then declined, they have focused on a linear relationship between homicide rates and economic development. Thus, it seems that the investigation of a possible quadratic, inverse U-shape relationship between income and homicide rates in new EU member countries is lacking.

Secondly, this oversight is also noteworthy because modernization and civilization theories in criminology literature, as well as the Kuznets curve concept for homicide rates, may suggest that homicide rates may follow a reverse U shaped pattern during the development process. The modernization theory posits that crime rates may increase in the early phase of development, while the civilization theory predicts a decline in later phase. This suggests that the relationship between crime rates and economic progress may take the form of a reversed U. The Kuznets curve concept for homicide rates may also suggest the relationship between homicide rates and economic development can also be an inversed U-shape form. Kuznets (1955) proposed the first Kuznets curve hypothesis to conceptualize the income-inequality nexus by using an inverse U-shaped curve. According to the Kuznets curve hypothesis, when income rises, inequality rises first and then reduces when a certain level of income is attained. The Kuznets curve concept and the argument of a reverse U shape relationship have recently been extended to crime rates by Germani et al. (2020) and Buonanno et al. (2017). The Kuznets curve hypothesis has been extended to environmental crime by Germani et al. (2020). Using the Environmental Kuznets curve (EKC) hypothesis on a dataset from Italy over the period 2010-2015, Germani et al. (2020) argued that environmental crime and income also have a reversed U-shape form relationship. Buonanno et al. (2017) have extended this hypothesis for violent and property crimes. They explored the emergence of a crime Kuznets curve by investigation the link between income per capita and crime rates in the United States over the period 1970-2011. They suggested several criminological explanations for nonlinear relationship between income and crime, including criminal opportunity and motivation. Hence, similar to the concept of the crime Kuznets curve by Buonanno et al. (2017), homicide

rates and economic development can also have an inverted U-shaped relationship called the homicide Kuznets curve (HKC).

This chapter seeks to explore the existence of the homicide Kuznets Curve in new EU member countries, which empirically investigates an inverted U-shaped relationship between homicide rates and income per capita over the period 1995–2017. To this end, drawing upon a panel level dataset from new EU member countries, the chapter uses advanced panel data techniques. Theoretically, the chapter uses modernization and civilization theories and the concept of the Kuznets curve to explain to explain why homicide rates and economic growth have an inverted U shape relationship. This chapter also examines the existence of a homicide Kuznets curve while accounting for the heterogeneity of socioeconomic development. Consistent with prior research, this chapter measures socioeconomic development by urbanization and unemployment rates and uses them as control variables. This chapter relies only on homicide data because it is generally perceived as the most valid measure of crime in cross-country settings (Aebi & Linde, 2012; LaFree, 2005; Pratt & Godsey, 2003; Soares, 2004).

Chapter 2 adds two contributions to the related literature. Foremost, as far as we know, this is the first study that explores a homicide Kuznets curve in new EU member countries. As stated before, research on homicide rates in EU member countries that joined the EU in the 2000s has exclusively hypothesized a linear relationship between homicide rates and economic development. The investigation of the existence of a possible nonlinear link between homicide rates and economic development in new EU member countries has been an unexplored area.

Second, Chapter 2 contributes theoretically to the literature on the Kuznets curve for crime rates. As already mentioned, there is extremely little empirical research on the presence of the Kuznets curve in crime rates, and this literature seems to be theoretically undeveloped. Based on a review of the literature, the work of Buonanno et al. (2017) appears to be quite relevant to this study. However, the present study differentiates from Buonanno et al.'s work through two channels. First, while Buonanno et al. (2017) relied on micro-level theories, namely motivation and opportunity theories, to explain the presence of crime Kuznets curve, or an reversed U-shaped relationship between economic growth and crime rates in the United States,

this study relies on the theories of modernization and civilization, which are macro-level theories that predict a positive and negative relationship between economic development and crime rates, respectively. Micro-level theories are by no means trivial, but focus on a small group of criminals or an individual crime, and thus often fall short of explaining the homicide rates-economic development nexus. Therefore, as this study uses macro-level theories, it may have a potential to theoretically better explain the presence of an inverse U-shaped relationship between homicide rates and economic development. Second, while Buonanno et al. (2017) have made strides in examining the potential factors that affect the nonlinear relationship between economic growth and homicide rates, such as population density, unemployment, inequality, and deterrence, they have used the fixed effects estimation method to estimate these factors. However, the fixed effects estimator seems to be biased and inconsistent in the dynamic panel data models, as it may not eliminate heterogeneity and endogeneity problems. To ensure consistent results, the present study uses the pooled mean group (PMG) estimator developed by Pesaran et al. (1999), which is more efficient due to the valid long-run restrictions. In particular, the PMG estimator permits for differences in the short-run coefficient, error variances, and the intercepts. Therefore, the PMG estimator is well fit to study the Kuznets curve hypotheses. Furthermore, the PMG estimator provides for the estimate of a long-run connection in a consistent and efficient manner without estimating the series' stationarity, because both stationary and nonstationary variables are allowed in the model with the condition that cointegration exists between variables (H. H. Pesaran & Shin, 1998). To bring forth more insight and robustness, in addition to Fully Modified OLS (FMOLS), the chapter uses two Dynamic OLS (DOLS) estimators, one of them is proposed by Kao and Chiang (2001) and the other is developed by Mark and Sul (2003). Whereas FMOLS estimator uses non-parametric methods to eliminate serial correlation problem, DOLS estimators are based on parametric methods to solve such problem.

In Section 2.2, the modernization and civilization theories as well as the Kuznets curve concept and frames the relevant empirical literature are firmly discussed. Section 2.3 introduces the data, empirical model, and methodology. Section 2.4 presents empirical results, while Section 2.5 outlines conclusions and policy implications.

2.2. MODERNIZATON-CIVILIZATION THEORIES, THE KUZNETS CURVE CONCEPT, AND RELEVANT LITERATURE

Modernization and civilization theories in criminology literature predict homicide trends in the first and last stages of economic development, respectively. Whereas modernization theory contends that the early phases of economic growth are marked by more homicides, civilization theory contends that as the economy progresses, individuals and the state become more civilized, resulting in fewer homicides. Therefore, these two hypotheses suggest an inverse U-shaped link between economic growth and homicide rates; specifically, that in the early phases of development, homicide rates increase with increasing income per capita and decline when a particular income threshold is achieved.

Modernization theory builds on Durkheim's (1951) theory of anomie, which asserts that crime rates are likely to increase in the first phases of economic development. The advocates of this theory suggest that as an economy starts to industrialize, modernize, and urbanized, social disruptions will accelerate, and thus crime will likely increase (Howard & Newman, 2000; La Free & Drass, 2002; Shelley, 1981). In this respect, increased homicide rates can be evaluated as a side effect of economic growth at this stage. On the other hand, civilization theory, based on Elias's theory of civilization (1969), argues that homicide rates will decline in the later phases of development. According to this theory, further industrialization and modernization fueling the civilization process could reduce homicide rates. Thus, further economic growth leads to an improvement in homicide rates in the latter phase of development.

There are numerous examples that support the presumptions of modernization and civilization theories. Several studies, for example, have indicated an increase in homicide rates in numerous CEE countries after the transition from a communist to a market economy, confirming the modernization theory (Bye, 2008; Ceccato, 2008, 2009; Gruszczyńska, 2004; Lehti, 2001; Neapolitan et al., 1997; Stamatel, 2008, 2012). Some studies have argued that homicide rates tend to decline in the later stages of this transition, which can confirm the civilization theory (Stamatel, 2008). Moreover, many studies examining historical crime data of Western developed countries have found a general decline in homicide rates and revealed results consistent

with civilization theory (Eisner, 2003; Fletcher, 2013; Gurr, 1981; Johnson & Monkkonen, 1996b; Mares, 2009).

The Kuznets curve concept is also a versatile tool for testing potential nonlinear behavior of homicide rates in the stages of development. Kuznets (1955) assumed that income inequality and economic growth has a reversed U-shaped form relationship, speculating that as income rises, income disparity rises first, then reaches a crucial level, and finally falls. In recent years, the concept of the Kuznets curve has been used to investigate the crime-growth nexus. Buonanno et al. (2017) suggest that crime and income also have a reserve U-formed relationship. They have argued that it increases with per capita income until it reaches a maximum, and then decreases as income rises in the United States. Buonanno et al. (2017) assessed the relationship between income and crime in the United States over the period 1970-2011. By using parametric and nonparametric panel methods, they documented the existence of a Kuznets curve for property and violent crimes in the United States.

2.3. DATA AND METHODOLOGY

2.3.1. Data

Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic, and Slovenia were chosen as new Central and Eastern European EU members. Homicide rates (number of recorded intentional homicides per 1 million people), GDP per capita in constant 2010 US dollars, unemployment rate (% of total labor force) (modeled ILO estimate), and proportion of urban population were utilized in this study. The World Bank's World Development Indicators were used to collect the data.

Table 2.1 provides descriptive statistics for the intentional homicide rate, GDP per capita, unemployment, and urbanization rates. The average intentional homicide rate ranges from 1.1 in Slovenia to 7.89 in Estonia. Slovenia seems to be richest country in the panel, and Bulgaria appears to be the poorest. The number of unemployed people seems to be highest in the Slovak Republic, while unemployment rate appears to be lowest the Czech Republic. Finally, the Czech Republic seems to be most urbanized country, and Slovenia seems to be the least urbanized one in the EU.

Table 2.1: Summary statistics of time series variables

		HR	PGDP	U	UR
Bulgaria	Mean	2.922	5774.677	11.601	71.004
	Stdev	1.368	1556.540	3.717	2.199
Croatia	Mean	1.696	12677.150	12.911	54.469
	Stdev	0.696	2072.941	2.716	1.276
Czech Republic	Mean	1.222	17899.050	6.238	73.711
	Stdev	0.406	2977.187	1.698	0.426
Estonia	Mean	7.891	13744.390	9.581	68.857
	Stdev	4.207	3719.924	3.068	0.699
Hungary	Mean	2.026	12386.700	7.897	67.306
	Stdev	0.511	2038.107	2.103	2.331
Latvia	Mean	6.543	10454.600	12.990	68.057
	Stdev	3.130	3366.665	3.992	0.281
Lithuania	Mean	8.552	10739.440	11.981	66.970
	Stdev	2.299	3636.564	4.011	0.244
Poland	Mean	1.430	10856.660	11.983	61.147
	Stdev	0.553	2838.658	4.500	0.558
Romania	Mean	2.209	7239.153	6.713	53.496
	Stdev	0.570	2009.048	0.781	0.403
Slovak Republic	Mean	1.813	14160.720	13.840	55.276
	Stdev	0.556	3666.834	3.197	0.976
Slovenia	Mean	1.100	21292.330	7.020	51.986
	Stdev	0.511	3240.470	1.438	1.243

Note: Obs. denotes number of observations. Std. Dev. denotes standard deviation. All series are in their natural log.

To test the HKC hypothesis of an inverted U relationship between homicide rates and income, the empirical model is constructed as follows:

Model 1:

$$lnHR_{it} = \alpha + \beta_1 lnPGDP_{it} + \beta_2 lnPGDP_{it}^2 + \varepsilon_{it} \quad (2.1)$$

Natural logarithms are used for all variables. Country and time are represented by the subscripts *I* and *t* represent, respectively. HR is intentional homicide rate, as measured by the number of intentional homicides per 1,000,000 inhabitants. $PGDP$ denotes GDP per capita, and $PGDP^2$ denotes square of GDP per capita. The long-run elasticities of the intentional homicide rate for GDP per capita is β_1, and for GDP per capita squared is denoted by β_2. Thus, an increasing part of the inverted U curve, an increase in income per capita is expected to yield lower intentional homicide rates, and $\beta_1 > 0$ and $\beta_2 < 0$ are expected.

Two controls that are typically used in homicide research were added to the model to see whether developmental characteristics influence the link between homicide rates and income per capita, as shown in Model 2:

Model 2:

$$lnHR_{it} = \alpha + \beta_1 lnPGDP_{it} + \beta_2 lnPGDP_{it}^2 + \beta_3 lnU_{it} + \beta_4 lnUR_{it} + \varepsilon_{it} \quad (2.2)$$

where Udenotes unemployment rate and UR signifies the share of urban population.

2.3.2. Methodology

2.3.2.1. Panel Unit Root Tests

To determine the stationarity properties of the variables, five types of panel unit root tests are used in this work. Levin et al. (2002, henceforth LLC) offer a panel-based Augmented Dickey Fuller (ADF) test that assumes homogeneity in the dynamics of all panel units' autoregressive coefficients. Im et al. (2003, henceforth IPS) on the other hand, present the panel unit root test, which allows for heterogeneity in the dynamics of the autoregressive coefficients for all panel units. The Fisher-ADF and Fisher-Phillips-Perron (PP) tests are used to estimate the nonparametric panel unit root tests proposed by Maddala and Wu (1999). Whereas Hadri's (2000) test presupposes stationarity under the null hypothesis, the null hypothesis in the other aforementioned unit root tests is unit root.

LLC (2002)'s panel unit root test involves estimating the following panel model:

$$\Delta y_{it} = \mu_i + \rho y_{it-1} + \sum_{j=1}^{k} \alpha_j \Delta y_{it-j} + \delta_i t + \theta_t + \varepsilon_{it} \quad (2.3)$$

Where μ_i and θ_t are unit-specific fixed and temporal effects, respectively, and Δis the first difference operator. In the model, the null hypothesis of $\rho = 0$. The rejection of the null hypothesis suggests that the process is panel stationary.

It should be noted that, the assumption of strong homogeneity in the LLC test is cannot be met because cross-sectional units may adapt at various rates to the long-run equilibrium. Therefore, IPS (2003), based on weak homogeneity, introduced a panel unit root test which permits ρ to vary across all i, which can be written as in the following equation:

$$\Delta y_{it} = \mu_i + \rho_i y_{it-1} + \sum_{j=1}^{k} \alpha_j \Delta y_{it-j} + \delta_i t + \theta_t + \varepsilon_{it} \quad (2.4)$$

In this regard, the null hypothesis of $\rho_i = 0$ for all i is tested against the alternative hypothesis of $\rho_i < 0$ for at least one i. If the null hypothesis indicates that all series have a unit root.

The following are the two forms of panel unit root tests, ADF and PP unit root tests, which are based on Fisher-type tests:

$$I = -2\sum_{i=1}^{N} \log(\rho_i) \sim \chi_2^N \quad (2.5)$$

Choi (2001) also revealed that:

$$Z = \frac{1}{\sqrt{N_{i=1}}} \sum_{i=1}^{N} \Phi^{-1}(\rho_i) \sim N(0,1) \quad (2.6)$$

where Φ^{-1}signifies the reverse function of the normal distribution.

Hadri (2000) presents testing strategies for contrasting the null hypothesis where each individual series are stationary to the alternative that one or more unit roots exist. Eq. (2.7) might be used to define the model:

$$y_{it} = r_{it} + \beta_i t + \varepsilon_{it} \quad (2.7)$$

where r_{it} is a random walk given by: r_{it}=r_{it-1}+v_{it}, where v_{it} shows white noise. The null hypothesis showing that series are stationary is denoted as H_0: ${\sigma_v}^2 = 0$,. The alternative hypothesis suggests that one or more series can be nonstationary is defined by H_1: ${\sigma_v}^2 > 0$.

2.3.2.2. Panel Cointegration Tests

The panel cointegration tests established by Pedroni (1999, 2004) are utilized in this chapter to determine the long-run cointegration in Model 1 and Model 2. More precisely, Pedroni (1999, 2004) provides two groups of cointegration test statistics are relied on the residuals of the Engle and Granger (1987) cointegration regression. The first group of tests is characterized "Within" the dimension, which included the panel-

v statistic (Z_v), panel rho-statistic (Z_ρ), panel PP-statistic ($Z_{\rho\rho}$) and panel ADF-statistic (Z_{ADF}). The second group of tests is based on the "Between" dimension and covers three group statistics: group rho-statistic $\tilde{Z}_\rho$, group PP-statistic $\tilde{Z}_{\rho\rho}$, and group ADF-statistic $\tilde{Z}_{ADF}$. The averages of the multiple autoregressive coefficients associated with the unit root tests of the residuals for each cross-sectional unit are commonly used to create these statistics.

These test statistics are performed on the projected residuals from the long run model given below:

$$Y_{it} = \alpha_i + \lambda t + \sum_{j=1}^{m} \beta_j X_{jit} + \varepsilon_{it} \quad (2.8)$$

$$\varepsilon_{it} = \phi \varepsilon_{it-1} + \sum_{k=1}^{K_i} \phi_{ik} \Delta \varepsilon_{it-k} + v_{it}$$

2.3.2.3. Panel Cointegration Estimations

After the detection of the existence of the cointegrated relationship, the long-run coefficients in Model 1 and Model 2 can be forecasted. The chapter uses two panel cointegration estimators to estimate long-run values: Pedroni's (2000, 2001), as a group-mean panel Fully Modified Ordinary Least Squares (FMOLS) and Kao and Chiang 's (2001) and Dynamic Ordinary Least Squares (DOLS) estimators introduced by Mark and Sul's (2003).

Pedroni (2000) proposes a cointegrated system for panel data where independent and dependent variables are correlated. The panel FMOLS estimator is denoted as $\hat{\beta}^*_{GFM} = N^{-1} \sum_{i=1}^{N} \beta^*_{FMi}$ where β^*_{FMi} is obtained from the time series FMOLS estimations of Eq. (2.1) and Eq. (2.2) for each member of the panel. In this regard, t-stat can be derived as $t_{\widehat{\beta}^*_{GFM}} = N^{-1/2} \sum_{i=1}^{N} t_{\widehat{\beta}^*_{FMi}}$.

Given that the ordinary least squares (OLS) estimator has a bias due to endogeneity, Pedroni (2001) suggests using DOLS estimator which uses averages of individual cross-sections. In this case, the group-mean panel DOLS estimator is denoted as $\hat{\beta}^*_{GD} = N^{-1} \sum_{i=1}^{N} \beta^*_{Di}$ where β^*_{Di} is derived from the individual OLS

estimation of Eq. (2.9) and Eq. (2.10). The associated t-ratio can be obtained as $t_{\widehat{\beta}^*_{GD}} = N^{-1/2} \sum_{i=1}^{N} t_{\widehat{\beta}^*_{Di}}$.

Kao and Chiang (2001) and Mark and Sul (2003) also propose DOLS estimators to overcome this issue. The former proposes the pooled DOLS estimator, in which we use ordinary least squares to estimate pooled, an augmented panel model, whereas the latter proposes a simple weighted DOLS estimator that allows for long-run variance heterogeneity.

The following models are estimated with the OLS for each member of the panel to get the panel cointegration:

$$lnHR_{it} = \beta_{0i} + \beta_{1i} lnPGDP_t + \beta_{2i} lnPGDP_t^2 + \sum_{k=-Ki}^{K_i} \alpha_{ik} \Delta\, lnPGDP_t + \sum_{k=-Ki}^{K_i} \lambda_{ik} \Delta\, lnPGDP_t + \varepsilon_{it} \quad (2.9)$$

$$lnHR_{it} = \beta_{0i} + \beta_{1i} lnPGDP_t + \beta_{2i} lnPGDP_t^2 + \beta_{3i} lnU_t + \beta_{4i} lnUR_t + \sum_{k=-Ki}^{K_i} \alpha_{ik} \Delta\, lnPGDP_t + \sum_{k=-Ki}^{K_i} \lambda_{ik} \Delta\, lnPGDP_t + \sum_{k=-Ki}^{K_i} \psi_{ik} \Delta\, lnU_t + \sum_{k=-Ki}^{K_i} \xi_{ik} \Delta\, lnUR_t + \varepsilon_{it} \quad (2.10)$$

This chapter, as a final step, uses the Pooled Mean Group (PMG) estimator to test the validity of cointegrated relationship and the robustness of the previous results. The PMG estimator proposed the cointegration form of the standard the Autoregressive Distributed Lag, ARDL(p, q, q,..., q) model (M. H. Pesaran et al., 1999). The main benefit of PMG over the FMOLS and DOLS models is that it allows the short-run dynamic specification to differ across cross-sectional units while keeping the long-run coefficients constant.

Panel form of the Autoregressive Distributed Lag, ARDL(p, q, q,..., q) model introduced by Pesaran et al. (1999) as follows:

$$lnHR_{it} = \sum_{j=1}^{p} \lambda_{ij}\, lnPGDP_{i,t-j} + \sum_{j=0}^{q} \hat{\delta}_{ij}\, lnPGDP_{i,t-j} + \sum_{j=1}^{p} \psi_{ij}\, lnPGDP2_{i,t-j} + \sum_{j=0}^{q} \dot{\omega}_{ij}\, lnPGDP2_{i,t-j} + \mu_i + \varepsilon_{it} \quad (2.11)$$

$$lnHR_{it} = \sum_{j=1}^{p} \lambda_{ij}\, lnPGDP_{i,t-j} + \sum_{j=0}^{q} \grave{\delta}_{ij}\, lnPGDP_{i,t-j} + \sum_{j=1}^{p} \psi_{ij}\, lnPGDP2_{i,t-j} + \sum_{j=0}^{q} \grave{\omega}_{ij}\, lnPGDP2_{i,t-j} + \sum_{j=1}^{p} \gamma_{ij}\, lnU_{i,t-j} + \sum_{j=0}^{q} \grave{\xi}_{ij}\, lnU_{i,t-j} + \sum_{j=1}^{p} \eta_{ij}\, lnUR_{i,t-j} + \sum_{j=0}^{q} \grave{\tau}_{ij}\, lnUR_{i,t-j} + \mu_i + \varepsilon_{it} \quad (2.12)$$

where i=1, 2,...,N signifies cross section units; t=1, 2,...,T represents time periods, μ_i represents the fixed effect, λ_{ij}, ψ_{ij}, γ_{ij}, and η_{ij} denote the coefficient of the previous period of dependent variables, and $\grave{\delta}_{ij}$, $\grave{\omega}_{ij}$, $\grave{\xi}_{ij}$ and $\grave{\tau}_{ij}$ are k×1 coefficient vectors.

2.4. EMPIRICAL RESULTS

Table 2.2 shows the results of panel unit root tests. The findings show that variables have a unit root at level, and that the initial discrepancies between these variables are all stationary. As a result of these findings, it can be suggested that I (1) process exists in series. The results for panel cointegration tests suggested by Pedroni (1999, 2004) are displayed in Table 2.3. As can be seen in the panel and group statistics for cointegration, the majority of test statistics are statistically significant, and so the null hypothesis of no cointegration can be rejected. Hence, the results suggest that variables are highly cointegrated in Model 1 and Model 2 as well.

Table 2.2: Panel Unit Root Tests Levels and First Differences

	lnHR	lnPGDP	lnPGDP2	lnU	lnUR
Levels					
LLC	0.347	-2.494***	-2.143**	2.387	1.321
	(0.636)	(0.006)	(0.016)	(0.992)	(0.907)
IPS	3.032	1.546	1.785	-1.408*	1.771
	(0.999)	(0.939)	(0.963)	(0.080)	(0.962)
Fisher ADF	8.670	11.030	9.465	27.877	11.929
	(0.995)	(0.974)	(0.991)	(0.180)	(0.959)
Fisher- PP	16.129	15.357	13.132	18.550	17.464
	(0.809)	(0.847)	(0.930)	(0.673)	(0.737)
Hadri	10.244***	21.893***	10.846	1.223	5.521***
	(0.000)	(0.000)	(0.000)	(0.111)	(0.000)
First Difference					
LLC	-14.839***	-7.913***	-8.220***	0.918	-3.609***
	(0.000)	(0.000)	(0.000)	(0.821)	(0.000)
IPS	-17.083***	-5.990***	-6.664***	-2.422***	-1.613*
	(0.000)	(0.000)	(0.000)	(0.008)	(0.053)
Fisher ADF	225.454***	73.971***	82.856***	34.056**	42.441***
	(0.000)	(0.000)	(0.000)	(0.049)	(0.006)
Fisher- PP	604.953***	66.996***	67.411***	50.612***	11.638
	(0.000)	(0.000)	(0.000)	(0.001)	(0.964)
Hadri	13.362***	0.879	0.794	-0.140	3.692***
	(0.000)	(0.190)	(0.214)	(0.556)	(0.000)

The Barlett technique was used as the "Kernel" estimator in the LLC and Hadri tests to calculate the long-term consistent error variance, and the bandwith was chosen using the "bandwith" Newey-West method. The maximum lag length in the LLC, Breitung, IPS, Maddala, and Wu Fisher-ADF and Fisher PP tests was 3 and the best lag length was found using the Schwarz information criteria. ***, **, and * show the statistical significance levels of 1%, 5%, and 10%, accordingly.

Table 2.3: Pedroni's (2004) Cointegration Test Results

Between dimension Model 1*:* lnPGDP $lnPGDP^2$	test statistics		Within dimension	test statistics	
Panel v-stat	1.768**	(0.039)			
Panel rho-stat	-3.069***	(0.001)	Group rho-stat	-2.138**	(0.016)
Panel PP-stat	-4.162***	(0.000)	Group PP-stat (non-parametric)	-5.152***	(0.000)
Panel ADF-stat	-2.018**	(0.022)	Group ADF-stat (non-parametric)	-1.801**	(0.036)
Between dimension *Model 2:*lnPGDP $lnPGDP^2$ lnUlnUR	test statistics		Within dimension	test statistics	
Panel v-stat	-0.488	(0.687)			
Panel rho-stat	-2.401***	(0.008)	Group rho-stat	-1.521*	(0.064)
Panel PP-stat	-7.945***	(0.000)	Group PP-stat (non-parametric)	-9.147***	(0.000)
Panel ADF-stat	-4.281***	0.000	Group ADF-stat (non-parametric)	-2.995***	0.001

Note: p-Values are reported in parentheses

Table 2.4 shows the results of the FMOLS and DOLS estimations for Model 1 and Model 2. As it can be seen in Table 2.4, in all estimations, the coefficient of income per capita are positively significant while the coefficients of income per capita square are reported as negative. The results obtained from FMOLS and DOLS estimations suggest an inverted-U and validates the presence of the HKC in new EU member nations between 1995 and 2017.

The results for Model 1 and Model 2 enable us to calculate the elasticity of homicide rate in terms of income per capita in the long-run. For Model 1, the estimated elasticities reported by FMOLS, DOLS(1), and DOLS (2) are 14.87 %, 8.37%, and 10.13%, respectively. Therefore, FMOLS provides higher long-run elasticity of coefficient than DOLS does. As can be seen in Table 2.4, these elasticities in Model 2 are remarkably greater than in Model 1. According to FMOLS, DOLS(1), and DOLS(2) results for Model 2, an 1% increase in per capita income is increases homicide rates by 15.10%, 19.94, and 19.51%, respectively. Contrary to the expectation, unemployment and urbanization rates are found as negatively correlated with homicide rates in new EU member countries.

Table 2.4: Long-run Estimates Using FMOLS and DOLS Estimators

		Pedroni (2000) FMOLS	Kao and Chiang (2000) DOLS (1)	Mark and Sul (2003) DOLS (2)
Model 1: lnPGDP lnPGDP2	lnPGDP	14.87*	8.369**	10.128*
		(1.671)	(2.166)	(3.669)
	lnPGDP2	-0.851*	-0.532**	-0.623***
		(-1.83)	(-2.463)	(-4.07)
Model 2: lnPGDP lnPGDP2 lnUlnUR	lnPGDP	15.095	19.94***	19.513***
		(1.614)	(4.245)	(9.912)
	lnPGDP2	-0.794	-1.136***	-1.114***
		(-1.636)	(-4.441)	(-10.248)
	lnU	-0.378***	-0.153*	-0.043
		(-5.658)	(-1.808)	(-1.118)
	lnUR	-5.784	-6.746**	-10.398***
		(-1.602)	(-2.539)	(-7.593)

Table 2.5 displays the estimation results using the PMG model for Model 1 and Model 2 using ARDL (3, 1, 1) and ARDL(2, 3, 3, 3, 3), accordingly. All of the predicted coefficients are statistically significant. The PMG test findings, like the FMOLS and DOLS long-run estimates, show that income per capita positively and squared income per capita negatively contribute to homicide rate, indicating an inverted U-formed connection between homicide and income.

In contrast to FMOLS and DOLS estimates, Model 2 results demonstrate that unemployment and urbanization have a positive and statistically significant long-run influence on homicide rates. According to the findings, a 1% rise in unemployment and a 5% increase in urbanization raises homicide rates by 0.14% and 5.04%, correspondingly.

Last, the error correction term emphasizes that there is a correction of the disequilibrium circumstances inside the cointegration model at the following ratios: 47.6% for Model 1 and % 80.2 for Model 2. In this regard, the pace of adjustment towards long-run equilibrium can simply be calculated around 2.1 years for Model 1, and 1.24 years for Model 2.

Table 2.5: Long-run Estimates Using PMG Estimator

	Variable	Value
Model 1: lnPGDP lnPGDP2	lnPGDP	12.834***
		(3.900)
	lnPGDP2	-0.773***
		(-4.266)
	Error correction	-0.476***
		(-2.852)
	Selected Model: ARDL(3, 1, 1)	
Model 2: lnPGDP lnPGDP2 lnUlnUR	lnPGDP	8.207***
		(3.181)
	lnPGDP2	-0.489***
		(-3.437)
	lnU	0.147***
		(5.090)
	lnUR	5.014***
		(2.954)
	Error correction	-0.802*
		(-1.974)
	Selected Model: ARDL(2, 3, 3, 3, 3)	

t-values are in parenthesis.

2.5. CONCLUSION

The homicide rates and economic growth relationship in new EU member countries has drawn attention recently. While most previous studies found that homicide rates in new EU member countries increased in the first years of membership and then declined, no studies have investigated whether a Kuznets curve for homicide rate exists among newly admitted countries. Using a panel level dataset from newly admitted EU countries over the period 1995–2017, the chapter explores the existence of homicide Kuznets curve in new EU member countries, that is empirically investigate the relationship between homicide rates, income per capita and squared of income per capita. The chapter also investigates this relationship while controlling for urbanization and unemployment to assess whether socioeconomic heterogeneity influences the characteristics of the homicide Kuznets curve in new EU member countries. To theoretically explain the emergence of an inverted U-form linkage between economic growth and homicide rates, and the existence of the homicide Kuznets curve, the chapter uses the Kuznets curve concept, as well as modernization and civilization theories in the cross-country criminology literature.

The results based on the FMOLS, DOLS, and PMG estimations revealed that homicide rates increase with income per capita in new EU member countries until they reach maximum, and then decrease as income keeps rising. Hence, the results suggest the existence of the homicide Kuznets curve in new EU member countries over the period 1995-2017. The results also support previous research which suggests that EU accession has increased the homicide rates in newly admitted countries (Andresen, 2011; Piatkowska et al., 2016). However, the estimates obtained for urbanization and unemployment are mixed. While the results based on FMOLS and DOLS suggests that homicide rates are negatively related with urbanization and unemployment, the estimates obtained from PMG show that homicide rates have positively associated with these two. Therefore, individual countries might have different socioeconomic factors that may influence the homicide rates and economic growth nexus.

The results of this study would be very important from a policy perspective. The existence of the homicide Kuznets curve implies that in the early stages of accession, homicide rates tend to increase rapidly as income rises. However, with a

further rise in income in the later stages, homicide rates begin to decline. As the EU aims to improve both the economic and security conditions of its member states, the overall goal is to ensure that all countries are on the right side of the reversed U-formed homicide Kuznets curve, where economic development contributes to the decrease in homicide rates. The presence of the homicide Kuznets curve in new EU member countries demonstrates that, while the EU may fail to meet these goals in the early stages of admission, economic growth will decrease homicide rates later in the process.

CHAPTER THREE
THE RELATIONSHIP BETWEEN CRIME AND INFLATION IN TURKEY: EVIDENCE FROM PANEL DATA

3.1. INTRODUCTION

Since the 1980s, a plethora of literature has examined the impact of economic growth on crime rates. More recently, the possible criminogenic effects of inflation on crime rates have attracted significant scholarly attention. Some studies have examined the impacts of inflation on crime rates in the United States and Western developed countries (Devine et al., 1988; Land & Felson, 1976; Nunley et al., 2016; Rosenfeld, 2014; Rosenfeld et al., 2019; Rosenfeld & Levin, 2016; Tang, 2009). Some others have investigated such effect for non-Western countries, such as China (Cheong & Wu, 2015), India (Hazra & Cui, 2018), Nigeria (Adekoya & Abdul Razak, 2016), Pakistan (Ahad, 2016; Gillani et al., 2009), and Malaysia (Tang, 2009). Additionally, a few studies have recently examined the criminogenic effects of inflation in cross-country settings (Rennó Santos et al., 2021; Tuttle et al., 2018).

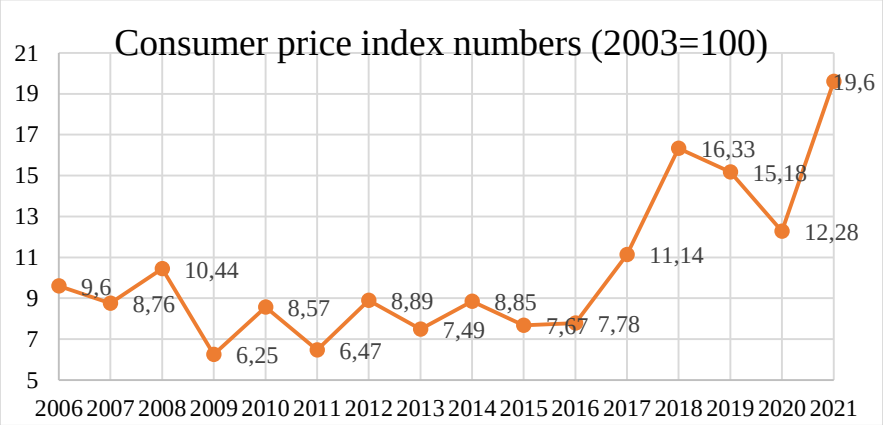
While several studies have emerged to explain the inflation and crime nexus, investigation this nexus is far from complete, both empirically and theoretically (Rosenfeld, 2014). Prior studies have suggested some reasonable explanations for the inflation-crime nexus, but they have mainly focused on single causes that are loosely connected with macro-level theoretical literature. For instance, some studies have discussed that inflation can increase crime rates by decreasing consumer confidence (Rosenfeld, 2009, 2014; Rosenfeld & Levin, 2016; Rosenfeld & Vogel, 2021). Some have argued that inflation drives crime by deteriorating trust in economic and political institutions (Fischer, 1999; LaFree, 2018; Roth, 2012). Therefore, a general explanation of how rising inflation affects crime is lacking, as previous studies have not been based on macro-level crime theories.

Additionally, although existing studies have emerged to explain whether increases in inflation lead to increases in crime rates, this subject has not yet been fully addressed. Prior research has tended to concentrate on nations with historically low rates of inflation. It is hardly surprising considering inflation has been on the decline

in many developed and developing nations since the mid-1990s. However, the COVID-19 pandemic put an end to this period of global disinflation. In many advanced and emerging countries, inflation began to rise in 2021, and it escalated with the outbreak of the Ukraine-Russian War in early 2022. As inflation increases globally, there are growing concerns that it may lead to social problems and a sharp rise in crime. In this context, determining whether and to what extent rising inflation affects crime rates is critical and requires extensive empirical research.

This chapter seeks to close these gaps in the literature in two different ways. The chapter first investigates the connection between inflation and crime rates in Turkey, where rates of inflation have been high and rising since 2015. As seen in Figure 3.1, while the inflation rate fluctuated between 6% and 9% between 2006 and 2015 in Turkey, it started to increase in 2015 and reached 19.6% at the end of 2021. Hence, this chapter aims to contribute to the crime-inflation literature by presenting empirical results from a large panel dataset covering 26 sub-regions of Turkey on an annual basis from 2006 to 2020.

Figure 3.1: Consumer Price Index (2003=100) between 2006 and 2021



Source: TURKSTAT, rate of change in twelve months moving averages (%)

Second, the chapter uses modernization theory—most commonly used to macro-level research in the criminology literature—to investigate the connection between inflation and crime rates in Turkey. According to modernization theory, which is based on Durkheim's (1951) analysis of the transition from traditional to

modern society, rapid economic and social change results in normative deterioration, which raises crime rates. Whereas modernization theorists have heavily recognized the criminogenic effects of economic factors such as GDP per capita, urbanization, income inequality, and unemployment rate, no research to date has examined inflation as an economic predictor of modernization theory. Since a sharp rise in inflation can cause normative deterioration, which leads to increased criminal behavior, the criminological effects of inflation can be evaluated in the context of modernization theory.

The System Generalized Method of Moments (GMM) approach is applied to a dataset encompassing 26 sub regions between 2006 and 2020 to assess the inflation and crime rates nexus in Turkey. Using the consumer price index (CPI) and the number of people who are admitted to prison for murder, robbery, and theft per 100,000, it will first be analyzed how inflation affects violent and property crimes. Next, this chapter examines the effects of inflation on crime rates while controlling for GDP per capita and unemployment rate to determine whether economic development impedes or accelerates up the impact of inflation on crime rates. Prison admissions for homicide, robbery, and theft are used to measure crime since prison entry statistics are published regularly by the judicial authorities and are therefore considered more reliable data than crimes recorded by the police.

The chapter also seeks to contribute to the research on the examination of crime rate drivers and evolution in Turkey. Several studies have been conducted to determine whether economic conditions, such as unemployment and economic growth, influence crime rates in Turkey (Çiftçi & Akkoç, 2019; Cinar & Tas, 2022; Elgin, 2019; Erbay & Buker, 2021; Gültekin & Oğuzhan, 2021; Taş et al., 2014; Tunca, 2018, 2019). However, investigation into how inflation affects Turkey's crime rates is lacking. To the best of our knowledge, only Hayati and Akkuş (2010) have investigated the impact of inflation on crime rates in Turkey. Hayati and Akkuş (2010), in particular, evaluated the impact of socioeconomic variables such as per capita income, education, and inflation rates on property crimes between 1970 and 2007. Therefore, it is impossible to extrapolate the results of this study to rates of violent crime. Furthermore, since this analysis spans the years 1970 to 2007, it does not provide information on whether and how inflation is related to crime rates within the last two decades.

Assessing the effects of inflation on crime rates in Turkey is also important from a policy perspective. Turkey has an inflation target regime with an independent central bank, with the primary goal of achieving and maintaining price stability. To meet this target, Turkey put in place implicit inflation targeting as its monetary policy, and a stand-by program with the IMF was established in May 2001 for the years 2002-2004. However, in November 2010, the purpose function of the Central Bank of Republic of Turkey (CBRT) was rearranged to include financial stability in order to mitigate the effects of financial market fluctuations and unhealthy price formations. Whatever the CBRT's declared objective, the ultimate goal is to ensure that current monetary policies do not worsen living and security conditions while maintaining price stability. As a result, understanding what extent the increases in inflation influence crime rates is critical so that policymakers can implement appropriate policies and initiatives and assess the success of current monetary policies in improving living and security conditions.

Chapter 3 is structured as follows: In Section 3.2 the relevant literature on the inflation and crime nexus is presented. Section 3.3 introduces the data and econometric methodology. Section 3.4 presents and discusses the estimation results. Section 3.5 outlines our conclusion and policy implications.

3.2. RELEVANT LITERATURE

During the last few decades, possible effects of inflation on crime rates has received significant attention. Researchers have proposed several channels through which inflation affects crime. Most prior studies have argued that high inflation may lead to increased crime by decreasing confidence in economic and political institutions. Rosenfeld (2014, 2018) posited that consumer confidence generally declines in the face of high inflation. In turn, decreased confidence may increase the propensity for acquisitive crimes. As acquisitive crimes are often associated with violence, inflation may also intensify violent crimes. Some studies have argued that decreased institutional confidence can undermine social control, leading to illegitimate means of resolving conflicts and thus leading to crime (Elgar & Aitken, 2011; Kirk & Papachristos, 2011; Nivette, 2011; Nivette & Eisner, 2013; Tyler, 2006). Other studies

have argued that inflation creates uncertainty, fear, and frustration, thereby increasing aggression and violence. Inflation, according to Devine et al. (1988), is likely to boost crime by "fostering anomie and fueling a broad environment of uncertainty and dread," as well as restricting the government's ability to control crime. There are also other studies suggesting that inflation causes economic misery, resource scarcity, frustration, and, eventually, aggressiveness(Hsieh & Pugh, 1993; Nivette, 2011).

Existing studies can be separated into two main groups based on whether their analysis is single-country or cross-country. Single-country studies have mainly focused on the inflation-crime nexus in the United States. For example, examining aggregate level data from the United States over the period between 1948 and 1985, Devine et al. (1988) revealed a positive influence of inflation on both violent and property crimes. Rosenfeld and Levin (2016) examined the effects of inflation on acquisition crimes in the United States from 1960 to 2012 using Uniform Crime Report data. They showed that inflation has a positive impact on acquisition crimes in both short-term and long-term. Nunley et al. (2016) also verified that inflation is positively related with crime by examining the effects of inflation on four types of property crimes, namely theft, motor vehicle theft, and robbery in the United States from 1950 to 2000. In a more recent study, Rosenfeld et al. (2019) examined data on inflation and acquired crimes in 17 US cities between 1960 and 2013. They also confirmed the positive impact of inflation on acquired crimes at city level.

Several non-Western studies have also identified a positive impact of inflation on crime. Adekoya and Abdul Razak (2016) investigated the inflation and crime nexus in Nigeria from 1970 to 2013 and found that 1% increase in inflation led to increases in armed robberies, arson, and fraud of 0.4%, 0.3%, and 0.2%, respectively. Inflation and crime rates were found to be positively correlated in two Pakistani studies. Using data on Pakistan from 1975 to 2007, Gillani et al. (2009)discovered both short- and long-term cointegration between inflation and crime. Ahad (2016) also confirmed that there was a direct correlation between inflation and crime in Pakistan between 1984 and 2012. Cheong and Wu (2015) conducted a cross-regional analysis in China and found a high and positive impact of inflation on crime rates between 1997 and 2007. Based on national-level data from India over the period 1991-2015, Hazra and Cui (2018) found a similar positive connection between inflation and crime rates.

Intriguingly, they provided evidence of reverse causality, demonstrating that crime rates had an impact on long-term economic consequences. According to Tang (2009), inflation in Malaysia between 1970 and 2006 was a remarkably significant role on long-term crime patterns.

In recent years, some studies have examined the crime-inflation linkage in cross-country settings. Rosenfeld (2014) has assessed the effects of inflation on crime rates in developed countries. Employing dataset of 14 countries including the United States and Europe from 1981 to 2010, Rosenfeld (2014) showed a substantial positive effect of inflation on both homicide and burglary rates. Tuttle et al. (2018) examined the inflation and homicide linkages across OECD member countries from 1990 to 2005. Tuttle et al. (2018) reported that countries with high inflation rates would have higher rates of homicide, but they found that inflation is uncorrelated with the changes in homicide rate over time. In a more recent study, Rennó Santos et al. (2021) examined the data from 65 developed and developing countries from 1965 to 2015 and confirmed that inflation is positively related with homicide rates across economically varied nations. They also found that economic progress may help to reduce the criminogenic consequences of inflation.

3.3. DATA AND METHODOLOGY

3.3.1. Data

The empirical evidence relies on panel data from 26 subregions of Turkey from 2006 to 2020. [24] The Turkish Statistical Institute provided all data (TurkStat). Crime data is comprised of the prison admissions for homicide, robbery, and theft per 100,000 people by year and sub regions. The rate of change in twelve-month moving averages (%) in the consumer price index (CPI) with 2003=100 as the base year is used to calculate the inflation rate. The data on GDP per capita at constant 2009 prices (TL), and unemployment rate were also retrieved from this database (TurkStat).

[24] This includes 26 regions according to the Statistical Classification of Regional Units Level 2 (NUTS2)

Table 3.1: Descriptive Statistics

	Num. of Obs.	Mean	Std. Dev.	Min.	Max.
Inflation rate	130	2.25	0.24	1.79	2.76
Homicide rate	130	1.91	0.53	0.55	2.71
Theft rate	130	2.92	0.88	0.95	4.49
Robbery rate	130	1.50	0.99	-1.14	3.24
Income per capita	130	9.84	0.64	8.42	11.38
Unemployment rate	130	2.27	0.38	1.45	3.39

Num. of Obs., Std. Dev., Min. and Max. signify the number of observations, the standard deviation, minimum, and maximum, correspondingly.

Table 3.1 provides descriptive statistics for inflation, homicide, theft, and robbery rates, per capita income and unemployment rate for 3-year time intervals. The variables are in natural logarithms. In order to reduce serial correlation problem, 3-year time intervals are preferred.

3.3.2. Methodology

To investigate how inflation affects crime rates in Turkey, the following dynamic panel equation is estimated:

Model 1:

$$lnc_{it} = \theta \cdot lnc_{i,t-1} + \gamma \cdot lnp_{it} + \mu_i + \phi_t + \varepsilon_{it} \; for \; i = 1, \dots, N \; and \; t = 2, \dots, T \quad (3.1)$$

where c_{it} represents the vector of dependent variables, which consists of the homicide rate, robbery rate, and theft rate. $c_{i,t-1}$ denotes the previous period of dependent variable, and p_{it} is the vector of inflation. μ_i and ϕ_t measure country-

specific (fixed) effects and time-specific intercepts, correspondingly and u_{it}denotes the error term. ε_{it} denotes the idiosyncratic shocks, which vary across countries *i*, and time periods *t*. In order to ensure the assumption of no correlation across individuals in the idiosyncratic disturbances, time dummies are also included in Model 1 (Roodman, 2009a).

Model 2:

$$lnc_{it} = \theta \cdot lnc_{i,t-1} + \gamma \cdot lnp_{it} + \delta \cdot X_{it} + \mu_i + \phi_t + \varepsilon_{it} for i = 1, \dots, N and t = 2, \dots, T \quad (3.2)$$

X_{it} is the vector of control variables, As mentioned before, GDP per capita and unemployment rate are used as control variables.

This study implements Blundell and Bond (1998) System GMM estimator as a two-step panel econometric analysis. Despite the fact that the efficiency advantage in two-step estimations is minor and that the asymptotic standard errors associated with two-step GMM estimators may be skewed downwards in small samples, the chapter employs two-step estimators (Blundell & Bond, 1998; Hoeffler, 2002). In all estimations, the lag dependent variable is assumed to be fixed, whilst the control variables are considered exogenous.

Accordingly, the first-order autoregressive panel data model is given by:

$$y_{it} = \theta \cdot y_{i,t-1} + \gamma \cdot X_{it} + \mu_i + \phi_t + \varepsilon_{it} for\ i = 1, \dots, N\ and t = 2, \dots, T$$
$$u_{it} = \mu_i + \phi_t + \varepsilon_{it} \quad (3.3)$$

In Equation (3.2.), $y_{i,t-1}$ shows the previous period of dependent variable, and X_{it} denotes the vector of explanatory variables. μ_i and ϕ_t measure country-specific (fixed) effects and time-specific intercepts, correspondingly. ε_{it} denotes the idiosyncratic shocks, which vary across countries *i*, and time periods *t*. u_{it} is the error term.

In order to resolve the endogeneity problem caused by the correlation between $y_{i,t-1}$ and u_{it}, the variables are transformed (by first-differencing) in the first phase of the estimate procedure:

$$\Delta y_{it} = \theta \cdot \Delta y_{i,t-1} + \gamma \cdot \Delta X_{it} + \Delta \phi_t + \Delta \varepsilon_{it} \; for \; i = 1, \dots, N \; and \; t = 3, \dots, T \qquad (3.4)$$

The transitory mistakes are considered to be serially not correlated and independent across cross sections in this model:

$$E(\varepsilon_{it}\varepsilon_{is}) = 0 \; for \; t \neq s \qquad (3.5)$$

and that the initial conditions satisfy this condition:

$$E(y_{i1}\varepsilon_{it}) = 0 \; for \; t \geq 2 \qquad (3.6)$$

these assumptions suggest that $y_{i,t-1}$ is fixed with respect to ε_{it}.

Even though μ_i are eliminated from the regression, $y_{i,t-1}$ would be endogenous, since $y_{i,t-1}$ in $\Delta y_{i,t-1}$ is correlated with $\varepsilon_{i,t-1}$ in $\Delta \varepsilon_{it}$. To eliminate the issue of endogeneity, the moment restrictions proposed by Arellano and Bond (1991) are given in Equations (3.7) and (3.8):

$$E\left(y_{i,t-s}\Delta\varepsilon_{it}\right) = 0 \; for \; t = 3, \dots, T \; and \; s \geq 2 \qquad (3.7)$$

$$E\left(X_{i,t-s}\Delta\varepsilon_{it}\right) = 0 \; for \; t = 3, \dots, T \; and \; s \geq 2 \qquad (3.8)$$

Blundell and Bond (1998) demonstrated that when the explanatory factors are persistent across time, the past values of these variables are weak instruments for the first-differenced equation. As a result of the poor connection between the instruments and the endogenous variables, the estimations are susceptible to finite sample bias, particularly in small samples.

Blundell and Bond (1998) establish a system with two sets of equations to address this problem: The transformed equation in first differences is one set of equations, for which past values of y_{it} and X_{it} are utilized as instruments. The original equation in levels is utilized as an instrument in the other set of equations, for which the past values of first differences of y_{it} and X_{it} are employed as well. Blundell and Bond (1998) derived additional moment constraints, which are shown in Equations (3.9) and (3.10):

$$E\left[\Delta y_{i,t-1}(\mu_i + \varepsilon_{it})\right] = 0 \; for \; t = 3, \dots, T \tag{3.9}$$

$$E\left[\Delta X_{i,t-1}(\mu_i + \varepsilon_{it})\right] = 0 \; for \; t = 3, \dots, T \tag{3.10}$$

Five conditions should be addressed to assure the consistency of the GMM estimates. First, the error term should not have any serial correlation. The Arellano-Bond (1991) test looks for first and second order autocorrelations in first-differenced residuals. The second-order correlation in first differences is used to analyze the first-order serial correlation in levels because it detects the correlation between $\varepsilon_{i,t-1}$ in $\Delta\varepsilon_{i,t-1}$ and $\varepsilon_{i,t-2}$ in $\Delta\varepsilon_{i,t-2}$ (Roodman, 2009a). The Arellano-Bond test for AR(2) in first differences provides test statistics for the null hypothesis of no second order serial correlation.

The second criteria for instrument validity is that there be no association between the instruments and the error term. Hansen (1982) test of over-identifying also provide test statistics for the null hypothesis of instrument validity.

The third requirement is that the extra moment constraints are valid for the consistency of GMM estimations. The test statistics for the validity of extra moment conditions are reported using the Difference-in-Hansen test.

In order to avoid the finite sample bias driven on by the over-fitting issue, the last requirement is a rule of thumb that the number of instruments in a regression should be less than or equal to the number of groups (Roodman, 2009b).

3.4. EMPIRICAL RESULTS

Tables 3.2, 3.3, and 3.4 present the panel regression results from estimating Equation (3.1) using two-step system GMM estimators with 3-year span data for 26 Turkish subregions from 2006.[25] In all tables, column (1) presents the direct criminogenic impact of inflation. Columns (2) and (3) show the estimation results, which include GDP per capita and the unemployment rate, respectively. In column 4, control variables are added to Model 1. Following modernization theory, the coefficients of the inflation rate, GDP per capita, and unemployment rate are expected to be positively significant in all estimations. Furthermore, other developmental factors are expected to mitigate the effects of inflation. Thus, the inclusion of control variables is expected to reduce the estimated coefficients of inflation.

The results of the system GMM estimate using the homicide rate as the dependent variable are shown in Table 3.2. In all estimations of the homicide rate, the inflation rate coefficient is positive and statistically significant at 1%. Even if the signs of the unemployment rate do not match predictions, the control variables appear to be statistically significant. The coefficient of inflation decreases when GDP per capita and the unemployment rate are added together. When all control variables are included in the model, the predicted coefficient for the inflation rate is 1.553. As a result of the findings, GDP per capita and the unemployment rate may be able to attenuate the impact of inflation on homicide rates.

Table 3.2: System GMM Estimation Results for the Inflation-Homicide Nexus

Variables	Homicide rate			
	(1)	(2)	(3)	(4)
Homicide rate (-1)	0.726***	0.748***	0.734***	0.788***
	(0.037)	(0.038)	(0.047)	(0.051)
Inflation rate	1.882***	1.829***	1.742***	1.553***
	(0.444)	(0.464)	(0.487)	(0.400)
GDP per capita		0.10***		0.074***

[25]In Stata (v. 13), the command "xtabond2" is used for system GMM estimates, and the instrument matrix is compressed using the Stata command "collapse," as indicated in Roodman (2009b).

		(0.034)		(0.022)
Unemployment rate			-0.091**	-0.067*
			(0.04)	(0.034)
Instruments	20	21	21	22
Groups	26	26	26	26
Hansen test	0.291	0.221	0.336	0.239
Difference-in-Hansen test	0.128	0.107	0.133	0.091
AR(2)	0.883	0.885	0.923	0.972

Notes: "(-1)" denotes one lag of the homicide rates.

Table 3.3: System GMM Estimation Results for the Inflation-Robbery Nexus

Variables	Robbery rate			
	(1)	(2)	(3)	(4)
Robbery rate (-1)	0.785***	0.738***	0.797***	0.746***
	(0.218)	(0.049)	(0.020)	(0.501)
Inflation rate	1.244***	1.213***	1.360***	1.291***
	(0.389)	(0.286)	(0.465)	(0.332)
GDP per capita		0.130**		0.126**
		(0.059)		(0.059)
Unemployment rate			-0.034	-0.13
			(0.035)	(0.31)
Instruments	20	21	21	22
Groups	26	26	26	26
Hansen test	0.112	0.092	0.115	0.092
Difference-in-Hansen test	0.288	0.365	0.327	0.445
AR(2)	0.276	0.237	0.283	0.249

Notes: "(-1)" denotes one lag of the robbery rate.

Table 3.4: System GMM Estimation Results for the Inflation-Theft Nexus

Variables	Theft rate			
	(1)	(2)	(3)	(4)
Theft rate (-1)	0.947***	1.068***	0.923***	1.051***
	(0.037)	(0.050)	(0.025)	(0.502)
Inflation rate	-0.271	-0.294	0.060	-0.517
	(0.329)	(0.313)	(0.363	(0.312)
GDP per capita		-0.159***		-0.156***
		(0.040)		(0.043)
Unemployment rate			0.011	0.010
			(0.016)	(0.015)
Instruments	20	21	21	22
Groups	26	26	26	26
Hansen test	0.590	0.638	0.528	0.523
Difference-in-Hansen test	0.930	0.936	0.935	0.941
AR(2)	0.266	0.279	0.272	0.282

Notes: "(-1)" denotes one lag of theft rate.

Table 3.3 shows the system GMM estimate results using the robbery rate as the dependent variable. In all assessments of the robbery rate, the inflation rate coefficient is positive and statistically significant at 1%. Whereas unemployment has no effect on the robbery rate, GDP per capita seems to be positively significant. Only when GDP per capita is included does the coefficient of the inflation rate fall, implying that an increase in GDP per capita has the ability to reduce the influence of inflation on the robbery rate.

Table 3.4 shows the system GMM estimate results when the theft rate is used as the dependent variable. The findings of all estimations demonstrate that the inflation rate is insignificantly connected to the theft rate. In terms of the impacts of control factors on the theft rate, GDP per capita has a highly substantial and negative influence, but unemployment has no effect.

Four main diagnostics should be examined for the consistency assessment of the system GMM estimations in Tables 3.2-3.4. To begin, in any of the estimations, the p-values of AR (2) statistics show no indication of second-order serial correlation in the first-differenced residuals. Second, the Hansen test of over-identifying limits p-values show that instruments are valid in all estimations. Third, the p-values of the Difference-in-Hansen test suggest that additional moment restrictions are justified. Finally, the rule of thumb is met since the number of groups in all estimations is more than the number of instruments.

3.5. CONCLUDING REMARKS

Despite over a century of scientific research, our knowledge about the link between violent crimes and economic conditions is still limited. For instance, whereas there is no scarcity of macro-level studies on the homicide-growth nexus, as well as the homicide-unemployment nexus, whether and how inflation affects homicides uncertain both theoretically and empirically. Existing studies have often linked the criminogenic effects of inflation with consumer confidence and institutional legitimacy, suggesting that inflation declines consumers' confidence crime and trust in institutions, and fuels crime (Fischer, 1999; LaFree, 2018; Rosenfeld, 2009; Rosenfeld & Levin, 2016; Rosenfeld & Vogel, 2021; Roth, 2012). These studies provided no theoretical explanation why inflation may lead to an increase in crime rates. In addition, empirically, this line of research has mostly concentrated on countries with historically low inflation rates. This focus is not surprising given the global deflationary environment from the mid-1990s. However, after the COVID-19 pandemic and Ukraine-Russia war, inflation started to rise globally. Therefore, investigating the criminogenic effects of high and increasing inflation has become important.

The current study sought to fill such gap in the literature by providing empirical analyses on the possible criminogenic effects of high inflation in Turkey, where inflation has been on the rise since 2015. To this end, this study used the system GMM to a panel of 3-year data from 26 sub-regions of Turkey between 2006 and 2020 and investigated the effects of inflation rates on homicide, robbery, and theft rates. This

study also investigated the criminogenic effects of inflation while accounting of the effects of GDP per capita and the unemployment rate. This study employed modernization theory, which holds that rapid economic changes may cause an increase in crime.

The results of the system GMM estimation on a panel of 3-year data from 26 sub-regions of Turkey between 2005 and 2020 revealed that inflation had no effect on the rate of theft but had a positive and significant impact on the rates of homicide and robbery. All estimates of GDP per capita were statistically significant, but they had different effects on the rates of property and violent crime: GDP per capita had a positive impact on homicide and robbery rates yet a negative impact on theft rates. However, the findings indicated that unemployment rate has not been linked to increased crime rates.

These findings offer important implications for modernization theory and research related to inflation and crime. The results described here support modernization theory, which suggests that rapid economic changes lead to an increase in crime rates. Although prior research has consistently used modernization theory in the analysis of the effect of economic changes on crime rates, research has produced no evidence regarding whether increases in inflation affect crime rates in the same way. The current findings show that high and rising inflation in Turkey has positive effects on homicide and robbery rates while having negative effects on the theft rate. In theory, this is important because it suggests that the effects of sudden changes in the economy may be specific to violent crime rather than property crimes. The findings also offer important implication for the contribution of per capita GDP to the crime-inflation nexus. The results show that increase in GDP per capita mitigate the effects of inflation on the homicide and robbery rates, it could enhance the effects on the theft rate.

These findings also have important and practical policy implications. Although monetary policy is primarily intended to control inflation and preserve price stability, current findings indicate that it may also have an impact on violence. A successful monetary policy could reduce not only inflation but also violence.

CONCLUSION

The relationship between economic growth and crime rates is one of the crucial research fields in the criminology literature. Prior research on crime and economic growth has primarily focused on modernization theory, implying that industrialization, modernization, and economic development cause normative disruptions that lead to an increase in crime rates. However, a large body of literature has concentrated on civilization theory and proposed that crime rates would decline as national economies developed and individuals and states became more civilized. Therefore, the theory of civilization has frequently been recognized as a theory of high modernization.

While a sizable body of research on modernization and civilization theory has been produced, there are still many limitations. First, several studies on modernization theory have postulated that countries with similar stages of development will achieve convergence in crime rates, but they have examined absolute crime convergence, in which crime rates tend to converge over time. Thus, the impact of development on the crime convergence process has not been distinguished yet.

Chapter 1 in this thesis sought to address this gap in the research by providing both absolute and conditional convergence analyses of homicide rates across EU member countries over the period 1990–2018. Using difference and system GMM methods, the chapter first examined absolute convergence to assess whether EU member countries have achieved convergence in their homicide rates between 1990 and 2018. The chapter then looked at "conditional convergence," or looking at homicide convergence while controlling for GDP per capita and unemployment rate to see how development affects homicide convergence in the EU. The results revealed robust evidence for both absolute and conditional convergence of homicide rates in the EU. GDP per capita and the unemployment rate were also significant and increased the speed of homicide convergence. These findings provided several key implications for modernization theory and research related to crime convergence. First, the results presented in the conditional convergence analysis provided support for modernization theory and revealed how economic development affects the crime convergence process. Second, the findings offered important implications about the success of EU projects in achieving better and equal security conditions between member countries.

The existence of an absolute convergence of homicide rates in the EU clearly suggested that European policymakers have succeeded in reducing disparities in homicide rates across member countries. Moreover, the results presented in the conditional convergence analyses showed that economic development has contributed to the homicide convergence process across the EU member countries.

Second, while modernization theory predicts an increase in crime rates in the early stages of development and civilization theory suggests a decline in the later stages, to the best of our knowledge, no study has combined these theories and investigated whether crime rates follow a reverse U-shaped pattern over the process of development. This oversight is also surprising because the Kuznets curve concept for crime rates also suggests that the relationship between crime rates and economic growth might be inverted U-shaped.

Chapter 2 sought to address this gap in the literature by using modernization-civilization theories and the Kuznets curve concept to investigate the existence of a homicide Kuznets curve in new EU member countries over the period 1995–2017. The chapter also investigated whether and how urbanization and the unemployment rate affect the homicide Kuznets curve in new EU member countries. The results shown evidence for the existence of the homicide Kuznets curve in new EU member countries between 1995 and 2017. However, the impact of urbanization and unemployment has been mixed; while the FMOLS and DOLS results provided evidence of the negative effects of urbanization and unemployment on homicide rates, the PMG results suggested that these effects might be positive. Hence, these findings provided clear support for the modernization and civilization theories and suggested that the link between homicide rates and economic growth would be a reversed U-shaped. Moreover, although there were not any significant effects of unemployment and urbanization on homicide rates, this suggested that socioeconomic differences might affect the relationship between homicide rates and economic growth.

The results presented in Chapter 2 also offered important practical and political implications for the EU. In the current criminology literature, there exists a central research concern about the criminogenic effects of European economic integration. Although prior research has consistently supported that accession to the EU first increased homicide rates and then declined, research has not examined whether there

exists an inverted U-shaped relationship between economic growth and homicide rates in new EU member countries. The findings provided support for this relationship and suggested that homicide rates might increase in the early stages of EU economic integration and decrease in the later stages. These findings are also important as they indirectly show that the EU meets the expectation of improvement in both economic and security conditions with its accession.

Third, while there is no shortage of macro-level research on the effects of GDP per capita, income inequality, and unemployment on crime rates, the crime-inflation literature is both theoretically and empirically scant. Prior research on the inflation-crime nexus has suggested that rising inflation leads to lower consumer confidence and trust in institutions, thus driving crime rates. Hence, the criminogenic effect of inflation has not yet been explained theoretically. To clarify the effects of inflation on crime rates, most existing studies have focused on countries with historically low inflation rates, due in part to a global disinflation period between 1990 and 2020. Thus, this line of research has not examined how high and increasing inflation affects crime rates. This investigation is important considering the rapid rise in inflation after the COVID-19 pandemic in 2020 and the Ukraine-Russia war in early 2022 that, in turn, fueled concerns about social problems, including crime and violence.

Chapter 3 therefore sought to address this gap in the literature by using modernization theory and presenting analyses examining how inflation affects crime rates in Turkey, which has been witnessing high and increasing inflation since the mid-2010s. Chapter 3 also investigated the inflation-crime nexus in Turkey while controlling GDP per capita and the unemployment rate to distinguish whether other main economic factors mitigate or enhance the criminogenic effects of inflation. Results based on system GMM estimation in a panel of 3-year data for 26 sub-regions of Turkey during the 2005-2020 period showed that high and rising inflation has led to an increase in homicide and robbery rates. However, results showed that rising inflation has not been linked to increased theft rates. Notably, these findings contrast with prior research indicating that increasing inflation may have higher effects on property crime. The results indicated that growing GDP per capita was associated with increasing homicide and robbery rates and declining theft rates. In contrast to

expectations, the unemployment rate has been linked to decreased homicide rates and has had no effect on robbery or theft rates.

The results presented in Chapter 3 have important implications. First, the findings suggested that the effects of high and increasing inflation are limited to violent crimes. This finding has important implications for research on the inflation-homicide linkage and suggests that not all types of crime may be generally increased by inflation. Second, these findings have also provided policy implications for efforts aimed at combating both inflation and crime rates. The results presented in Chapter 3 suggested that successful monetary policy might lower inflation as well as violence. As inflation had no impact on the rate of theft, this chapter suggested that policymakers focus on other economic or social factors.

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