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Master in Economic Development and Growth

Does Inequality cause Crime?
Evidence from a Latin American Panel

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Abstract: In this thesis, I investigate if inequality has a significant impact on crime rates in Latin America and the Caribbean for the period from 1950 to 2010. Several studies in the past have found robust correlation between indicators of inequality and crime incidence, even when accounting for confounding factors and country-fixed effects. However, a major drawback of those studies is that they ignore the possibility of spurious regression in panel data. By pre-testing the data for unit roots and adjusting the model accordingly, I avoid the possibility of nonsense regression. My results show that once taking into account the possibility of spurious regression, it is no longer possible to find any significant correlation between inequality and crime rates. Applying fixed effects methodology and including additional control variables does not change the results; additional tests likewise suggest that inequality does not Granger-cause crime incidence. The findings lead me to the conclusion that inequality and crime are possibly unrelated in Latin America and the Caribbean and that the significant correlation found by previous studies might have been driven by the commonality of stochastic or deterministic trends in both series.

Key words: Crime, Inequality, Latin America

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1. Introduction: The Economic Costs of Crime

On the 6th of January 2014, on a highway close to Caracas, the Venezuelan ex-beauty queen Mónica Spear and her husband were shot dead when hiding in their vehicle during an assault. Their five-year old daughter was shot in the leg during the incident but survived (Mo 2014). - News like these are nothing uncommon in the Caribbean country with one of the highest murder rates in the world. The entire Venezuelan population lives terrified and under the constant fear of armed robbery, kidnapping or homicide. Nevertheless, the death of the former beauty queen has unsettled people not only in Venezuela, but has met with an overwhelming response all over the world, reverberating throughout the social media for several days (El Universal 2014).

This resounding worldwide response demonstrates that murder and personal insecurity are topics of great importance for people in many parts of the world, affecting negatively their quality of life: Apart from the intangible, personal costs such as the constant fear and strain as well as the grief and pain experienced after the loss of a family member or friend, crime and insecurity also have measurable social costs for the entire economy. These emerge first of all from the direct and indirect expenses to prevent and clear up criminal incidents: Police protection, correction and prosecution. Further costs arise due to the losses and medical treatment of the victims and crime prevention and deterrence measures (Anderson 1999). Anderson (1999) estimates for the case of the US that the aggregate burden of crime including all the above mentioned components is equivalent to an 11.9 percent of annual GDP, or an annual $4,118 per capita - an enormous sum. Even in countries with relatively low levels of crime, the aggregate social cost is still considerable (for example 6.5 percent of GDP in England and Wales, Brand and Price (2000)).

According to Detotto and Otranto (2010) however, these sums still considerably understate the total impact of crime on society, since they do not account for the detrimental effect crime has even on the (legal) economic activity. The uncertainty and inefficiency created by high crime rates discourage investments and reduce the competitiveness of firms, consequently slowing down overall economic growth and imposing an even higher cost on the entire population. These numbers prove that the overall costs of crime are very high, even in societies with quite low levels of crime. Consequently, we can expect that in countries with a higher crime incidence, crime's detrimental impact is enormous and able to paralyze the development of the entire economy. Londoño and Guerrero (1999) estimated the social cost of only the violent crimes to be as high as 14.3 percent of GDP on average in Latin American countries. In some countries such as El Salvador, costs of violence account for even a quarter of annual GDP.

Given these facts, it is evident that we have to counteract the recent trends of increasing violence in several LAC countries, but the question is how? Is it enough to promote economic growth or reduce poverty and crime will disappear automatically along the way or do we need specific interventions aimed at crime reduction? To understand how we can alleviate and/or prevent crime, we have to understand the mechanisms that determine its incidence. An important piece of the puzzle seems to be the connection between inequality and crime: LAC does not only display extraordinarily high murder rates, but is also characterized by exceptionally high inequality (Gasparini and Lustig 2011). For as long as data has been available, income, consumption, health, education or political influence inequality were highest in LAC (Ferranti 2004). Some striking examples of countries with both extraordinarily high inequality and homicide rates are Venezuela, Honduras, Belize, Jamaica, Guatemala, Colombia and Mexico. It is interesting, that also in Africa, countries with exceptionally high murder rates such as Zambia, South Africa, Lesotho, Angola or the Central African Republic are characterized by high levels of inequality. This observed positive correlation between inequality and homicide rates raises the question if there is a causal link. It seems logical that in an unequal society, poor people with nothing to lose decide to commit crimes directed

against the wealthier citizens since the expected returns are extraordinarily high compared to their alternative earning opportunities. The murder of Monica Spear is a recent example of such a criminal incidence directed against a relatively rich member of the Venezuelan society.

So is inequality a driving force behind crime incidence? Whereas the theories (presented in Section 2) predict a positive impact from inequality on crime, the empirical evidence on this matter is rather ambiguous (LaFree 1999) and no clear conclusion has been reached. Understanding the role of inequality is however important to design new strategies of crime prevention and reduction. Therefore, in this thesis I want to investigate if there is causality running from inequality to crime in the continent with the highest levels of both phenomena. Using a newly assembled, unbalanced panel data set from 21 Latin American and Caribbean countries that roughly covers the second half of the twentieth century, I conduct fixed effects regressions and Granger-causality tests in order to check for a causal impact from inequality on crime. Homicide rates are employed as a proxy for overall crime levels since it has been shown in various studies that they are a very suitable indicator (Neapolitan 1997).

In contrast to previous papers that all used panels with a large number of cross-sections but only a short time period, I have at hand a panel with a relatively low number of countries but with a large time dimension of around 50 years. This allows me to observe the development of crime over a longer time period. Apart from a larger sample, I also contribute to the academic discussion by updating the methodology: I take into account the possibility of spurious regression. Whereas former studies completely ignored the potential non-stationarity of their data, I pretest the data for the presence of unit roots and accordingly adjust the model specification to avoid the possibility of nonsense regression. Not surprisingly, my results differ widely from the results obtained by previous research. Moreover, I also perform Granger-causality tests as an additional step, a methodology that has not been applied in previous studies.

The remainder of my thesis is structured as follows: Section 2 gives an overview over the general theories of crime as well as the implications of those theories for the relationship between inequality and crime. Furthermore, I review the results and methodology of previous empirical studies that investigated the role of inequality as crime determinant. Section 3 presents the assembled data set, the data sources as well as the methodology used to measure and proxy crime rates and inequality. Descriptive statistics give an overview over the past development of inequality and homicide rates in LAC. Section 4 introduces the methodologies that will be employed for the empirical analysis of the research question and the results of the preliminary unit root tests are presented. The results of the fixed effects estimations and the Granger-causality tests are reported in Sections 5 and 6 respectively, while Section 7 offers some concluding remarks.

2. Literature Review

2.1. General Theories of Crime

Crime has been present across all cultures and periods of human history and almost every person has been victim of a bigger or smaller offense at least once in life. Crime appears in a variety of forms that can be divided into two major categories: offenses against the person (homicide, assault, robbery, kidnapping or sexual assault) and offenses against property (theft, robbery, burglary, fraud, forgery, etc.). From the 1920s on, scholars in the disciplines sociology and psychology started to study crime as a social phenomenon and eventually criminology emerged as an independent discipline, examining the reasons why individuals engage in criminal behavior (Cook et al. 2013). Until the late 1960s, the analysis of crime was determined by the notion that the character of criminals was fundamentally different from the "normal", law abiding people. Delinquents, especially killers, were assumed to be "vicious, depraved or psychologically disturbed individual[s]" (Cook and Laub 2001, p. 14). An increase in criminal activity was therefore explained by an unusual prevalence of these anomalous individuals (Cook and Laub 2001), also called the "super-predators" (Bennett, DiIulio and Walters 1996).

In 1968, Gary Becker revolutionized the view of criminality when presenting an economic approach to crime theory. He simply applied the standard tools of an economist to the topics of criminology, pointing out that criminal activity is an option open to everyone that can even be a rational choice, depending on the individual's preferences and the expected utility of the crime. Is the expected return of the crime, including possible punishment and opportunity costs such as foregone income, higher than the expected return of the individual's legal alternatives, he will most likely chose to commit the crime (Becker 1968).

While certain aspects of the human character, in economic terms "preferences", still play a role when determining criminal behavior, Becker's rational perspective shifted the focus from the time-stable characteristics of the individual to situational factors such as the social, economic and political environment that determines the expected returns of the criminal activity (Cook et al. 2013). Even though a criminal's preferences may be distinct from the preferences of non-delinquents, both groups respond rationally to changing incentives (Eide, Rubin and Shepherd 2006), which has important implications for crime-prevention policies. One logical consequence of this approach is the possibility of deterrence: by aggravating the punishment the criminal expects in the case of being captures, the expected return of the crime is reduced and might sink below the level of the other options. Thus, crime rates are expected to be "inversely related to the likelihood and severity of punishment" (Cook et al. 2013, p. 8).

The second determinant of crime independent from an individual's character is the opportunity cost, because individuals with something to lose are less prone to engage in criminal activity. The opportunity cost is defined by the amount a person can earn in the legal sector. Therefore, by improving the earning opportunities of potential delinquents, it should be possible to reduce crime rates. Since Becker's first approach, economists and other researchers have shown that the "super-predator" view of crime is not supported by the data (for example Cook and Laub 1998). Deterrence is indeed possible, since an increase in the probability and severity of the punishment has a negative effect on criminal occurrences (Eide, Rubin, Shepherd 2006 Dezhbakhsh et al. 2003) and an increase of the opportunity costs such as higher wages also reduces crime (Trumbull 1989; Machin and Meghir 2000).

The economic theory of crime, also called the "*rational choice theory*" is nowadays widely accepted; nevertheless it cannot explain the mechanisms that determine criminal behavior alone. Other disciplines such as biology, sociology and criminology have developed their own valid theories about the determinants of criminal behavior.

Especially in the field of violent and hate crimes, biological and psychological explanations seem to offer an adequate amendment to the rational choice theory. Typical biological explanations are that "some people are more likely to commit violent crimes because of the genes they have inherited; or that there is more chance of acting in an impulsive way [. . .] if you have attention deficit hyperactivity disorder" which results in lower levels of self-control (Marsh and Melville 2006, p.15).

Sociological theories of crime focus more on the social circumstances that are conducive to criminal behavior. The most influential example of a sociological explanation of crime is the *strain theory*, founded by Robert Merton in 1938. He indicated that in every society, there are certain goals that are considered worth achieving. One very famous example of such a cultural goal is the "American Dream", which implies that everyone should accumulate wealth, regardless of social class. For some people however, social blocks make it impossible to achieve those culturally defined goals, creating a strain and pushing those people into using illegal methods in order to succeed. Many times, the importance of the goal outshines the means by which it is achieved, and consequently individuals under strain will see crime as an adequate adjustment mechanism (Merton 1968). Strain is especially tough among the lower class, because they "don't have their fair share of opportunities" (Samaha 2005, p. 88) which would explain why crime is especially prevalent among the lower classes of society. Several empirical studies have presented evidence on the impact of strain on delinquency, an important one being Agnew and White (1992).

Theory	Determining Factor
Economic Theory	Expected Utility of Crime
Biological and Psychological Theories	Genes, Psychological Disorders
Sociological Theories	
- Strain Theory	Inequality, Social Barriers
- Social Disorganization	Ethnic Heterogeneity, Residential Instability
Theories Describing the Development of Crime over Time	
- Modernization Theory	Crime increases with Economic Growth
- Theory of the Civilizing Process	Crime decreases with Economic Growth
Cohort Effect	Fertility/Age Distribution

Table 1: Overview over the General Theories of Crime

A second theory that focuses on the social conditions in society is the *social disorganization theory*. Social disorganization "refers to the inability of a community structure to realize the common values of its residents and maintain effective social controls" (Sampson and Groves 1989, p. 777). In their classic work, Shaw and McKay (1942) found that the three structural factors low economic status, ethnic heterogeneity and residential instability weaken the social bonds within a community, what translates into a higher number of individuals engaging in criminal activity.

Lastly, there are also theories that instead of looking at factors that determine crime at a certain moment in time in a certain society, they look at the development of crime over time or over the course of economic progress.

Emile Durkheim founded the *modernization theory* when already in the 19th century he realized that the transition from an agricultural to an industrial society and the concurrent increase in the division of labor weakened solidarity and the social norms that "ordinarily control our natural [. . .] urges" (Samaha 2005, p. 88). The consequence was an increase of crime in Europe during industrialization (Rogers 1989; Clinard and Abbott 1973). This theory gives rise to concerns since it predicts a sustained increase in crime as a country experiences economic growth. Shelley (1981) further developed this theory, predicting an initial upswing in crime during the initial phase of the industrialization; however she predicted that as economies mature, crime would decline again.

Contrarily and less concerning, Norbert Elias stated that as a country develops, it undergoes a "*civilizing process*", experiencing a dramatic change of the nature of human interaction, for example regarding violence, sexual behavior and manners. The more sophisticated division of labor makes people dependent on each other, and it becomes necessary to establish common rules, coordinate actions and to adopt self-control. Physical force and violence are monopolized by the government, resulting in a long term decrease of crime and violence (Eisner 2001). This theory has been confirmed by scholars such as Pinker (2011), who report that Europe experienced a tenfold-to-fiftyfold decrease in homicide rates between the middle ages and 1900.

One last driving factor of crime that is rather unrelated to the above mentioned theories is fertility and accordingly the age distribution of the population. Since most crimes are committed by men in that age group, smaller cohort size means that there are simply fewer individuals in that high-risk age group and consequently fewer crimes are committed. Higher fertility and consequently population growth might lead to an increase in crime rates when the bigger cohorts reach the critical age (Krahn et al. 1986).

2.2. The Link between Inequality and Crime

2.2.1. Theoretical Background

Already in early Marxian theories, inequality and crime were considered to be directly connected. Bonger (1916), a Marxian criminologist suggested that the exploitation and oppression of the poor by a powerful and rich minority produces criminal behavior as a primitive form of uprising against the ruling elite (see also Quinney 1974 and McDonald 1976).

Likewise, the more recent *economic theory of crime* has important implications on the relationship between inequality and crime rates: According to the rational choice theory, the expected pay-off from crime in comparison to the legal earning opportunities is an important determinant of criminal behavior. In unequal societies, the high income differential makes criminal activities especially profitable for the poor part of society: If we assume that the benefit from activities such as robbery and theft can be proxied by the mean income of the society (Ehrlich 1973), then the spread between the mean income and the legal earning opportunities represents the expected return from crime, which is especially high for individuals at the lower end of the income distribution (Demombynes and Özler 2002). This makes it more likely that criminals come from the lower classes of society (Machin and Meghir 2000). An increase in inequality increases the spread between the mean income and the income of the individuals situated at the bottom end of the income distribution, increasing the payoff from criminal activity and thus leading to a rise in crime. This relationship between inequality and crime has been suggested by many scholars (Ehrlich 1973, Chiu and Madden 1998, Bourguignon 1999, Demombynes and Özler 2002), however it "does not imply that inequality per se causes crime" (Demombynes and Özler 2002, p.267). In fact it rather suggests that income inequality is a good proxy for the returns of criminal activity.

Also from the sociological theories introduced above, important implication about the relationship between inequality and crime emerge: For example the *social disorganization* theory implies that ethnic as well as income heterogeneity in communities favors the social disorganization process, which ultimately results in higher violence and crime rates (Sampson and Wilson 1998, Shaw and McKay 1942).

The sociological *strain theory* of crime likewise indicates a positive relationship between inequality and crime. The founder of the theory himself, Merton (1938), suggested that antisocial behavior ensues as a result of the strain suffered by the disadvantaged in a society. The lack of upward mobility, especially if it is perceived as permanent and/or unfair may drive individuals into hostile and impulsive behavior such as criminal activity. Coser (1968) and

Blau and Blau (1982) argue in a similar way. While general inequality already comprises the potential for conflicts and violence, more so does inequality related to ascribed characteristics such as race, religion or ethnicity (Agnew 2001; Blau and Blau 1982): Ascriptive inequality is usually perceived as particularly unjust and high in magnitude. As a consequence, countries displaying big income and political power differences between ethnic groups are prone to suffering from higher crime rates, as for example South Africa.

Concerning the theoretical background, it is clear that the three main theories of crime, Becker's rational choice theory, the social disorganization theory (Shaw and McKay) and Merton's strain theory, predict a positive impact from inequality on crime incidence. In the next section I will take a look at the empirical studies that investigated this link.

2.2.2. Empirical Evidence

In past research, crime has mostly been considered a "social cost of poverty and inequality" (Bourguignon 1999). Scholars have been convinced that higher inequality causes higher crime levels, however the empirical evidence on the matter has been mixed. Most of the empirical work has been realized in the form of cross-sectional studies. More recently, panel data and time series approaches have been added to the scientific discussion.

▷ Cross-Sectional Studies

On the community, city or state level, many studies have shown that general income inequality, as well as inequality between races, is a powerful predictor of crimes such as homicides or assault (Blau and Blau 1982, Hsieh and Pugh 1993, Sampson and Wilson 1995, Morenoff et al. 2001). On the aggregate level, LaFree (1999) and more recently Nivette (2011) have compared the results of dozens of cross-national studies on the determinants of crime and concluded that the positive link between inequality and crime rates is one of the most consistent. Some examples are Krahn et al. (1986), McDonald (1976), Neapolitan (1994), Saridakis (2004) and Fajnzylber et al. (1998). Although the majority of studies found a significant link, a considerable number of studies was not able to prove this connection between inequality and crime (Paré 2006, Messner and Rosenfeld 1997). The discrepancies show that the relationship between inequality and crime is not as clear as it might look at first sight. A possible explanation why some studies fail to establish a link is suggested by Messner and Rosenfeld (1997). They assume that an income inequality indicator is not broad enough to capture the concepts of strain and social disorganization. Another reason for the variations in outcomes could be the small number of observations of the cross-sectional studies. Given that the total number of countries in the world is only 200 and since for many reliable data is not available, the scope of a cross-sectional sample is quite limited. To overcome these limitations, researchers have recently turned towards time series and panel data methodology in order to obtain clearer results.

▷ Time-Series and Panel Data Studies

Two of the most extensive studies in this field were realized by Fajnzylber, Lederman and Lozoya (FLL) (2002a and 2002b). Using panel data of 39 and 37 mostly developed countries for the period from 1965 to 1995, they show that the positive link between income inequality and crime rates is robust to controlling for country specific effects as well as for other crime determinants. In contrast, Neumayer (2005) claims that these results are only valid in the "artificially restricted" (p. 2) sample used by FLL. As soon as he uses a sample of more than 50 countries that also includes developing countries, the indicator of income inequality turns insignificant. According to Neumayer, the spurious relationship between inequality and crime might be caused by the fact that inequality is "strongly correlated with country-specific fixed effects such as cultural differences" (2005, p. 2). The contrary positions of Neumayer (2005) and FLL (2002a, 2002b) illustrate that there has not been found any consensus in the debate over the role of inequality as crime determinant.

▷ Special Case: Latin America and the Caribbean

As mentioned in the introduction, the LAC region might be a special case since it displays extraordinarily high rates of both homicide rates and inequality. This hypothesis is confirmed by Nivette (2011) who mentions that a Latin America regional dummy variable is a strong predictor of homicide rates in many cross-sectional studies. Studies that focus exclusively on LAC are rare. The only quantitative study has been conducted by Gaviria and Pagés (1999) using a sample of only 17 Latin American countries. They could not find any association between victimization rates and inequality.One additional interesting result of this study that is worth mentioning is that the authors found that the typical victims of property crimes are indeed members of the middle or upper class that live in larger cities, just as predicted by the theories. Apart from the work of Gaviria and Pagés, only two more qualitative studies have been realized: Hojman (2004) presents a qualitative study on the differences of Latin American studies and concludes that especially diversity, inequality and poverty are conducive to crime. Neapolitan (1994) indicates that also the history and culture of Latin America has to be taken into account when explaining variation in homicide rates. Structural and demographics characteristics are often conducive to violence in Latin America, since they emerged out of a period of colonization and subjugation. Given the fact that there has only been conducted one quantitative study of inequality and crime in LAC, my thesis clearly fills a gap.

2.2.3. Major Drawbacks of Previous Studies

As already discussed by Neumayer (2005), the results of most previous studies are not reliable because they have been based on OLS estimations. Since differences in income inequality as well as homicide rates are strongly correlated with time fixed cultural factors, applying OLS estimation technique will yield biased results. Neumayer (2005) himself, as soon as he accounts for the unobserved time-invariant variables by using fixed effects estimation, finds inequality to be not significantly related to crime rates.

However, Neumayer fails to account for another source of possible spurious regression: the possible non-stationarity of the data. He does not pre-test his variables for stationarity and consequently runs the risk of finding nonsense correlation between them. Phillips and Moon (2000) already criticized that in panel regression analysis, non-stationarity received way too little attention in the past. Extensively studied series like the Penn-World Table feature evident non-stationarity; however this has been completely ignored. The same is true for the study of homicide rates. Even though the panels used by previous researchers do not have a time dimension as large as in

my sample, they still should have paid attention to obvious signs of non-stationarity in the data (see also Section 5.4).

In this thesis I will apply a more cautious approach, avoiding the possibility of spurious regression. Hence my contribution to the academic controversy is empirical: I update the methodology applied by Neumayer (2005) including pre-tests for stationarity and adjusting the model accordingly. As I avoid the possibility of spurious regression in my analysis, my hypothesis is that I won't find any prove for causality running from inequality to crime. Another methodological innovation is to apply Granger-causality tests to see if there is some sort of causality running from inequality to crime rates.

Apart from the methodological improvements, I also contribute a more extensive sample. Whereas FLL (2002a) and Neumayer (2005) used small panels containing only between 80 and 150 observations, my sample contains approximately 600 observations, even though it contains only countries from LAC.

Using this vast sample as well as the more cautious methodology, my results are more reliable than the findings of previous research.

3. Historical Background: LAC from 1950 to 2010

After centuries of colonial rule and independence wars, Latin America and the Caribbean experiences a gradual transition towards democratic governmental forms during the second half of the 20th century. Nevertheless, parts of the region are severely affected by brutal military regimes and the emergence of drug cartels. Dictators or military juntas rule in Brazil, Nicaragua, Paraguay and Guatemala, Bolivia is the staging ground for a military coup and the consequent Marxist revolution led by Che Guevara. After 1970, also in Chile and Uruguay authoritarian regimes are established, followed by Argentina in 1976 and Panama in 1983. It is said that the USA was involved in most of the violent coups throughout the region, trying to avoid "Marxist infiltration" of the region as well as to stop the steady flow of narcotics originating in Bolivia, Colombia and Mexico. Corruption as well as drug related murders are alarmingly frequent particularly in these countries (Lewis 2006). After the 1980s, almost all the Latin American countries succeed in abolishing the authoritarian rule and introducing an often slow and arduous transition to democracy.

Economically, most Latin American countries adopted an inward-looking model of development between the 1930s and the 1980s (Taylor 1998) and experienced steady growth in the decades after WW II. By 1970 however, serious doubts emerge if this "Import Substitution Industrialization"-strategy can solve the region's economic problems. Economic growth slowed down and led lastly to the "lost decade" of the 1980s when many countries struggled with a financial debt crisis (Baer 1972). As a reaction, in the following decade of the 1990s, many countries adopted profound structural reforms introducing a more market-oriented economic system (Gasparini and Lustig 2011). Since 2000, Latin America and the Caribbean has recovered from the previous stagnation and experienced a steady GDP growth by an average of 1.9 percent (Weisbrot and Ray 2011). By the end of the 20th century, many countries of the LAC regions experienced a left-swing of the political regimes. Starting with the election of Hugo Chavez in Venezuela in 1999, other countries such as Chile, Argentina, Brazil, Ecuador, Bolivia and Nicaragua all broke with past neoliberal policies and established governments that focused more on social concerns (Birdsall, Lustig and McLeod 2011).

4. Measurement, Data Sources and Descriptive Statistics

4.1. Crime

4.1.1. Measuring Crime: Homicide Rates

Since not all crimes are equal, it is meaningful to distinguish between the two main types of crime, property crimes and violent crimes. The theories presented above have different implications regarding the two types of crime. If income inequality increases, the economic theory predicts an upswing in property crimes since the expected return from such activities is increased for the poorer part of society. On the other hand, the strain and the social disorganization theory rather predict an increase in violent crimes as a consequence of increasing social tensions, pressure and conflicts resulting from increased inequality. Kelly (2000) found some evidence that supports the sociological theories: His results imply that inequality has no impact on property crime but strongly influences violent crimes. Already Rosenfeld (1982) obtained similar results: He showed that a measure of relative deprivation successfully predicts homicide, rape and assault, but not robbery. These empirical results indicate that mostly violent crimes are affected by changes in inequality. In this thesis I will however not focus on the differences between violent and property crime, since my crime-proxy is able to capture the extent of both violent and property crime: Homicide rates. This indicator has been used as a crime proxy in most of the previous research presented in Section 2.2.2. The official definition of homicide is "unlawful death deliberately inflicted on one person by another person" (OECD, 2011). Homicide rates are expressed as the number of murders per 100,000 people, since the size of the population has to be taken into account. [1]

In the literature it has been argued that homicide rates are the most reliable indicator of both violent and property crime in cross-national research (Neapolitan 1997, Nivette 2011) since they have certain characteristics that make them superior to other indicators of crime (Baten et al., 2014): Most importantly, the definition of homicide or murder is very clear and fairly stable across cultures and time periods, an advantage for studies that include large periods of time or a wide cross-section of countries. Secondly, homicides are drastic and incisive incidents, making it easy to measure their frequency, which in turn results in a lower probability of measurement errors. Another advantage is that the incidence of homicide is more or less equal across social groups; consequently homicide rates capture overall crime levels and not the crime levels affecting only parts of the society. It has also been shown that other crimes are correlated with homicide rates (OECD, 2011). Consequently homicide rates can also be regarded as a feasible proxy for overall crime rates.

4.1.2. Data Sources

I obtained most of the observations on homicide rates from the Comparative Homicide Time Series assembled by Martti Lehti and Tapio Lappi-Seppälä (2013) from the Finnish National Research Institute of Legal Policy. This data set combines the available data from the WHO, UNODC and the Historical Violence Database with other, minor sources on historical homicide rates. The researchers obtained the data from both public health and criminal justice records. I added about 20 observations for Mexico (INEGI 2013) as well as 22 observations from the Tübingen Clioinfra-Database on homicides.

In total, my data set contains 1,665 observations on homicide rates from 37 Latin American and Caribbean countries for the period from 1893 to 2012. Figure 1 gives an overview over the distribution of the observations

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[1]Homicide rates do not include deaths that result from armed conflicts such as interstate or civil wars.

over time. For the first half of the twentieth century, there are only few observations available. However, from the 1960s on, observations are available for almost all 37 countries.

The summary statistics of all the variables in my data set as well as the distribution of observations over countries are presented in Tables 15 and 16 in the appendix.
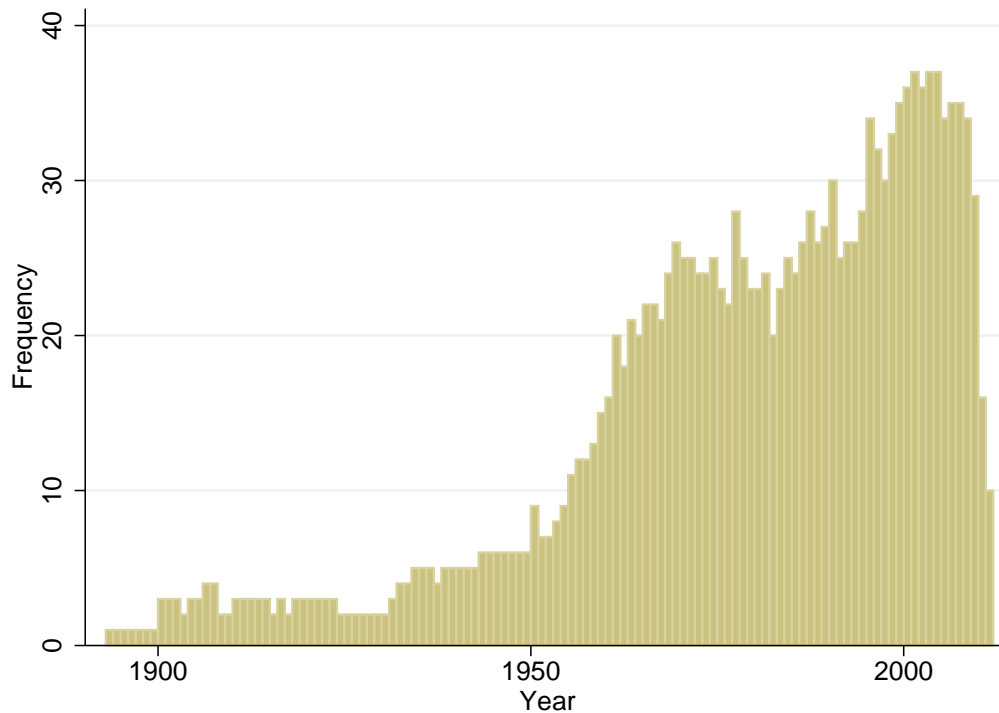
Figure 1: Distribution of the Observations over Time

4.1.3. Long-Term Trends in Homicide Rates

Latin America and the Caribbean is the region with the second highest mortality rates due to murder in the world (only Southern Africa has higher murder rates) and violence is one of the main public health concerns (Briceño-León, Villaveces and Concha-Eastman 2008). Using homicide rates as a proxy of the overall crime level one can get an idea of how much higher insecurity and crime incidence are in Latin America in comparison to Europe. Whereas in the UK there are only 1.2 homicides per 100,000 inhabitants, in Honduras and El Salvador occur as many as 92 and 69 murders respectively (UNODC 2011). The global homicide capitals are all situated in LAC with the top three being Caracas, Guatemala City and Basseterre (UNODC 2011).

Nevertheless, the distribution of homicides across countries is very heterogeneous and developed differently over the past decades. Some countries such as Argentina, Chile and Uruguay display very low homicide rates almost on European level, Peru, Nicaragua, Ecuador and Panama have moderate rates whereas Brazil, Mexico, Honduras and especially Venezuela and Colombia have extraordinarily high rates (Briceño-León, Villaveces and Concha-Eastman 2008). These findings are confirmed by the data in my sample (see Figure 2).

Figure 2: Homicide Trends in Selected Countries (1930-2010)
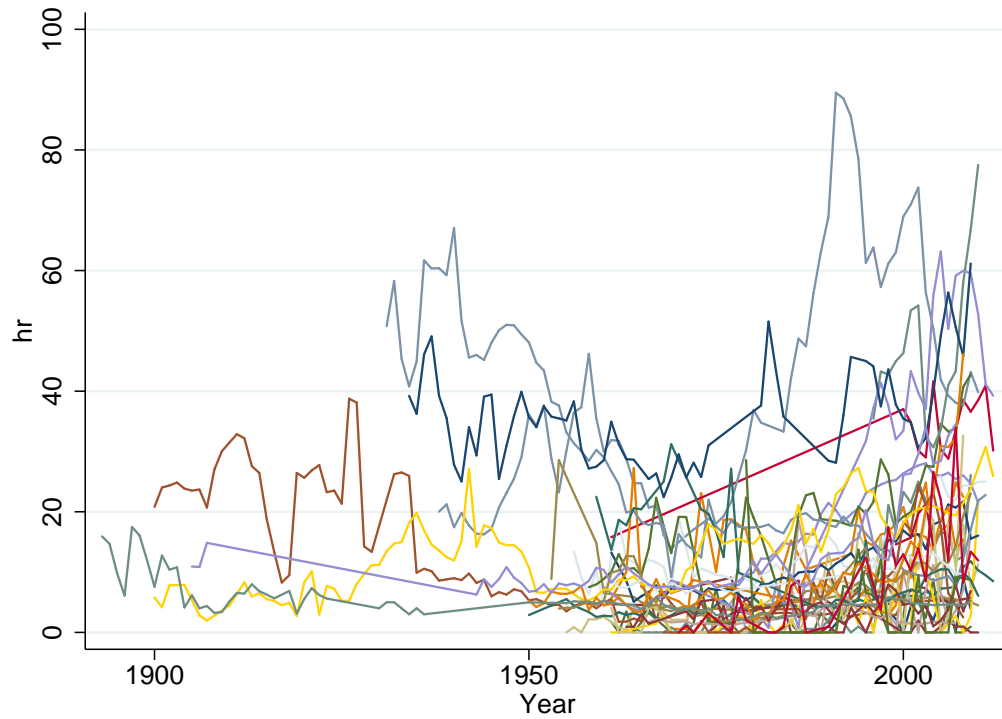
Figure 3: Homicide Rates - Total Sample (1890-2010)

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It is hard to summarize the development of crime rates in the past decades, since the temporal trends in LAC vary widely (Briceño-León, Villaveces and Concha-Eastman 2008).

Looking at the development of homicide rates for all 37 countries in the sample (Figure 3), it seems that in the first half of the twentieth century, most of the countries experienced a decline of homicide rates whereas after 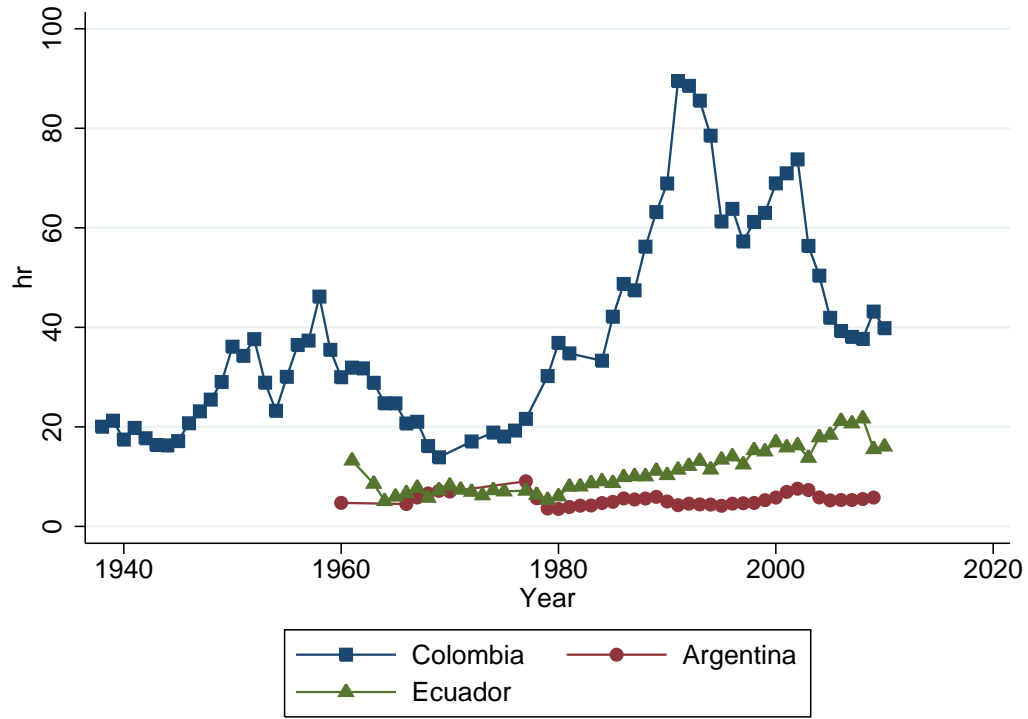1960, homicide rates display a general upswing, resulting in an almost U-shaped pattern. This is not surprising, since we know that after 1970 economic growth slowed down which probably drove more individuals towards criminal behavior. However after the adjustments of the 1990s and consequent improvements of living conditions, one would expect crime rates to decrease, which is not the case.

In order to have a closer look, I now inspect the homicide series by country in Figure 4[2]. Here it is evident that the majority (24) of the countries experienced an overall increase of homicide rates (Aruba, Bahamas, Belize, Bolivia, Brazil, Barbados, Colombia, Costa Rica, Cayman Islands, Dominica, Dominican Republic, Ecuador, Guatemala, Honduras, Jamaica, Saint Lucia, Panama, Puerto Rico, Paraguay, El Salvador, Suriname, Trinidad and Tobago, Saint Vincent and Venezuela). Some countries such as Mexico, Nicaragua and Uruguay display an overall fall of homicide rates whereas for the other countries there is no clear pattern visible. The prevalence of a trend-like behavior suggests that the homicide rates series is not stationary.
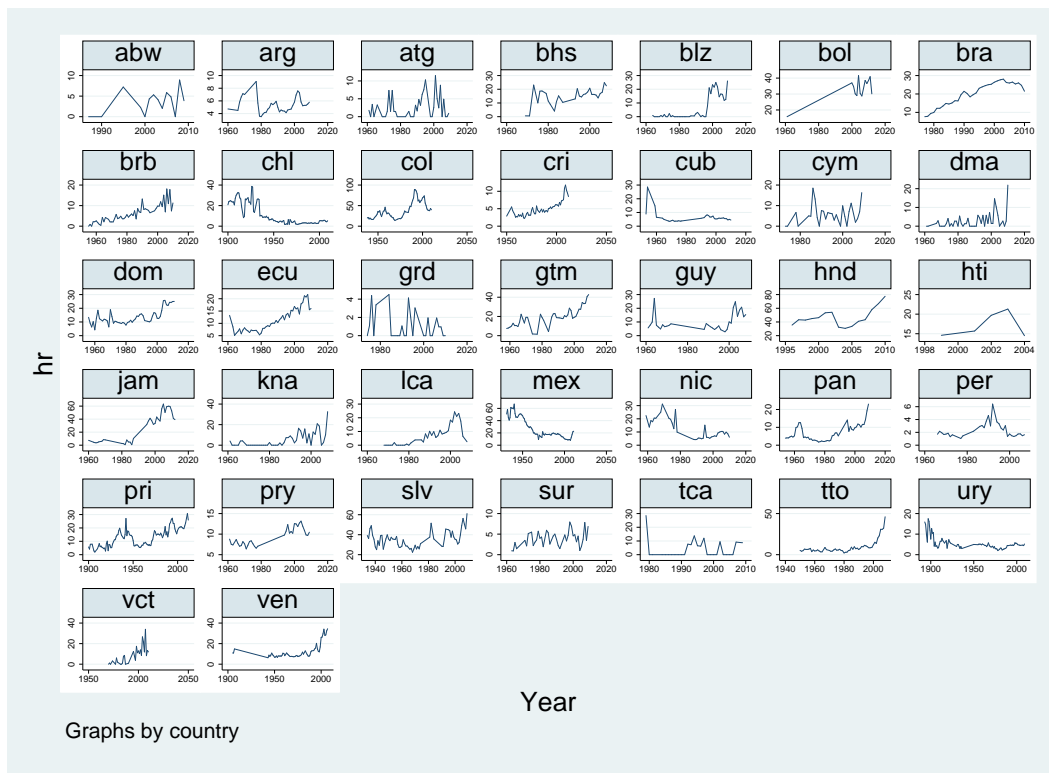
Figure 4: Homicide Rates by Country (1890-2010)

The finding that homicide rates have rather increase than decreased in the last century in Latin America is in sharp contrast to the theory of the civilizing process and to the steady decline of crime in North America and Europe (Pinker 2011). This exceptional development in Latin America gives rise to concern, since the continent does not

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[2]The abbreviations used are explained in Table 16 in the appendix.

seem to follow the pleasing development that is occurring in other parts of the world. The question that arises is why the development in Latin America is so different from other regions. May the extraordinarily high levels of inequality be a driving force behind this development? In order to further assess this question, I will have a look at the past development of inequality in the next section.

4.2. Inequality

4.2.1. Measuring Inequality: Gini Index

For my analysis, I will use the most common indicator of inequality, the Gini index. It captures by how much a wealth or income distribution deviates from a perfectly equal distribution. It varies between 0, which indicates perfect equality and 100, indicating that all wealth or income is possessed by one individual (World Bank 2014).

The data on inequality was obtained from two main sources: The UNU WIDER World Income Inequality Database (2008) and the Estimated Household Income Inequality Data Set (EHII). The database was replenished with a few observations from the data set assembled by van Zanden, Baten, Foldvari and van Leeuwen (2012).

When matching the observations on homicide with the available observations on inequality, the sample is reduced to 27 countries and 702 observations. Figure 5 displays how the observations are now distributed over the time interval. For the following analysis, I restricted my sample to the years after 1950 due to the lack of observations for the first half of the twentieth century.
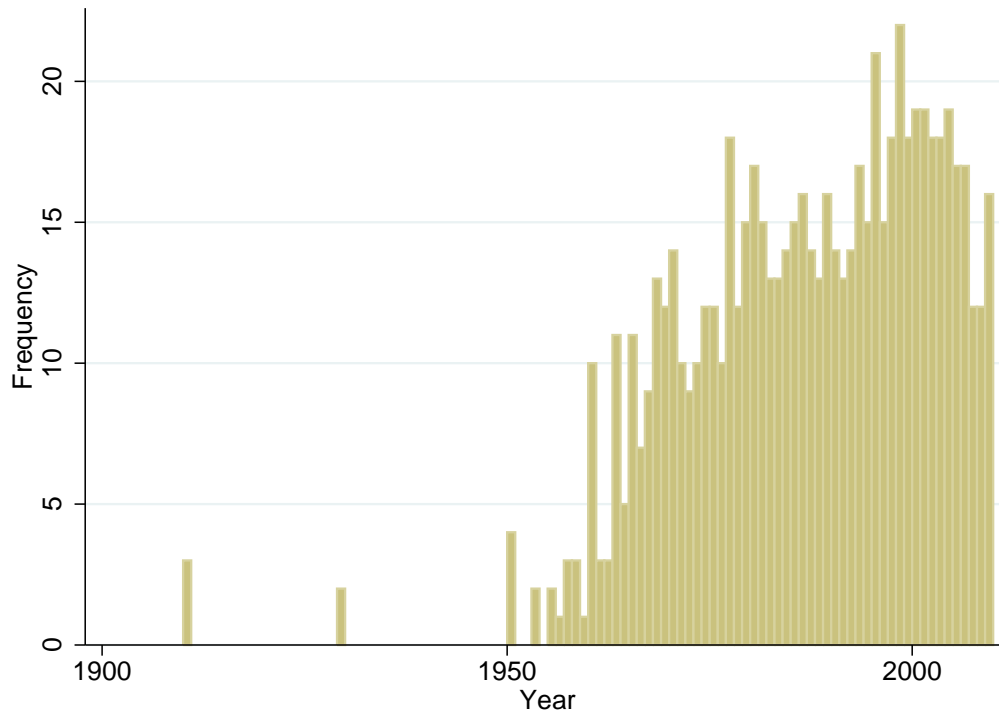
Figure 5: Distribution of Observations over Time

4.2.2. Long-Term Trends of Inequality

Previous studies have commonly identified two opposite trends for the development of inequality since 1980: For the "lost decade", López-Calva and Lustig (2010) distinguished a sharp increase in inequality throughout the region. This increase continued as in the 1990s the market-oriented structural reforms most frequently hurt the poor disproportionally. Since the 2000 however, falling skill premia in the labor market and large-scale cash transfer programs alongside with increased social spending on education and health led to a decrease in inequality in almost all countries of the region (Gasparini and Lustig 2011).
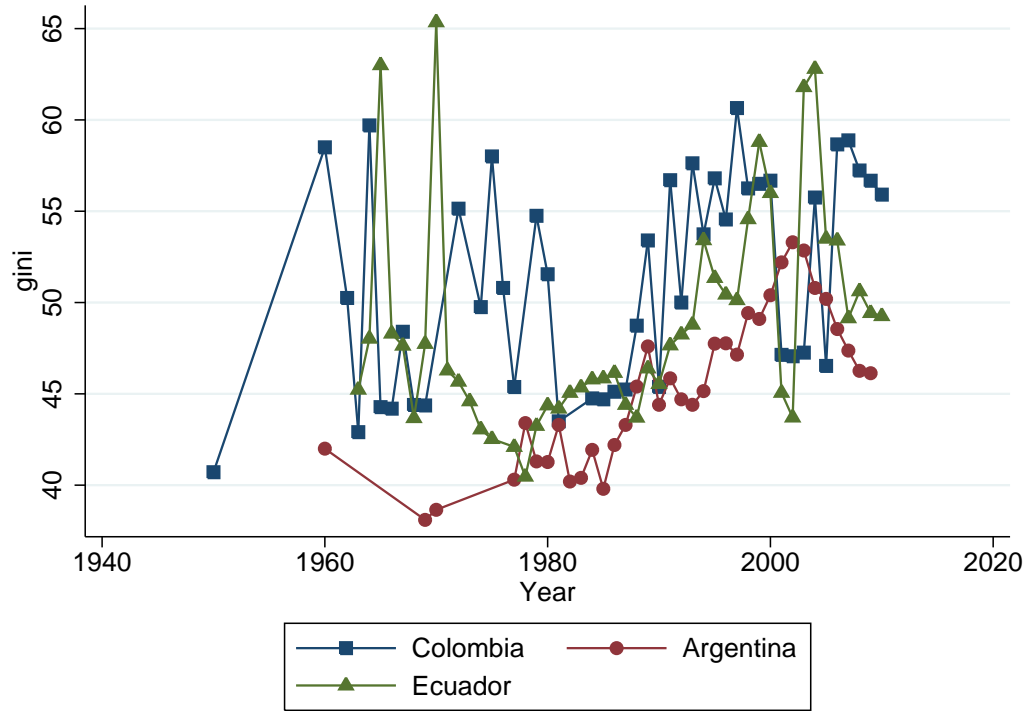
Figure 6: Inequality Trends in Selected Countries (1950-2010)

Argentina for example follows this inverted U-shaped pattern (see Figure 6), with increasing inequality from 1970 until 2000 and a rapid decline afterward. When looking at other countries, it is however hard to discern the same pattern. For the case of Colombia as well as Ecuador, the inequality seems to fluctuate around a long-term mean that is about 50.
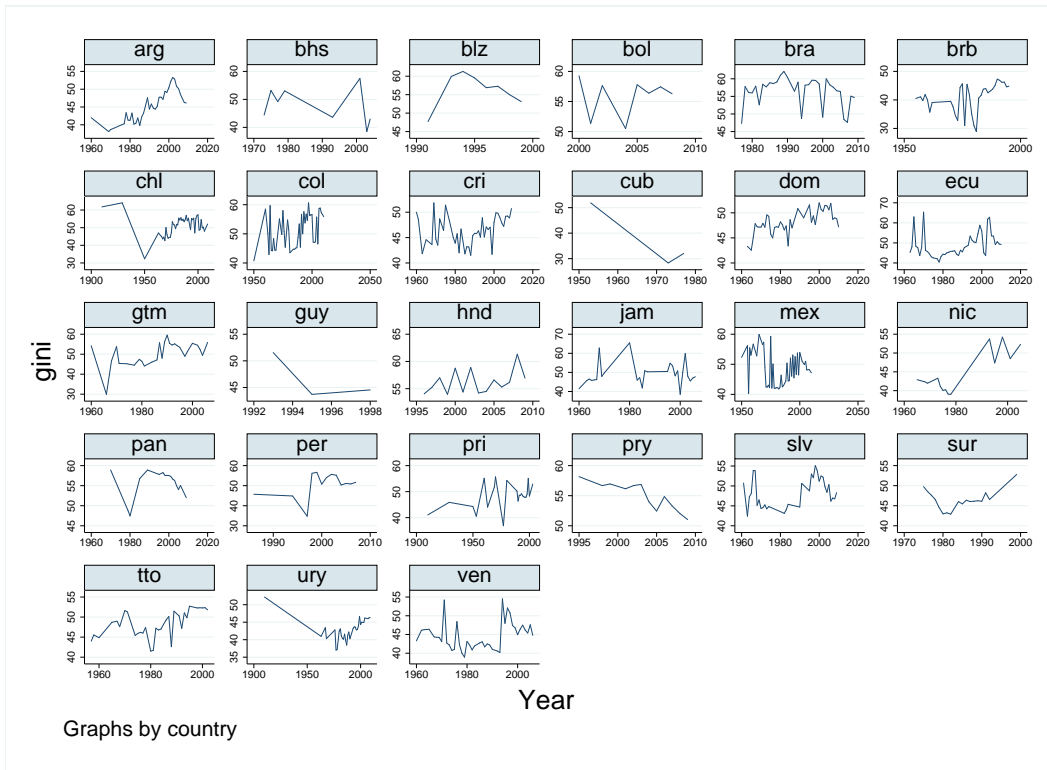
Figure 7: Inequality Trends - Total Sample (1890-2010)

For the entire sample (Figure 7), it is hard to discern a common pattern. Just as in the case of homicide rates, the development of inequality displays wide variations across countries. In some countries inequality has fallen, in others increased, and in many countries inequality levels just fluctuate around a single mean and no trend behavior is visible. Overall, the Gini series look more stationary than the homicide rates.
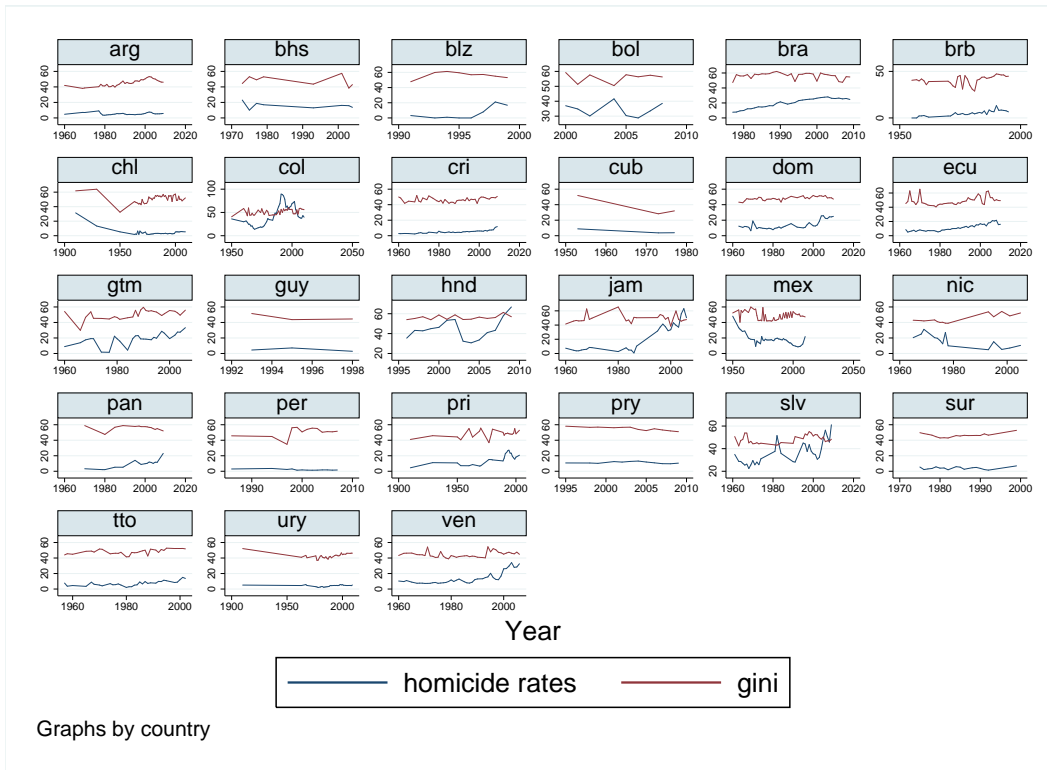
Figure 8: Combination Plots of Homicide Rates and Gini Index (1890-2010)

Since I am interested in the relationship between inequality and crime, I plot the two series together for each country. When looking at these combined plots (Figure 8), it seems that the two series are moving together in many countries. The lines are almost parallel, suggesting a stable long-term relationship between the two variables. The mere correlation however does not predicate a causal relationship between the two variables. In order to uncover the true nature of the link between the two phenomena, I have to apply more advanced techniques which will be described in the following chapter.

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5. Methodology

In this thesis I want to examine if there is a causal link running from inequality to homicide rates in a panel of Latin American countries. In a (hypothetical) experimental framework that is set up in order to test the impact of inequality on crime levels one would take several identical countries and "shock" them with different levels of inequality. In the next step, the crime rates associated with the different levels of inequality could be observed. Since the countries are otherwise identical, it would be evident that the differences in crime rates are due to the different levels of inequality. The causal effect could be estimated with the following naive regression:

$$Homicide\,Rate_{it} = \alpha + \beta_1 * Inequality_{it} \quad (1)$$

In equation (1), time is indicated by t and countries by i, α is a constant and β_1 is the coefficient of interest, capturing the causal effect of inequality on homicide rates. An error term is not necessary, since inequality explains all of the variation in homicide rates in the experimental context.

Reality however confronts the researcher with a number of heterogeneous countries that display different levels of inequality and crime where the causal relationship between the two variables is not evident. As described in the theories presented above, high crime rates can be triggered by a multitude of social and economic factors:

The wealth or income level of a country is important to both determine the potential return from a crime as well as the potential opportunity cost in form of foregone income. Another indicator of (low) opportunity costs is unemployment, since it indicates the lack of legal earning opportunities. The direct costs in from of potential punishment are determined by the juridical system. Turning towards sociological explanations, factors such as racial heterogeneity, residential instability, education and cultural background, legal and political system as well as institutional quality of a country can all greatly impact crime rates. These so called "confounding" factors and the indicators they can be measured with are summarized in Table 2.

Factor	Indicator	Proxy in Regression
Economic Theory: Factors determining the net return from crime		
Direct Benefit: Expected Return from Crime	Wealth/Income Level	GDPpc
Direct Cost: Punishment	Severity/Probability of Punishment	Death Penalty Dummy
	Income/Poverty	GDPpc
Opportunity Costs: Foregone Income	Unemployment/Legal Earning Opportunities	Growth Rate of GDPpc
Sociological, Modernization and Civilizing Process Theories		
	Ethnic Heterogeneity	-
	Residential Instability	Growth Rate of GDPpc/ Urbanization Rate
Strain, Change and Economic Progress	Education	-
	Cultural Background	Removed by FE
	Political System	Partly removed by FE
	Institutional Quality	Partly removed by FE
	Legal System	Removed by FE
	Modernization/Economic Progress	GDPpc

Table 2: Confounding Factors

In terms of the regression equation, the unobserved factors are collected in an error term μ_{it}:

$$Homicide\ Rate_{it} = \alpha + \beta_1 * Inequality_{it} + \mu_{it} \quad (2)$$

The regression represented in equation (2) would only yield consistent estimates of the causal effect from inequality to crime if the unobserved factors were uncorrelated with inequality. However, it is very likely that there exists correlation between inequality and most of the other determinants of crime. Therefore, equation (2) would overestimate the causal effect from inequality, since it would attribute the effect of the confounding factors contained in the error term to inequality.

Consequently, if I want to find causal inference between inequality and homicide rates, it is important to control for confounding factors, e.g. the factors determining crime that are likely to be correlated with inequality.

5.1. Additional Control Variables

The preferred methodology in order to isolate the pure causal effect from inequality on crime would be to include all of these variables as additional controls in the regression equation. Unfortunately, this is not possible because for the period contemplated in this thesis, there is hardly any data available. Nevertheless I could obtain data on GDP per capita (GDPpc) and urbanization rates as well as create a dummy variable for the existence of the death penalty. These variables are able to proxy many of the unobserved factors.

5.1.1. GDP per Capita

The most important unobserved variable in this context is probably GDP per capita, since it is a good proxy for several of the confounding factors and certainly correlated with inequality. The hypothesis, that GDPpc and inequality are linked by a close relationship has already been introduced by Kuznets (1955). He suggested that the level of inequality increases first at the onset of industrialization and decreases afterward.

When introducing GDPpc into the regression equation, it captures the effect of some of the economic factors determining the net expected return from criminal activities that have been emphasized in Becker's economic model of crime: income level and/or poverty. Wealth increases the amount of material goods available for theft, which would increase crime. However, wealth also decreases poverty which translates into an increase in opportunity costs of potential delinquents, leading to a fall of crime. Furthermore, GDPpc also proxies certain aspects of the social circumstances in a society according to the modernization theory and the theory of civilizing process. Higher GDPpc implies a higher developmental stage and consequently a higher level of self-control. Due to these multiple and opposed impacts of GDPpc on crime, the expected sign of the coefficient of GDPpc in the regression is not obvious. In general, I would expect a negative sign, since the negative impact of GDPpc on crime from the civilizing process and the higher opportunity costs outweighs the positive impact from a higher expected return. The effect of GDPpc might even change the sign over time, or at least change its intensity. To model a changing relationship between GDPpc and crime, I include also the squared GDPpc as explanatory variable in the regression.

Of course GDPpc is a very primitive and incomplete proxy for the confounding factors mentioned, however, given the lack of data for the contemplated period, it is a feasible solution. The data on GDPpc has been obtained from the Maddison Historical GDP database and is measured in constant 1990 international GK\$.

5.1.2. Economic Growth

Not only the level of GDPpc but also its growth rate is an important confounding factor in this context. According to Kuznets hypothesis (1955), fast growing economies are likely to have high inequality, since the country experiences a transition from a low to a higher income which occurs only gradually. Therefore, inequality and the growth rate of GDPpc are correlated.

Again as suggested by the modernization theory, fast growing economies experience disorganization and the breakdown of traditional ties, as industrialization, technological progress, structural change and urbanization are reshaping the country. Under these circumstances, individuals may react violently to the challenges and frustrations of the new, unfamiliar lifestyle. On the other hand, as suggested by the "civilizing process" theory, the rapidly changing society might present new earning opportunities for many individuals, reduce unemployment and prevent that individuals engage in criminal activity (Chiricos 1987). So again here, the expected sign is not obvious.

5.1.3. Dummy Variable: Abolition of Death Penalty

Another confounding factor is the potential punishment a delinquent has to face if captured. A more severe punishment such as the death penalty could put off potential delinquents and consequently lower crime rates. However, Kelly (2000) shows that death penalty has no correlation with homicide rates but affects only property crime. I will include in my regression a dummy variable in order to reexamine this relationship. The dummy takes the value 0 in the years the death penalty was practiced and turns 1 in the years death penalty is not practiced anymore. The expected sign of this variable is positive, since I expect homicide rates to increase as soon as the death penalty has been abolished. The data on the practice of the death penalty has been obtained from the "Death Penalty Worldwide"database (2012) assembled by the Center for International Human Rights. However since in many LAC countries the death penalty never existed or was not practiced as in other regions of the world, there are certain caveats to including this variable in my regression. I will therefore also exclude it in some specifications to avoid potential problems caused by this variable.

5.1.4. Urbanization Rates

Urbanization rates are a good proxy for living conditions, social interactions as well as the stage of industrialization but are also likely to be correlated with inequality. The data on urbanization rates has been obtained from the World Bank database and observations are only available from1960 on. Therefore, when including urbanization rates as additional controls, I lose another decade of observations.

5.2. Fixed Effects Regression

As mentioned above, it would be optimal to include proxies of all the factors determining crime rates in the model. However, due to data limitations this is not possible and I only have the above mentioned variables at hand. An alternative approach would be to get at causal effects using an instrumental variable strategy, however since there is no data available for this early period it is also impossible to find a valid instrument.

The advantage of having at hand a large sample of panel data is that I can partly deal with the omitted variable bias even though most of the confounding factors are unobserved. Applying a fixed effects estimation strategy, I am able to control for the unobserved omitted variables that are fixed over time.

Already Bourguignon (2001, p. 26) noted that cross-country differences in inequality and homicide rates are strongly related to factors that are time invariant. Examples are the cultural background as well as geographical

conditions and climate. Also the political system and the quality of institutions are fairly stable over time and can partly be accounted for using fixed effects estimation: As discussed by Acemoglu and Robinson (2008), the quality of institutions is very persistent over time and consequently can be assumed to be constant over the here contemplated period. Furthermore, the legal system which is very important in this context can be assumed to be stable over time since a legal system is mainly characterized by its colonial origins (Acemoglu, Johnson, Robinson 2001; La Porta, Lopez de Silanes, Shleifer 2007).

Using fixed effects estimation, the compound error term μ_{it} from equation (1) can be divided into two parts ν_i and ε_{it}, where

ν_i – contains the unobserved factors that impact homicide rates and inequality and are constant over time within a specific country, for example geography, legal origins or institutional quality. In equation (1), this so called "fixed effect" was contained in the compound error and consequently caused unwanted correlation between the error term and the regressor. By taking the fixed effect out of the error term, we avoid this correlation.

ε_{it} – contains all the remaining factors that impact homicide rates and vary over time such as GDP, institutions, poverty rates, jurisdiction (especially monopoly of violence), literacy, democratization and political stability.

Then, the regression equation looks as follows:

$$Homicide\ Rate_{it} = \alpha + \beta_1 * Inequality_{it} + \beta_2 * X_{it} + \nu_i + \varepsilon_{it} \quad (3)$$

with X_{it} being the additional control variables.

We can now get rid of the fixed effect by applying the within transformation. This way, some of the very important unobserved-but-fixed omitted variables can be accounted for. Nevertheless there still remain some confounding factors unaccounted for.

5.3. Remaining Unobserved Factors

Now that both the time-fixed unobserved variables as well as the observed confounders (GDP growth, urbanization, and death penalty) are accounted for, there remains only little unobserved variation in the error term. One useful additional control variable would be an indicator of educational attainment in order to capture the effects from education and the overall progress of society. Obtaining reliable data on education for periods as early as the 1950s for LAC is difficult and thus I am not able to include them in my regression. Another variable that I would like to include but am not able to is an indicator of the ethnic composition of the population, since according to the disorganization theory, ethnic heterogeneity is a determinant of high crime rates. Including these control variables could be addressed in further research. Another control variable used by previous studies is poverty; however studies by Baily (1984) and Kennedy et al. (1996) found that indicators of relative deprivation (inequality) are stronger predictors of homicide and violence than indicators of absolute deprivation such as poverty. Once inequality is controlled for, poverty no longer plays a role (Blau and Blau 1982). Hence there is no need to include poverty into my regression.

5.4. Spurious Regression in Panel Data

When working with time series data, spurious regression is a well-known phenomenon and testing for unit roots is common practice. In the field of panel data analysis however, the topic of non-stationarity has long been ignored

and tests for unit roots have only been around for about a decade (Baltagi and Kao 2000). Nevertheless, when working with panel data, it is just as important to take into account the potential problems that can arise from non-stationarity.

Even if the cross-sections display only simple trending mechanisms, spurious regression can be a problem and the probability of finding a nonsense correlation is very high (Noriega and Ventosa-Santaularia 2007). Entorf (1997) already showed that even applying fixed effects estimation to non-stationary panels results in nonsense regression. The phenomenon of spurious regression however only occurs if the non-stationary behavior is present in both dependent and explanatory variables. If only one of the variable groups displays a deterministic or stochastic trend, the spurious regression disappears.

In standard panel data analysis, non-stationarity and spurious regressions are not of concern since they mostly deal with samples that have large N (number of countries) and small T (length of the time series) (Baltagi 2005, p.237). In panels with slightly larger time dimension however, spurious regression can already appear. It has been shown that the presence of deterministic or stochastic trends in the data could lead to spurious regression and give misleading results even for time dimensions as small as T=25 (Noriega and Ventosa-Santaularia 2007). Since my sample contains a large number of time periods (T50) and only a smaller number of countries (N22), it is crucial to check for non-stationarity before applying any econometric regression technique. Previous papers (Neumayer 2005, Fajnzylber et al. 2002a and 2002b) failed to do so.

5.5. Unit Root Tests

In the descriptive analysis of the development of homicide rates and inequality in Section 4 I already mentioned that the series display characteristics of non-stationarity. Consequently it is important to pre-test them for their order of integration to avoid spurious regression. In the panel case, to determine the order of integration is not as straightforward as in the case of time series, since each cross-section might have a different order. Nevertheless there exist several tests that combine the p-values from the augmented Dickey-Fuller tests from each cross-sectional unit. Since my panel is unbalanced, I have to use the Maddala-Wu test, the only test not requiring a strongly balanced panel. The Null hypothesis (H0) of the test is that all the cross-sectional units contain a unit root against the alternative that at least one of them is stationary.

To test if the series are stationary, I proceeded in two steps: In the first step, I used the Akaike-Information-criterion (AIC) to select the optimal lag length for each cross-section. Then I continued to apply the Maddala-Wu test on the panel data, using the entire range of optimal lag lengths determined in step 1.

5.5.1. Homicide Rates

As already suggested in the descriptive part, the plots of the homicide rates of the total sample did not look stationary but rather followed a trend-like behavior (see Figure 9). Now, looking at the restricted sample that includes only the years after 1950, this impression is confirmed.
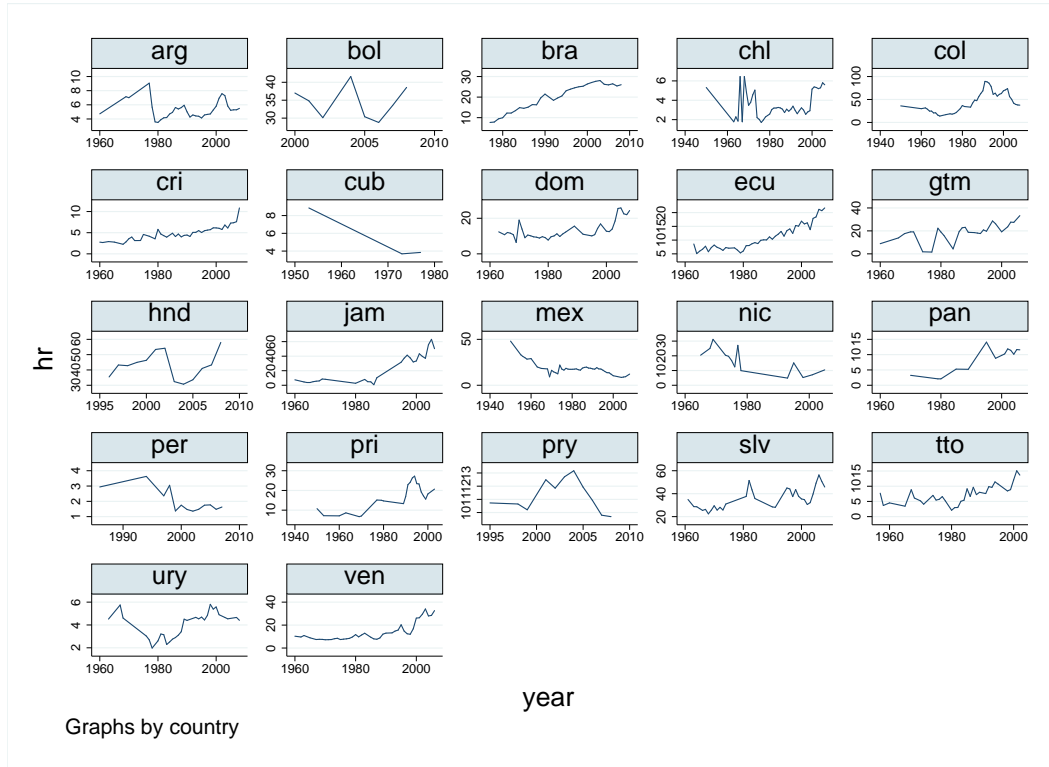
Figure 9: Homicide Rates by Country (1950-2010)

In Argentina, Bolivia and Paraguay, the series seems to have a time independent mean; however, the observations do not fluctuate but rather meander. This indicates the presence of a unit root. In almost all remaining countries, homicide rates follow either a clear upward or downward trend that looks deterministic in some (Ecuador, Brazil, Costa Rica) and stochastic in other cases (Colombia, Guatemala, Honduras, Jamaica). To account for possible non-linearities in the relationship between homicide rates and its determinants and to stabilize the variance of the series, I transformed the homicide rates into log form prior to the testing. The test results of the unit root tests rates are summarized in Table 3.

Variable	Trend?	# of lags	P-Value	Conclusion
$Ln(Homicide\,Rate)$	No	4	0.9995	Cannot reject H_0
$Ln(Homicide\,Rate)$	No	3	0.9651	Cannot reject H_0
$Ln(Homicide\,Rate)$	No	2	0.9862	Cannot reject H_0
$Ln(Homicide\,Rate)$	No	1	0.0000	Reject H_0
$Ln(Homicide\,Rate)$	Yes	4	0.9995	Cannot reject H_0
$Ln(Homicide\,Rate)$	Yes	3	0.0000	Reject H_0
$Ln(Homicide\,Rate)$	Yes	2	0.9619	Cannot reject H_0
$Ln(Homicide\,Rate)$	Yes	1	0.0000	Reject H_0
$\Delta Ln(Homicide\,Rate)$	No	4	0.0003	Reject H_0
$\Delta Ln(Homicide\,Rate)$	No	3	0.0000	Reject H_0
$\Delta Ln(Homicide\,Rate)$	No	2	0.0000	Reject H_0
$\Delta Ln(Homicide\,Rate)$	No	1	0.0000	Reject H_0

Table 3: Unit Root tests for Homicide Rates

Using 4, 3 or 2 lags, I cannot reject the H0 of the presence of a unit root; but when using only one lag, H0 is rejected. However when checking the individual test results, I can see that only in one case (Paraguay), the Null hypothesis was rejected. Therefore it is not reasonable to assume that the homicide rates are stationary across the panel. I continue by including a linear trend into the underlying regressions, since the ocular inspection indicated that there might be some sort of linear trend present in the data. Again, the results are mixed and it is not possible to reject the H0 with certainty. The homicide rates are clearly integrated of some order. In the next step I took the first differences of the series and repeated the unit root tests. For the case of the first differences, I am able to reject the Null hypothesis in all the cases. Consequently it is reasonable to assume that the first differences are stationary. The homicide series is integrated of order 1.

5.5.2. Gini Index

Ocular inspection of the Gini series revealed that they look rather stationary. In order to confirm this impression, I proceeded in the same manner as described for homicide rates. The results are summarized in Table 4.

Variable	Trend?	# of lags	P-Value	Conclusion
$Gini\,Index$	No	4	0.0000	Reject H_0
$Gini\,Index$	No	3	0.6594	Cannot reject H_0
$Gini\,Index$	No	2	0.0670	Reject H_0
$Gini\,Index$	No	1	0.0001	Reject H_0

Table 4: Unit Root tests for Gini Index

In 3 out of 4 cases it is possible to reject the Null hypothesis of non-stationarity of all the cross-sections. Here it is hard to make a conclusion, since the panel-unit-root-tests do not have a clear interpretation. When checking the individual augmented Dickey Fuller-tests for the case of 3 lags, I can see that in most cases, the H0 was rejected. Since in the other cases, the H0 of the Maddala-Wu test was rejected, I assume that the Gini series is stationary, albeit under strong reservations: In some of the cross-sectional units, there is some kind of trending behavior present. I will keep this in mind for the following analysis.[3].

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[3]Since it is possible that both the homicide rates and the Gini index are integrated of order 1, I tested for the presence of cointegration vectors between the two variables. The results (not reported) suggest that there is no cointegration present. Therefore I continued with the standard procedure of panel data analysis.

5.5.3. GDP per capita

Before including GDP per capita into my regression, I have to make sure that it is in its stationary form. In order to test for the order of integration, I applied the same methodology as for homicide rates.

Variable	Trend?	# of lags	P-Value	Conclusion
$GDPpc$	No	4	1.0000	Cannot reject H_0
$GDPpc$	No	3	0.0000	Reject H_0
$GDPpc$	No	2	1.0000	Cannot reject H_0
$GDPpc$	No	1	1.0000	Cannot reject H_0
$GDPpc$	Yes	4	0.0000	Reject H_0
$GDPpc$	Yes	3	0.9998	Cannot reject H_0
$GDPpc$	Yes	2	1.0000	Cannot reject H_0
$GDPpc$	Yes	1	0.9004	Cannot reject H_0
$\Delta GDPpc$	No	4	0.0000	Reject H_0
$\Delta GDPpc$	No	3	0.0129	Reject H_0
$\Delta GDPpc$	No	2	0.0437	Reject H_0
$\Delta GDPpc$	No	1	0.0000	Reject H_0

Table 5: Unit Root tests for GDPpc

The results indicate that the GDP-levels series is clearly non-stationary. Consequently I proceed by including a trend into the underlying regression, but still am unable to reject the H0 with certainty. When repeating the test for the first differences, I can finally reject the Null hypothesis in all the cases and therefore assume that the series is now stationary.

5.5.4. Growth Rate of GDPpc

The next variable I am going to test for stationarity is the growth rate of GDPpc. Again I applied the same methodology and the results are as follows:

Variable	Trend?	# of lags	P-Value	Conclusion
$GDPpc\,Growth\,Rate$	No	4	0.0000	Reject H_0
$GDPpc\,Growth\,Rate$	No	3	0.0221	Reject H_0
$GDPpc\,Growth\,Rate$	No	2	0.0039	Reject H_0
$GDPpc\,Growth\,Rate$	No	1	10.0000	Reject H_0

Table 6: Unit Root tests for GDPpc Growth Rate

I can clearly reject the Null hypothesis at all common significance levels. The growth rate series is stationary.

5.5.5. Urbanization Rate
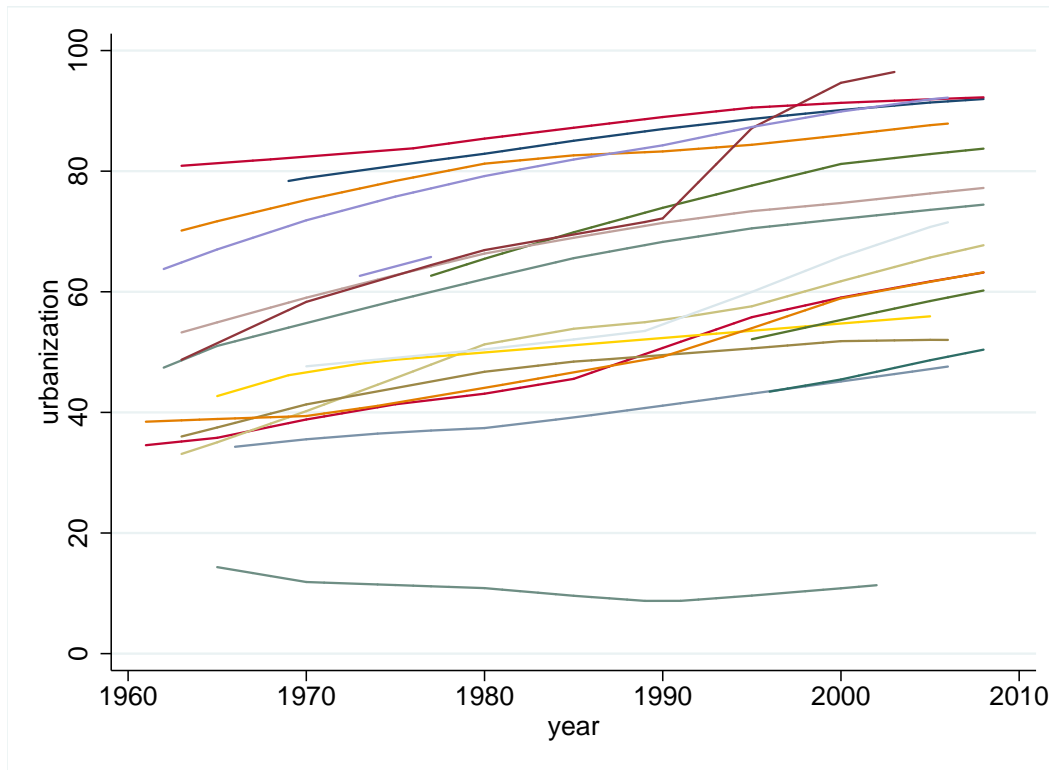
Figure 10: Long-Term Urbanization Rates (1960-2010)

Ocular inspection (see Figure 10) of the urbanization rates indicates that there is probably a common underlying positive trend, since basically all urbanization rates are increasing steadily over time. In the first specification of the Maddala-Wu test without modeling a trend I cannot reject the Null hypothesis in 3 out of 4 cases. When including the trend the result is almost the same. Even when transforming the series into first differences I am still not able to reject the Null hypothesis. The urbanization series is probably integrated of some order higher than 1.

Variable	Trend?	# of lags	P-Value	Conclusion
$Urbanization\ Rate$	No	4	0.8403	Cannot reject H_0
$Urbanization\ Rate$	No	3	0.1699	Cannot reject H_0
$Urbanization\ Rate$	No	2	0.2910	Cannot reject H_0
$Urbanization\ Rate$	No	1	0.0118	Reject H_0
$Urbanization\ Rate$	Yes	4	1.0000	Cannot reject H_0
$Urbanization\ Rate$	Yes	3	0.7239	Cannot reject H_0
$Urbanization\ Rate$	Yes	2	0.99996	Cannot reject H_0
$Urbanization\ Rate$	Yes	1	0.9999	Cannot reject H_0
$\Delta Urbanization\ Rate$	No	4	0.8918	Cannot reject H_0
$\Delta Urbanization\ Rate$	No	3	0.4247	Cannot reject H_0
$\Delta Urbanization\ Rate$	No	2	0.2096	Cannot reject H_0
$\Delta Urbanization\ Rate$	No	1	0.9960	Cannot reject H_0

Table 7: Unit Root tests for Urbanization Rates

6. Results

Since there are non-stationary variables among the independent variables and my dependent variable is integrated of order 1 as well, this leaves me three different valid model specifications:

a) All variables in their stationary form

b) Explanatory variables stationary, dependent variable non-stationary

c) Explanatory variables non-stationary, dependent variable stationary

Any other combination of variables would lead to spurious results. In options a) and b), I could only include the growth rate of GDP as control variables, since the other variables are not stationary and/or cannot be transformed easily into a stationary form. Since it allows me to include the maximum number of control variables, specification c) is the most appropriate one. In the following I will present and discuss the results of all three models.

6.1. Model a)

The first specification I will use to estimate the relationship between inequality and homicide rates employs all the variables in their stationary form. Since GDP per capita is not stationary, it is not possible to include the level of GDP but only the changes. However, the changes contain information that is very similar to the growth rate of GDP. To avoid multicollinearity, I include only the growth rate of GDP as control variable. It expresses the relative instead of the absolute changes. Urbanization rates cannot be included either, since the series is integrated of some order higher than 1 and the coefficient of the changes of the changes of the urbanization rate would not have any meaningful interpretation; therefore I decided not to include them into the regression.

The results of the regression are displayed in Table 8.[4]

In column (1), I estimated a simple OLS model without any further controls. Here, the coefficient of the Gini index is positive, indicating that higher inequality is generally associated with higher increases in homicide rates. The effect is however very small in magnitude and not significant. When controlling for the growth rate of GDP, the significance and sign of the index do not change. The coefficient of the growth rate of GDP is positive, indicating that in fast growing economies the homicide rate is expected to grow more than in others. However this effect is not significant either.

As discussed above, the results of a simple OLS regression are probably biased, since the unobserved but time-fixed variation is unaccounted for. Therefore I apply fixed effects estimation to avoid this bias (columns (3) and (4)), but in the result all the variables remain insignificant and the signs do not change.

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[4]The number of observations has been reduced due to first differencing and because the additional control variables are not available for all the observations previously contained in the sample.

	(1)	(2)	(3)	(4)
VARIABLES		$\Delta Ln(Homicide\ Rate)$		
Methodology	**OLS**	**OLS**	**FE**	**FE**
Gini Index	0.00123	0.00118	0.00171	0.00168
	(0.00209)	(0.00210)	(0.00286)	(0.00287)
GDPpc Growth Rate		0.132		0.150
		(0.278)		(0.288)
Constant	-0.0451	-0.0448	-0.0687	-0.0696
	(0.103)	(0.103)	(0.141)	(0.141)
Observations	496	496	496	496
R-squared	0.001	0.001	0.001	0.001
# of countries			21	21

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8: Results Model a)

These first results indicate that there is no direct causality running from inequality measured with the Gini index to homicide rates. The results are in contrast to the findings of Fajnzylber et al. (2002a, b), which is not surprising since the sample used by them was very restricted, they fail to control for omitted but time-fixed effects and did not check their data for non-stationary behavior. Using the other two remaining model specifications, I will now check the robustness of my results.

6.2. Model b)

In the second specification, I will use the dependent variable in its non-stationary level form and the explanatory variables in stationary form. As before, I can only include the Gini coefficient and the growth rate of GDP as (stationary) explanatory variables. Using standard OLS estimation (Table 9, column (1)), the coefficient of inequality presents very high significance and magnitude as well as the "correct" sign. As the Gini index increases by 1 unit, homicide rates are expected to increase by 4 percent. When controlling for the growth rate of GDPpc, the results do not change. This effect can however not be interpreted as causal but is obviously overestimated due to the omitted variable bias discussed above. When accounting for the unobserved but time-fixed variation between countries by using fixed effects regression (column (3)), the coefficient is still significant and positive but considerably diminished in magnitude. A 1 unit increase in the Gini index now leads to an expected increase in homicide rates by 1.8 percent ceteris paribus. This effect is larger than the effect found by Fajnzylber et al. (2002, p. 16, column (1)) of 0.0069. The large magnitude is probably due to the lack of additional control variables. Consequently, the effect of the omitted variables is still attributed to the Gini coefficient. However, when including growth rate of GDP as control variable in column (3), the coefficient of the Gini index unexpectedly increases. This would indicate the presence of a negative omitted variable bias and is implausible.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
			$Ln(Homicide\,Rate)$			
Methodology	**OLS**	**OLS**	**FE**	**FE**	**GMM**	**GMM**
$Gini\,Index$	0.0404***	0.0415***	0.0181***	0.0189***	0.00308	0.00300
	(0.00610)	(0.00730)	(0.00423)	(0.00477)	(0.00272)	(0.00273)
$GDPpc\,Growth\,Rate$		-1.535		-0.784		0.138
		(0.970)		(0.479)		(0.338)
$L.Ln(Homicide\,Rate)$					0.938***	0.939***
					(0.0174)	(0.0174)
Constant	0.401	0.397	1.493***	1.494***	0.0115	0.0122
	(0.300)	(0.360)	(0.208)	(0.235)	(0.131)	(0.131)
Observations	619	496	619	496	496	496
R-squared	0.066	0.065	0.030	0.037		
# of countries			21	21	21	21

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Results Model b)

The evidence obtained when using model specification b) suggests that there is a positive correlation between the extent of income inequality and the incidence of homicides. However, these results have to be viewed with caution. When testing for unit roots, it was not possible to assure that the Gini series is stationary. Consequently, when using the non-stationary form of homicide rates and the (potentially) non-stationary Gini series, the results might be driven by spurious regression.

One possibility of testing if the results are driven by the presence of trends in both inequality and crime, is to account for the inertial properties of crime by including a lagged dependent variable in a dynamic panel regression. Neumayer (2005) shows that the incidence of crime presents high persistence. Criminals might base their decision on current year's behavior on information from the past years. The resulting model including the lagged homicide rate as an explanatory variable has to be estimated with the systems generalized method of moments (GMM) estimator developed by Arellano and Bond (1991). The GMM estimator deals with the potential endogeneity of the lagged dependent variable.

When including the lagged value of homicide rates, the coefficient of the Gini index shrinks dramatically in magnitude and loses significance, indicating that once controlling for the inertia properties of crime, inequality does not longer contribute explanatory power to the model. This result does not change when including the GDP growth as control variable. The only significant variable is the lagged homicide rate, indicating that crime in Latin America is very persistent: The crime rate of the past period is a very good predictor future crime incidence. Once controlling for this trend-like behavior, there is no longer any relation between crime and inequality.

This result indicates that the significance of the inequality indicator in column (1) to (3) is probably driven by the commonality of stochastic or deterministic trends in both the Gini index and the homicide series. I conclude that there is no robust correlation between inequality and homicide rates. The evidence obtained with model specification b) is in line with the ones from a).

6.3. Model c)

The third model specification is the most feasible one because it features one main advantage over the previous models: By using the (stationary) first differences of homicide rates, I am able to include all the additional (non-stationary) control variables, accounting for most of the unobserved variation. As the homicide rates are used in their stationary form, the possible presence of any deterministic or stochastic trends in the explanatory variables does not lead to spurious results.

VARIABLES	(1)	(2)	(3)
	$\Delta Ln(Homicide\ Rate)$		
Methodology	**OLS**	**OLS**	**OLS**
$Gini\ Index$	0.00123		0.00143
	(0.00209)		(0.00237)
$GDPpc$			1.15e-05
			(2.26e-05)
$(GDPpc)^2$			-4.34e-10
			(1.58e-09)
$GDPpc\ Growth\ Rate$			0.207
			(0.306)
$Abolition\ Dummy$			0.00336
			(0.0387)
$Urbanization\ Rate$			-0.000618
			(0.000815)
$\Delta Gini\ Index$		-0.00155	
		(0.00246)	
Constant	-0.0451	0.0152	-0.0667
	(0.103)	(0.0115)	(0.136)
Observations	496	496	433
R-squared	0.001	0.001	0.005

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Results Model c), Part I

In column (1) of Table 10, the changes of homicide rates have been regressed on the Gini index using simple OLS. As expected, the coefficient of inequality is not significant, indicating no correlation of inequality and the growth rate of homicide rates. Now one might think that the level of inequality does not an impact on the change of crime, but that an increase in inequality should lead to an increase in crime. Therefore repeat the OLS regression using the change of the Gini index as explanatory variable in column (2). Still, the coefficient remains insignificant and even displays the "wrong" sign. In a third attempt I include now all of the potential confounders, this way accounting for omitted variable bias, but the relationship between inequality and crime does not become significant (column (3)). Surprisingly, none of the variables displays significance. When using the stationary form of homicide rates, none of the variables that are supposed to determine crime rates is correlated with crime.

Again, the OLS results might be biased due to the unaccounted variation of the time-invariant country characteristics. Therefore I repeat the analysis applying fixed effects estimation.

VARIABLES	(1)	(2)	(3)	(4)	(5)
		$\Delta Ln(Homicide\ Rate)$			$Ln(Homicide\ Rate)$
Methodology	**FE**	**FE**	**FE**	**FE**	**FE**
Gini Index	0.00171	0.000908	0.000356	0.000322	-0.00332
	(0.00286)	(0.00290)	(0.00349)	(0.00347)	(0.00468)
GDPpc		4.43e-05	6.85e-05	6.86e-05	0.000135*
		(3.48e-05)	(5.20e-05)	(5.19e-05)	(6.98e-05)
$(GDPpc)^2$		-1.90e-09	-3.41e-09	-3.45e-09	-1.03e-08**
		(2.21e-09)	(2.98e-09)	(2.97e-09)	(4.01e-09)
GDPpc Growth Rate			0.156	0.156	-0.613
			(0.322)	(0.321)	(0.432)
Urbanization Rate			-0.00231	-0.00236	0.0287***
			(0.00291)	(0.00287)	(0.00391)
Abolition Dummy			-0.00603		0.497***
			(0.0573)		(0.0769)
Constant	-0.0687	-0.202	-0.104	-0.104	0.0119
	(0.141)	(0.169)	(0.193)	(0.193)	(0.259)
Observations	496	496	433	433	433
R-squared	0.001	0.008	0.006	0.006	0.364
# of countries	21	21	18	18	18

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Results Model c), Part II

As evident from column (1) Table 11, the results do not change. Even when including different groups of control variables (columns (2) to (4)), none of the explanatory variables shows a significant correlation with the stationary form of homicide rates. I repeated the regression analysis replacing the Gini levels by the first differences, but the results were the same (not reported).

Once more I conclude that there is no impact from inequality on crime rates. The fact that the additional control variables are not significant either is however quite surprising. Basically all previous studies (for example Fajnzylber (2002a and 2002b) and Neumayer (2005)) did find significant relationships between homicide rates and the additional control variables. Since many of the additional control variables are not stationary either, I suspect that their significant results are likewise driven by spurious regression.

For illustrative purposes, I estimated the same fixed effects model as specified in column (3) but using the levels of the homicide rates as dependent variable, reproducing the regressions conducted by Neumayer (2005). In this model specification both the dependent and independent variables are potentially integrated, which might lead to spurious regression. And indeed, in this regression almost all the additional control variables are significant! Also the signs are consistent with theory: Just as suggested by Shelley's adaption of the modernization theory (1981), initially an increasing GDP is related to an upswing in homicide rates. However after reaching a certain threshold, the correlation turns negative, as indicated by the negative sign of $(GDPpc)^2$. For example, Argentina reaches this threshold in the 1960s, Brazil in the 1980s. Higher urbanization is significantly associated with higher crime rates, giving support to the theory of social disorganization. As expected, the abolition of the death penalty is related to an increase in crime as well, just as predicted by the economic theory of crime. The only control variable not significant in this specification is the growth rate of GDPpc.

None of the significant effects can be interpreted as causal since they are clearly driven by the commonality of

stochastic or deterministic trends in the dependent and explanatory variables. All the variables employed display some kind of increasing time trend, which might be mistaken as correlation by the model. The coefficient of the Gini index however is not significant, indicating that once controlling for confounding factors, the significance that was still present in Table b), column (2) and (3) vanishes. This result is exactly the same as obtained by Neumayer (2005) for his sample including countries from all over the world but less time periods.

The three models estimated in this section suggest that there is no causality running from inequality to crime incidence. I could also show that it is possible to reproduce the results of Neumayer (2005) with my sample when using the model specification that yields potentially spurious results. When using a model specification that eliminates the possibility of spurious regression however, the coefficient of inequality is never significant. To assess the robustness of this finding I will now proceed to estimate the model in the preferred specification (Table 11, column (4)) for several subsets of the sample.

6.4. Robustness Checks

In Latin American history, we can distinguish three periods that are each characterized by a particular economic strategy. From 1950 until 1975, most countries adopted an Import Substitution-strategy with mixed results. From 1975 until 1990, as military juntas and dictators led the region, economic growth slowed down and macroeconomic problems such as high debt severely affected the region during the "lost decade of the 1980s. Afterwards, from 1990 until 2010, most countries were able to introduce a stable democratic system and adopted a more market-oriented economic strategy, resulting in sustained economic growth. Since the three periods are characterized by completely different economic and political conditions, it is possible that the link between inequality and crime is not constant over the period examined (1950-2010) but changes over time. Maybe the link holds only in one of the periods and is distorted by the macroeconomic and political conditions in the others, for example by the violent rule of a military regime. Estimating the model for the entire period from 1950 from 2010 might therefore not reveal the true link between the two phenomena. To allow for a changing relationship between inequality and crime over time, I estimate the model separately for each period. I use the same fixed-effect model in the preferred specification as in column (4) of Table 11.

	(1)	(2)	(3)
VARIABLES		$\Delta Ln(Homicide\ Rate)$	
Methodology	**FE**	**FE**	**FE**
$Gini\ Index$	-0.00826	0.00774	0.000206
	(0.0133)	(0.0134)	(0.00308)
$GDPpc$	0.000432	0.000167	7.84e-05
	(0.000507)	(0.000240)	(5.63e-05)
$(GDPpc)^2$	-1.05e-08	-8.05e-09	-3.38e-09
	(2.97e-08)	(1.31e-08)	(2.86e-09)
$GDPpc\ Growth\ Rate$	0.678	0.576	-0.760***
	(1.936)	(0.735)	(0.280)
$Urbanization\ Rate$	-0.0541	0.00541	-0.00625
	(0.0461)	(0.0174)	(0.00485)
Constant	1.594	-1.330	0.127
	(1.689)	(1.266)	(0.342)
Time Period	**1950-1975**	**1975-1990**	**1990-2010**
Observations	72	132	211
R-squared	0.044	0.020	0.048
# of countries	14	16	17

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12: Results Robustness Checks I

The results of these robustness checks (see Table 12) are in line with my previous findings. Even when allowing for a different relationship between inequality and crime in each period, the coefficient of the inequality indicator is never significant. Interestingly, in the last period, the negative coefficient of the growth rate of GDP is significant, supporting the claims of the "civilizing process" theory: the fast growing economy offers new earning opportunities for many individuals and hence less people engage in criminal activity.

Lastly, it is also a possibility that the relationship between inequality and crime is not the same in all the countries. The region of LAC includes very heterogeneous countries that apart from their geographical and political disparities also experienced diverse trends of homicide rates and inequality. By dividing the LAC region into two sub-regions, I allow the relationship between inequality and crime to differ between the two. Column (1) of Table 13 estimates the preferred model specification including only South American countries, whereas column (2) repeats the analysis for Central America and the Caribbean.

	(1)	(2)
VARIABLES	$\Delta Ln(Homicide\ Rate)$	
Methodology	**FE**	**FE**
$Gini\ Index$	0.00207	-0.00305
	(0.00387)	(0.00628)
$\Delta GDPpc$	9.58e-06	8.63e-05
	(6.54e-05)	(8.95e-05)
$(GDPpc)^2$	1.86e-10	-5.06e-09
	(3.81e-09)	(4.54e-09)
$GDPpc\ Growth\ Rate$	-0.352	1.416**
	(0.318)	(0.707)
$Urbanization\ Rate$	-0.000541	-0.00121
	(0.00369)	(0.00591)
Constant	-0.118	-0.0450
	(0.237)	(0.321)
Region	**SOUTH**	**CENTRAL+ CARIBBEAN**
Observations	230	203
R-squared	0.011	0.032
#of countries	8	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: Results Robustness Checks II

Not surprisingly, the results are the same as above. Again, the Gini index is insignificant in both sub-regions, supporting the previous conclusion that there is no causality running from inequality to crime. For Central America and the Caribbean, the growth rate of GDP is significant but this time positive. This evidence favors the modernization theory that predicts that in fast changing society, individuals might react violently to the new challenges.

All the analysis conducted so far clearly suggests that there is no causal link present between inequality and crime. One advantage of having panel data at hand is that I can apply various methods of testing for causality between inequality and homicide rates. After applying standard panel data analysis above I will now move towards a method that has been developed in the context of time series - Granger-causality testing - to check if my previous results are confirmed by this alternative methodology.

7. Granger-Causality Tests

In the field of time series, the notion of causality is that the cause has to happen before the consequence. This concept of causality is also called Granger-causality: A variable X is said to Granger-cause Y if we are able to predict Y better when using the past history of X, even given the past of Y. The standard procedure to test for Granger-causality in time series is to estimate a VAR model of the form

$$Homicide\,Rate_t = \sum_{k=1}^{p}(\beta_k * Homicide\,Rate_{t-k}) + \sum_{k=0}^{p}(\theta_k * Inequality_{t-k}) + \varepsilon_t$$

and then test for the joint significance of the θ_k.

In a panel data context however, it is important to pay attention to cross-sectional heterogeneity. The first kind of heterogeneity is given by the permanent cross-sectional disparities. These can be accounted for by allowing for country-specific intercepts as for example in fixed effects estimation (Erdil and Yetkiner 2009). Secondly and more importantly, one should also allow for heterogeneous regression coefficients θ_k. To take into account both sources of heterogeneity, I decided to perform Granger-causality tests for each cross-section separately, obtaining the corresponding p-values. As a consequence, 7 countries had to be dropped from the sample due to an insufficient number of observations for a regression including lagged values.

Another issue in my data is the non-stationarity. Since at least one of the variables is known to be integrated of some order and there is no cointegrating vector between them, the standard asymptotic theory is not applicable and I have to apply the alternative procedure proposed by Toda and Yamamoto (1995): a lag augmented VAR in levels. Here is how I proceeded: Using the Phillips-Perron test, I determined the maximum order of integration d_{max} of the Gini index and homicide rate series for each cross-section. d_{max} is equal to 0 or 1 in all the cross sections. Secondly, according to the AIC, I decided on the optimum lag length q of the underlying VAR, again for each cross-section. Then I added d_{max} additional lags to the optimum length, estimated the VAR($q+d_{max}$) and finally tested the joint significance of the first q lags, all these steps for each cross-section separately. The additional d_{max} lags are not included in the significance test; it is only needed to fix up the asymptotics. The test has the Null hypothesis that the Gini index does not Granger cause homicide rates. The resulting test statistic follows a standard asymptotic chi-square distribution. The corresponding p-values are reported in Table 14.

Country	# of lags ($q+d_{max}$)	p-value	Conclusion
Argentina	3	0.6440	Cannot reject H_0
Brazil	2	0.8399	Cannot reject H_0
Chile	5	0.3264	Cannot reject H_0
Colombia	3	0.6566	Cannot reject H_0
Costa Rica	2	0.1376	Cannot reject H_0
Dominican Republic	2	0.2034	Cannot reject H_0
Ecuador	4	0.1168	Cannot reject H_0
Jamaica	2	0.8434	Cannot reject H_0
Mexico	3	0.1198	Cannot reject H_0
Puerto Rico	2	0.7397	Cannot reject H_0
El Salvador	2	0.4794	Cannot reject H_0
Trinidad and Tobago	2	0.0012	Reject H_0@ 5%
Uruguay	3	0.6051	Cannot reject H_0
Venezuela	2	0.5539	Cannot reject H_0

Table 14: Granger-Causality Tests

Only in the case of Trinidad and Tobago is it possible to reject the Null hypothesis of Granger-non-causality. For all the other countries there is no evidence for Granger-causality from inequality to homicide rates. To obtain one single result for the entire panel, I followed a meta-analysis approach suggested by Emirmahmutoglu and Kose (2010). By combining the p-values according to the formula proposed by Fisher (1932), this approach allows to merge the results from independent but identical Granger-causality tests into one single test statistic:

$$\lambda = -2 * \sum_{i=}^{N} ln(p_i) = 38.1048$$

p_i - p-value corresponding to the Wald statistic obtained from Granger-causality test for the ith country

N - number of cross-sections (countries) remaining in the sample (=14)

This combined test statistic λ follows a chi-square distribution with 2N degrees of freedom. The value of the test statistic is equal to 38.1048. The critical value of a chi-square distribution with 28 degrees of freedom and an alpha of 0.05 is 41.337. Since the test statistic does not fall into the rejection area, the panel Granger-causality test fails to reject the H0 that the Gini index does not Granger-cause homicide rates. The conclusion that inequality does not Granger-cause crime rates supports my previous findings.

8. Conclusions

In this thesis I have applied panel data estimation techniques as well as Granger-causality tests on an unbalanced panel of Latin American countries to check for causality running from inequality to homicide rates. The major difference to previous studies, apart from a larger sample, is that I pre-tested my variables for potential non-stationarity. Since unit roots are present in the data, estimating a model in levels as performed by other researchers (Neumayer 2005, FLL. 2002a and 2002b) is likely to result in spurious regression. Using models that avoid the possibility of spurious regression, I cannot find any significant correlation between inequality and crime rates. The additional control variables included, GDP per capita, growth rate of GDP per capita, urbanization rate and a dummy variable indicating the abolition of the death penalty, are not significant either. Also the tests for Granger-causality lead me to the conclusion that there is no Granger-causality running from inequality to crime. Additionally, the analysis showed that crime incidence has strong inertia properties such as high persistence. In a dynamic panel regression, the lagged value of homicide rates has very high significance. This high persistence property of crime calls for early intervention to prevent long lasting crime waves.

My primary result that there is no significant impact from inequality on crime is in line with the findings of Neumayer (2005) - even though I used a different methodology - and in sharp contrast to previous studies that did find a significant impact from inequality on crime such as FLL 2002a and 2002b. Since these studies did not take into account the probability of spurious regression, the significance of their results is probably driven by the commonality of stochastic and/or deterministic trends in both the inequality and the crime indicator. Also the fact that I cannot find significant correlation between the additional control variables and the homicide rates whereas Neumayer (2005) did might be explained by the presence of spurious regression in Neumayer's analysis.

The finding that there is no significant impact from inequality on crime detectable can lead to different conclusions. The first and obvious conclusion would be that there is indeed no impact from inequality on crime and that the underlying theories predicting a positive link are simply mistaken. Individuals suffering from strain might not be

driven towards criminal behavior, income heterogeneity might not favor the process of social disorganization and/or the income differential between social classes might not determine the net return from criminal activity.

A second and maybe more plausible conclusion is that the Gini index, as suggested by Messner and Rosenfeld (1997), fails to capture the complex social concepts of strain and social disorganization. Likewise, the index might not be a good proxy for the expected net return from crime. Therefore, using the Gini index as the only indicator of inequality it is impossible to find a significant impact on crime. In future analysis, it would be reasonable to use broader indicators of inequality and the expected benefits of crime to reassess the relationship between inequality and crime.

However, if we believe that the Gini index is a suitable proxy for inequality, then there is also a third conclusion possible: There is a causal link form inequality to crime, however not in Latin America. Due to the particular characteristics such as colonial history, a culture of masculinity as well as extraordinarily high inequality, LAC might be a special case. What is true for Europe or Africa might not hold here. As other studies employed samples including countries from all over the world whereas I focused on LAC, the results might not be comparable. To get reliable results on the relation of inequality and crime in the entire world, it is necessary to apply a methodology that takes into account the possibility of non-stationarity on an all-encompassing sample. Given these points, I stick with the third conclusion and for now assume that inequality is not a major determinant of crime in LAC, and neither are any of the other variables that have been included in my analysis: GDP levels, economic growth or urbanization. I found some weak evidence that economic growth might be related to homicide rates, however neither sign nor significance are consistent across different model specifications.

The finding that neither economic development nor decreasing inequality have a significant impact on crime rates is bad news, since it implies that in Latin America, crime rates will not automatically decrease over time as it has happened in Europe and North America (Pinker 2011), even if the countries keep experiencing economic growth. It also implies that the quest for the true determinants of crime in LAC is far from over. To understand and lower crime rates in Latin America, we have to find new theories and new approaches, since the theories developed so far cannot explain what we observe. Maybe factors that are more difficult to measures such as a culture of masculinity, the presence of drug gangs as well as the availability of firearms and the use of alcohol are able to explain the variation of crime rates across Latin America. To find measures or proxies of these factors and analyze their relationship to homicide rates is an interesting task for future research.

9. References

[1] Acemoglu, D., and J. A. Robinson (2008), Persistence of power, elites, and institutions, *The American Economic Review (Evanston)*.

[2] Acemoğlu, D., S. Johnson, and J. A. Robinson (2001), The colonial origins of comparative development: An empirical investigation, *The American economic review*, *91*(5), 1369–1401.

[3] Agnew, R. (2001), Building on the foundation of general strain theory: specifying the types of strain most likely to lead to crime and delinquency, *Journal of Research in Crime and Delinquency*, *38*(4), 319–361.

[4] Agnew, R., and H. White (1992), An empirical test of general strain theory, *Criminology*, *30*(4), 475–500.

[5] Anderson, D. A. (1999), The aggregate burden of crime, *The journal of law & economics*, *42*(2), 611–642.

[6] Arellano, M., and S. R. Bond (1991), Some tests of specification for panel data: Monte carlo evidence and an application to employment equations, *The review of economic studies*, (194, S. 277-297).

[7] Baer, W. (1972), Import substitution and industrialization in latin america: experiences and interpretations, *Latin American Research Review*, *7*(1), 95–122.

[8] Baily, W. (1984), Poverty, inequality, and city homicide rates: Some not so unexpected findings, *Criminology*, *22*(22), 531–550.

[9] Baltagi, B. H. (2005), *Econometric analysis of panel data*, 3 ed., Wiley, Chichester.

[10] Becker, G. S. (1968), Crime and punishment: An economic approach, *The journal of political economy*, *76*(2), 169–217.

[11] Bennett, W. J., J. J. DiIulio, and J. P. Walters (1996), *Body count: Moral poverty– and how to win America's war against crime and drugs*, Simon & Schuster, New York.

[12] Birdsall, N., N. Lustig, and D. McLeod (2011), Declining inequality in latin america: some economics, some politics, *Center for Global Development - Working Paper 251*.

[13] Blau, J., and P. blau (1982), The cost of inequality: metropolitan structure and violent crime, *American Sociological Review*, *47*(1), 114–129.

[14] Bonger, W. A. (1916), *Criminality and economic conditions: Translated by Henry P. Horton, with an editorial pref. by Edward Lindsey, and with an introd. by Frank H. Norcross*, The Modern criminal science series, Little, Brown, Boston.

[15] Bourguignon, F. (1999), Crime as a social cost of poverty and inequality: A review focusing on developing countries, *Desarrollo y sociedad*.

[16] Brand, S., and R. Price (2000), *The economic and social costs of crime*, *Home Office research study*, vol. 217, Economics and Resource Analysis, Research, Development and Statistics Directorate, Home Office, London.

[17] Briceño-León, R., A. Villaveces, and A. Concha-Eastman (2008), Understanding the uneven distribution of the incidence of homicide in latin america, *International Journey of Epidemiology*, (37), 751–757.

[18] Center for International Human Rights (2012), Death penalty worldwide database, *Northwestern University of Law*.

[19] Chiricos, T. (1987), Rates of crime and unemployment: an analysis of aggregate research evidence, *Social Problems*, *34*(2), 189–212.

[20] Chiu, W. H., and P. J. Madden (), Burglary and income inequality, *Journal of public economics*, *69*(1, S. 123-141).

[21] Clinard, M. B., and D. J. Abbott (1973), *Crime in developing countries: A comparative perspective*, A Wiley-interscience publication, Wiley, New York and NY.

[22] Cook, P., S. Machin, O. Marie, and G. Mastrobuoni (2013), Crime economics in its fifth decade, in *Lessons from the economics of crime*, edited by P. J. Cook, S. Machin, O. Marie, and G. Mastrobuoni, CESifo seminar series, pp. 1–17, The MIT Press, Cambridge and Massachusetts.

[23] Cook, P. J., and J. H. Laub (), The unprecedented epidemic in youth violence, *Crime and Justice*, *1998*(24), 27–64.

[24] Cook, P. J., and J. H. Laub (2001), *After the epidemic: Recent trends in youth violence in the United States*, *NBER working paper series*, vol. 8571, National bureau of economic research, Cambridge [US].

[25] Cook, P. J., S. Machin, O. Marie, and G. Mastrobuoni (Eds.) (2013), *Lessons from the economics of crime: What reduces offending?*, CESifo seminar series, The MIT Press, Cambridge and Massachusetts.

[26] Coser, L. A. (1968), *Conflict: Social aspects*, reprint from the international encyclopedia of the social sciences ed., Collier and Macmillan, New York.

[27] Demombynes, G., and B. Özler (2002), *Crime and local inequality in South Africa*, *Policy research working paper*, vol. 2925, Poverty Team, Development Research Group, World Bank, Washington and D.C.

[28] Detotto, C., and E. Otranto (2010), Does crime affect economic growth?, *Kyklos : international review for social sciences*, *63*(3), 330–345.

[29] Dezhbakhsh, H., P. H. Rubin, and J. M. Shepherd (), Does capital punishment have a deterrent effect? new evidence from postmoratorium panel data, *American Law and Economics Review*, (5), 398–426.

[30] Ehrlich, I. (1973), *Participation in illegitimate activities: An economic analysis*.

[31] Eide, E., P. H. Rubin, and J. M. Shepherd (2006), *Economics of crime*, *Foundations and trends in microeconomics*, vol. v. 2, issue 3, 2006, Now Publishers, Boston.

[32] Eisner, M. (2001), Modernization, self-control and lethal violence. the long-term dynamics of european homicide rates, *British Journal of Criminology*, *41*(4), 618–628.

[33] El Universal (), Asesinato de mónica spear conmociona en las redes sociales: 07/01/2014.

[34] Emirmahmutoglu, F., and N. Kose (2010), Testing for granger causality in heterogeneous mixed panels, *Economic modelling*, *28*(3), 870–876.

[35] Entorf, H. (1997), Random walks with drift: nonsense regression and spurious fixed-effect estimation, *Journal of Econometrics*, *80*, 287–296.

[36] Erdil, E., and I. H. Yetkiner (2009), A panel data approach for income-health causality: Paper provided by research unit sustainability and global change, hamburg university, *Working Papers FNU-47*.

[37] Fajnzylber, P., D. Lederman, and N. Loayza (1998), *Determinants of crime rates in Latin America and the world: An empirical assessment*, World Bank Latin American and Caribbean studies. Viewpoints, World Bank, Washington and D.C.

[38] Fajnzylber, P., D. Lederman, and N. Loayza (2002a), Inequality and violent crime, *The journal of law & economics*, *45*(1), 1–40.

[39] Fajnzylber, P., D. Lederman, and N. Loayza (2002b), What causes violent crime?, *European economic review : EER*, *46*(7), 1323–1357.

[40] Ferranti, D. M. d. (2004), *Inequality in Latin America: Breaking with history?*, World Bank Latin American and Caribbean studies, The World Bank, Washington and DC.

[41] Fisher, R. A. (1932), *Statistical methods for research workers*, *Biological monographs and manuals*, vol. 5, 4 ed., Oliver & Boyd, Edinburgh.

[42] Freeman, R. B. (1999), The economics of crime, *Handbook of labor economics*, *3C (1999)*, 3529–3571.

[43] Gasparini, L., and N. Lustig (2011), The rise and fall of income inequality in latin america, *ECINEQ - Society for the Study of Economic Inequality - Working Paper Series*, *ECINEQ 2011 - 213*.

[44] Gaviria Trujillo, A., and C. Pagés (1999), *Patterns of crime victimization in Latin America*, *Working paper*, vol. 408, Inter-American Development Bank, Research Dept., Washington and D.C.

[45] Hojman, D. (2004), Inequality, unemployment and crime in latin american cities, *Crime, Law & Social Change*, (41), 33–51.

[46] Hsieh, C.-C., and M. D. Pugh (1993), Poverty, income inequality, and violent crime: a meta-analysis of recent aggregate data studies, *Criminal Justice Review*, *18*(2), 182–202.

[47] INEGI, I. N. d. E. y. G. M. (2013), Base de datos sobre causas de mortalidad.

[48] Kelly, M. (2000), Inequality and crime, *The review of economics and statistics*, *82*(4), 530–539.

[49] Kennedy, D. M., A. M. Piehl, and A. Braga (1996), *Youth gun violence in Boston: Gun markets, serious youth offenders, and a use reduction strategy*, Program in Criminal Justice Policy and Management, John F. Kennedy School of Government, Harvard University, [Cambridge and Mass.

[50] Krahn, H., T. Hartnagel, and J. Gartrell (1986), Income inequality and homicide rates: cross-national data and criminological theories, *Criminology*, *24*(2), 269–294.

[51] Kuznets, S. (1955), Economic growth and income inequality, *The American economic review*, *45*(1), 1–28.

[52] La Londoño de Cuesta, J. L., and R. Guerrero (1999), *Violencia en América Latina: Epidemiología y costos*, *Documento de trabajo*, vol. 375, Banco Interamericano de Desarrollo, Oficina del Economista Jefe, Washington and D.C.

[53] La Porta, R., F. Lopez-de Silanes, and A. Shleifer (2007), *The economic consequences of legal origins*, *NBER working paper series*, vol. 13608, National bureau of economic research, Cambridge and Mass.

[54] LaFree, G. (1999), A summary and review of cross-national comparative studies of homicide, in *Homicide*, edited by M. D. Smith and M. A. Zahn, pp. 125–145, Sage Publications, Thousand Oaks and Calif.

[55] LaFree, G. (1999), Homicide: Cross-national perspectives, *Homicide: A sourcebook of social research*, pp. 125–145.

[56] Lehti, M. (2013), Nrilp comparative homicide time series.

[57] Lewis, P. (2006), *Authoritarian Regimes in Latin America: Dictators, Despots and Tyrants*, Rowman & Littlefield Publishers, INC., Oxford.

[58] López-Calva, L. F., and N. Lustig (2010), *Declining inequality in Latin America: A decade of progress?*, Brookings Institution Press, Baltimore.

[59] Machin, S., and C. Meghir (2000), *Crime and economic incentives*, *Working paper series / Institute for Fiscal Studies*, vol. no. W00/17, Institute for Fiscal Studies, London.

[60] Marsh, I., and G. Melville (2006), *Theories of crime*, Routledge, London.

[61] McDonald, L. (1976), *The sociology of law and order*, Faber and Faber, London.

[62] Merton, r. (1938), Social structure and anomie, *American Sociological Review*, (3), 672–682.

[63] Merton, R. K. (1968), *Social theory and social structure*, 1968 ed., Free Press, New York.

[64] Messner, S. F., and R. Rosenfeld (1997), *Crime and the American dream*, Contemporary issues in crime and justice series, 2 ed., Wadsworth, Belmont CA u.a.

[65] Mo, C. (2014), Venezuelan ex-beauty queen mónica spear murdered: 08/01/2014.

[66] Morenoff, J., R. Sampson, and S. Raudenbush (2001), Neighborhood inequality, collective efficacy, and the spatial dynamics of urban violence, *Criminology*, *39*(3), 517–559.

[67] Neapolitan, J. L. (1994), *Cross-national variation in homicides: The case of Latin America*, [s.n.], [S.l.].

[68] Neapolitan, J. L. (1997), *Cross-national crime: A research review and sourcebook*, Greenwood Press, Westport and Conn.

[69] Neumayer, E. (2005), Is inequality really a major cause of violent crime? evidence from a cross-national panel of robbery and violent theft rates, *Journal of Peace Research*, *42*(1), 101–112.

[70] Nivette, A. (2011), Cross-national predictors of crime: a meta-analysis, *Homicides Studies*, *15*(2), 103–131.

[71] Noriega-Muro, A. E., and D. Ventosa-Santaulària (2007), Spurious regression and trending variables, *Oxford bulletin of economics and statistics*, *69*(3), 439–444.

[72] OECD (2011), *How's life? Measuring progress and well-being*, OECD better liver initiative, Organisation for Economic Co-operation and Development, Paris.

[73] Pare, P.-P. (2006), *Income inequality and crime across nations reexamined*.

[74] Phillips, P. C. B., and H. R. Moon (2000), Nonstationary panel data analysis: An overview of some recent developments, *Econometric reviews*, *19*(3), 263–286.

[75] Pinker, S. (2011), *The better angels of our nature: Why violence has declined*, Viking, New York.

[76] Quinney, R. (1974), *Criminal justice in America; A critical understanding*, Little, Brown, Boston.

[77] Rogers, J. D. (), Theories of crime and development: An historical perspective, *Journal of development studies*. -.

[78] Rosenfeld, R. (1982), Inequality, relative deprivation and crime: explaining some discrepant findings., *Paper presented at the 1982 annual meeting of the American Society of Criminology, Toronto, Canada*.

[79] Samaha, J. (2005), *Criminal justice*, Thomson Wadsworth, Princeton and N.J.

[80] Sampson, R. J., and B. W. Groves (1989), Community structure and crime: Testing social-disorganization theory, *The American Journal of Sociology*, (94), 774–802.

[81] Sampson, R. J., and W. J. Wilson (1998), Toward a theory of race, crime, and urban inequality, *Community justice : an emerging field*, pp. 97–118.

[82] Saridakis, G. (2004), *Violent crime in the United States of America: A time-series analysis between 1960 - 2000*, *Discussion papers in economics / University of Leicester, Department of Economics*, vol. 03,14, [elektronische ressource] ed., Univ. of Leicester, Dep. of Economics, Leicester.

[83] Shaw, C. R., and H. D. McKay (1942), *Juvenile delinquency and urban areas: A study of rates of delinquents in relation to differential characteristics of local communities in American cities*, Behavior research fund monographs, The University of Chicago Press, Chicago and Ill.

[84] Shelley, L. I. (1981), *Crime and modernization: The impact of industrialization and urbanization on crime*, Science and international affairs series, Southern Ill. Univ. Press, Carbondale and Ill.

[85] Smith, M. D., and M. A. Zahn (Eds.) (1999), *Homicide: A sourcebook of social research*, Sage Publications, Thousand Oaks and Calif.

[86] Taylor, A. (1998), On the costs of inward-looking development: price distortions, growth, and divergence in latin america, *The Journal of Economic History*, *58*(1), 1–28.

[87] Toda, H. Y., and T. Yamamoto (1995), Statistical inferences in vector autoregressions with possibly integrated processes, *Journal of Econometrics*, *66*, 225–250.

[88] Trumbull, W. N. (1989), Estimations of the economic model of crime using aggregate and individual level data, *Southern economic journal*, (56), 423–439.

[89] United Nations University - World Institute for Development Economics Research (2008), World income inequality database v2.0c.

[90] University of Texas Inequality Project (), Estimated household income inequality data set, *2011*.

[91] UNODC (United Nations Office on Drugs and Crime) (2011), *Global Study on Homicide*, UNODC, Vienna.

[92] van Zanden, J. L., J. Baten, P. Foldvari, and B. van Leeuwen (), The changing shape of global inequality - exploring a new dataset: Working paper 0001, *Centre for Global Economic History*, *2011*.

[93] Weisbrot, M., and R. Ray (2011), The scorecard on development, 1960-2010: Closing the gap?, *UN-DESA*.

[94] World Bank (2014), Measuring inequality.

10. Appendix

Table 15: Summary Statistics				
Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Homicide Rate	15.977	14.875	0.75	89.5
Gini Index	48.902	5.803	28.3	65.5
GDPpc	5336.593	2736.958	1259	14488
GDPpc Growth Rate	0.016	0.042	-0.159	0.166
Urbanization Rate	56.28	21.045	8.534	98.959
Abolition Dummy	0.826	0.38	0	1

Table 16: Abbreviations of country names and number of observations per country in the final sample

Abbreviation	Country Name	# of Observations
abw	Aruba	0
arg	Argentina	35
atg	Antigua and Barbuda	0
bhs	Bahamas	0
blz	Belize	0
bol	Bolivia	8
bra	Brazil	31
brb	Barbados	0
chl	Chile	47
col	Colombia	43
cri	Costa Rica	41
cub	Cuba	3
cym	Cayman Islands	0
dma	Dominica	0
dom	Dominican Republic	38
ecu	Ecuador	45
grd	Grenada	0
gtm	Guatemala	28
guy	Guyana	0
hnd	Honduras	13
hti	Haiti	0
jam	Jamaica	27
kna	St. Kitts and Nevis	0
lca	St. Lucia	0
mex	Mexico	46
nic	Nicaragua	14
pan	Panama	15
per	Peru	13
pri	Puerto Rico	22
pry	Paraguay	11
slv	El Salvador	33
sur	Surinam	0
tca	Turks and Caicos Islands	0
tto	Trinidad and Tobago	33
ury	Uruguay	31
vct	St. Vincent	0
ven	Venezuela	42