PUBLIC SAFETY, POVERTY, AND INEQUALITY

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PUBLIC SAFETY, POVERTY, AND INEQUALITY

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DECLARATION OF ORIGINALITY

I, Mete Can, certify that

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ABSTRACT

Public Safety, Poverty, and Inequality

This thesis investigates how the optimal government response to criminal activity is shaped by national income and inequality in the manner of public safety expenditures. The literature on this issue is already well established with both theoretical and empirical studies. This thesis puts a different approaches on the government's motivation behind fighting against crime from the existing literature on choosing the government's objective function. In many of the studies, the government's objective is to maximize expected social welfare involving criminal activity. In this thesis, I argue that what a government should do is to consider the potential harm from the criminal activity, regardless to what is its expected realization. Otherwise, redistribution effect of criminal activity is legalized, which strictly contradicts with the philosophy behind the concept sovereignty.

I create a theoretical model and solve it using this approach, and first show that crime and criminal attempts act differently in response to inequality. Then, I let the government solve an objective function in which the government minimizes the potential harm from the criminal activity, which is defined as the aggregate utility loss in case of all the criminal attempts are successful, and the criminal activity is not taken into account as a redistribution mechanism. Solution to the problem shows that even if crime and the harm from criminal activity changes in inequality, public safety expenditure does not change in inequality while higher income causes higher expenditure.

As the last I use a panel data consisting of 54 countries and 3 years to conduct an empirical analysis whose results support the theoretical model.

ÖZET

Kamu Güvenliği, Fakirlik ve Eşitsizlik

Bu tez devletin suç karşısında yaptığı kamu güvenliği harcamalarının milli gelir ve eşitsizlik ile nasıl şekillendiğini araştırmaktadır. Bu konu hakkındaki literatür halihazırda hem teorik hem de ampirik pek çok çalışma ile oldukça gelişkindir. Bu çalışma devletin suça karşı savaşmadaki motivasyonuna ve devletin amaç fonksiyonunun seçilmesine var olan literatürden farklı bir yönden yaklaşmakta. Çoğu çalışmada devletin amaç fonksiyonu suçu da barındıran bir beklenen sosyal refah fonksiyonudur. Bu tezde, devletin esas olarak suç faalityetinin topluma vereceği potansiyel zararın, gerçekleşecek olan beklenen zarardan bağımsız olarak minimize etmesi gerektiğini, aksi takdirde suçun neden olduğu yeniden dağıtımın legalize edilmiş olacağını ve bu durumun egemenlik konsepti ile çelişmekte olduğunu tartışıyorum.

Bu çalışmada, bu yaklaşımı kullanarak teorik bir model kurup çözüyorum ve ilk olarak, suç oranı ve suçun ekonomik değerinin farklı hareket ettiğini gösteriyorum. Sonrasında devlete, suçun bir yeniden dağıtım mekanizması olarak devrede olmadığı ve tüm suç girişimlerinin başarılı olduğu taktirde ortaya çıkacak olan toplulaştırılmış refah kaybı olarak tanımlanan suçun potansiyel zararının minimize edildiği bir optimizasyon problemi çözdürüyorum. Modelin çözümü, her ne kadar suç oranı ve suçun ekonomik değeri gelir eşitsizliği değiştikçe değişse de, devletin kamu güvenliği harcamalarının eşitsizlikten etkilenmediği, gelir arttıkça ise güvenlik harcamalarının da arttığı sonucunu üretiyor.

Son olarak ampirik analiz için 54 ülke ve 3 yıldan oluşan panel veri kullanıyorum ve regresyon sonuçları modelin sonuçlarını doğruluyor.

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CHAPTER 1
INTRODUCTION

This thesis investigates how the optimal government response to crime is shaped by national income and inequality. The literature on this issue is already well organized. There are plenty of studies that investigate the relationship between income, inequality, crime and while their results can differ from each other. These studies set a government problem where the government maximizes a social welfare involving criminal activity. The result that the existing literature mainly suggests is that the government's public safety expenditure is an increasing function of inequality and income.

In this thesis, I argue that the government's motivation behind fighting against crime is not about its expected realization. This kind of an approach turns the direct effect of criminal attempt into redundant. Hence, I go with an optimization where the government minimizes the potential damage of criminal attempts to the society, which is defined as the aggregate utility loss from the criminal attempts in case all the attempts are successfully realized. Also, the utility term here does not include criminal activity gain to deter its redistributive effects.

Additionally, I argue, here, that crime rates do not reflect the harm from criminal activity. To show that, I first derive crime rate and the value of criminal activity, and then show that they act differently in changing inequality.

The literature, in general, is based on the study of Becker (1968), which shows that criminal behavior is a result of an economic optimization problem. In the study, Becker creates an economic framework where he first solves an expected individual maximization problem involving criminal activity, as stated by him "offense", and the problem yields an optimum offense where the expected marginal benefit from the offense is equal to the expected marginal cost of the offense, which is determined by penalties and fines. He, simply, shows that the number of offenses is strictly decreasing in higher rate of probability of being caught by the police and higher degree of punishment.

Ehrlich (1973) creates a one-period theoretical model in which the individuals choose the optimal participation in illegitimate market activities, and then he aggregates the number of criminal activities. Then, using U.S. data, he seeks an empirical support to his theoretical model. The study proves the deterrent effect of law-enforcement on crime and a strong positive correlation between income inequality and crimes against property.

Sala-i Martin (1997) creates and solves a theoretical model resulting that crime increases in inequality and poverty, and social safety nets and police expenditure helps the government to reduce it, especially when funded by income taxes. He starts with an individual maximization problem involving criminal activity choice, resulting in that an individual's time devoted to criminal activity is optimized where the expected marginal benefit and cost from it equals each other, just as what Becker does, and then states that better law enforcement, larger penalties and more social transfers reduce that activity.

Fender (1999) uses a theoretical model where the individuals chooses whether being a criminal or not, depending on their income levels, probability of success, and the punishment system, in which the solution to the individual expected utility maximization problem results in that an individual with an income level under a certain threshold decides to be a criminal. Using the solution of the individual problem he aggregates the number of criminals to generate crime and see how it acts in inequality. What the study puts forth about the relationship between inequality and crime is different then what the rest of the literature states: The relationship between crime and inequality is not monotonic, and reduction in inequality reduces crime if and only if crime is not too large, initially. The same result arises in this thesis.

Imrohoroğlu et al. (2000) solve a general equilibrium model, where a competitive equilibrium is characterized by a set of policies including taxes, transfers, and public safety expenditures, by calibrating it to the data from US, and suggest that expenditure on police and redistribution increase with inequality. I design my study here similar to this study, too, in the aspect that investigating the relationship between the government's optimal policy in income level and inequality.

Merlo (2003) creates a model with individual choice of criminal activity, and then shows the link between political-economic equilibrium levels of tax rate and police expenditure, and crime, using aggregated individual indirect utilities involving criminal activities.

When it comes to the determinants of crime, this is not only an economic issue but also related to psychology and sociology literature. Even though criminal behavior cannot be explained only by economic determinants since medical facts such as psychological and neurological disorders, hormonal activity or hereditary brain activity, and social structure precisely have a strong impact on it, the economic reasons behind it are unignorable. The crime literature shows the relationship between inequality, national income, and crime. Kelly (2000), shows the strong link between overall crime, violence, robbery, and income inequality. He finds that there is no effect of inequality on property crime, but a strong effect on violent crime. Contrarily, poverty and police activity have significant effects on property crime, but little on violent crime.

Fajnzylber and Lederman (2002) report the positive correlation between crime rates, for both homicide and robbery, and inequality both within and between countries, where that correlation also reflects causation from inequality to crime rates. The study also shows the negative relationship between income and crime rates. Nilsson (2004) shows the positive impact of poverty on overall crime stating that where poverty has a significant impact on burglary and auto theft, but the relationship between poverty and violent crime is insignificant.

Another study reports the significant relationship between robbery, burglary, and inequality while showing that there is no support for the relationship between inequality and other types of crime. (Choe, 2008).

Even if the significance of the effects of inequality and poverty on different crime categories is controversial in the literature, all these studies show a significant link between poverty, inequality, and crime in some way. In this study, I do not focus on a particular type of crime. Moreover, I create an environment with an endowment economy, and in this environment I use the economic value of criminal attempts instead of crime and the government tries to optimize a combination of social welfare and the economic value of criminal attempts. In this framework, the government chooses the optimal policy set consisting of net taxes and expenditure on public order and safety.

In his empirical study, Jacobs (1979) shows that unequal areas in the U.S tend to have more per-capita police or law enforcement personnel than relatively equal areas, and this correlation is statistically significant. Boustan et al (2013) find that the relationship between income inequality, government revenue and government expenditures have significant positive correlations, where one of these expenditure categories is police expenditure, which has a positive significant correlation with income inequality, in U.S municipalities.

This thesis distincts from the existing literature in two ways: First, I do not use crime rate as the key variable to deal with from the sight of the governments since it cannot reflect the real value of criminal activity. The second distinction is not taking criminal activity's redistribution effect into account since it is in contradiction with sovereignty concept.

When it comes to crime and crime rate side, one should note, first, that crime and crime rate are perfectly collinear variables since they are defined by each other, where crime rate is usually defined as (the number of) crime divided by 100.000 people. Hence, they perfectly substitute each other. The crime literature usually investigates act of crime rates since it is easy to access the crime data. However, it is not convenient to think that crime rates reflect the harm, or the economic value of crime. This issue is examined in the theoretical part of this study. Yet, to support this idea, I suggest a simple thought experiment: Let there be a society consisting of 100,000 individuals where all of them except one are criminals and steal 0.001% of the wealth from anyone they can do. Consider now another scenario in which only one of them is a criminal who steals all the wealth of the rest. If data on these societies' crime structures is collected, what would it say is that crime and crime rates in the first society is 100,000 and 0.99, and they would equal 1 and 0.00001, respectively. It would not be surprising for an ordinary, non-criminal, person to be willing to live in the second society, if she knew the true crime structure of these two societies. On the side, if she has checked only the crime rate data, she certainly would choose to live in the first society, which is obviously a big mistake. It is clear that this is an exaggerated and extreme example, yet, in the theoretical part of the study, it is still precise that value of crime and crime (rate) might act differently in some situations, and the crime rate could fail to reflect the value of criminal activity. Another issue about crime rate is that the data is consisting of reported crimes only, where it would not be surprising that reported/actual crime rates to be less in underdeveloped countries, which are expected to have more criminal activity, than the developed ones. However, I will not discuss this in this study since it is not designed as a strong empirical work and does not seek for a significant causal relationship between the crime and other things. Because of all the reasons given above, I do not use crime or crime rate in any kind in any part of this study.

The rest of the study is organized into two parts: Theoretical part and empirical part. In thetheoretical part, I create an endowment economy environment in which there is a given distribution of endowments, which is called income. I first create and solve an individual expected utility maximization problem which yields the optimal value of criminal attempt choice, taking government policy as given. Then, I introduce an explicit income function which is a function of individuals and state the properties of that function. Using the solution to the individual maximization problem and the income function, I define crime and the economic value of crime in terms of pre-tax and post-tax income, and pre-tax and post-tax inequality, and show how they act in these variables. As the last, I write down the government's problem. Solution to the government's problem states that public safety expenditure increases in higher income, but it is not related with inequality.

In the empirical part, to see whether these results are in line with the data, I conduct a panel-data analysis with 54 countries and 3 years. The relevant tests suggest using random effects model and the result of the random effect model is in line with what the theoretical model states. For robustness, I also conduct another random effects model analysis in which I first regress Gini on the other explanatory and control variables, then obtain the residuals from that regression and repeat the original regression by using the residuals in place of Gini coefficient in order to avoid the issues that can arise due to the collinearity between Gini coefficient and income, and show that results of this regression are similar to results obtained from the original regression.

CHAPTER 2

THEORETICAL MODEL

2.1 The Environment and Individual Problem

Let there be an endowment economy with N number of individuals, where $w(i)$, $t(i)$ and $y(i)$ denote pre-tax income, net tax, and post-tax income for individual i, respectively, with $y(i) = w(i) - t(i)$ where $i \in \mathcal{I} = [0, N]$. Let $w(i) < w(i')$ and $y(i) < y(i') \; \forall i < i'$. Each individual solves the following expected utility maximization problem:

$$\begin{aligned} &\max_{\alpha(i)_s} \; (1-\pi)u\big(c_s(\alpha(i))\big) + \pi u\big(c_f(\alpha(i))\big) \\ &\text{st} \quad \alpha(i) \geq 0 \end{aligned} \tag{2.1}$$

where π is the probability of success, as a function of s, which stands for government's expenditure on public order and safety with $\pi'(s) > 0$, and $\pi''(s) < 0$. I define π as $\pi(s) = 1 - exp\{-\sigma s\}$ where the term σ is the elactisity parameter. α, c_s and c_f denote value of criminal attempt, which are the amount that individual i is willing to steal, the consumption amount if the attempt is successful, and the consumption amount in the case where the criminal fails and penalized with

$$c_f(i) = y(i) - p(i) \tag{2.2}$$

$$c_s(i) = y(i) + \alpha(i) \tag{2.3}$$

$p(i)$ here is the punishment function showing the amount that a criminal who fails on criminal activity must pay as penalty. I define that function explicitly as:

$$p(i) = y(i)[1 - e^{-\phi\alpha(i)}] \tag{2.4}$$

where ϕ is an exogenous punishment constant. Note that, the penalty amount captures any kind of loss that the individual faces due to an unsuccessful criminal attempt. Hence, as an individual gets richer, the damage she takes from being penalized gets relatively larger, and when an individual gets poorer, she becomes a person who has nothing to lose, and the fraction of penalty to individual income is the same for two individuals with same value of attempt. Assume that each individual has an identical utility function with $u(\cdot) = log(\cdot)$. Then, plugging (2.2) and (2.3) into (2.1) the objective function becomes:

$$\big(1-\pi(s)\big)log\big(y(i)+\alpha(i)\big)+\pi(s)\big(logy(i)-\phi\alpha(i)\big) \tag{2.5}$$

First order condition with respect to $\alpha(i)$ yields:

$$\frac{1-\pi(s)}{y(i)+\alpha(i)} = \pi(s)\phi \tag{2.6}$$

Where the LHS is marginal benefit of criminal activity and the RHS is marginal loss from it. The solution, then, to the problem is:

$$\alpha(i) = \frac{1-\pi(s)}{\phi\pi(s)} - y(i) \tag{2.7}$$

If we take non-negativity constraint into account, we get the following optimal value of criminal attempt:

$$\alpha(i) = \begin{cases} \frac{1-\pi(s)}{\phi\pi(s)} & , y(i) < \frac{1-\pi(s)}{\phi\pi(s)} \\ 0 & \text{, otherwise} \end{cases} \tag{2.8}$$

Note that $\alpha(i) = 0$ when $y(i) \geq \frac{1-\pi(s)}{\phi\pi(s)}$. Then, RHS can be interpreted as the threshold which is the minimum income level makes an individual stay away from being a criminal. Then, letting $\underline{y} \equiv \frac{1-\pi(s)}{\phi\pi(s)}$ as the threshold, we get

$$\alpha(i) = \begin{cases} \underline{y} - y(i) & , y(i) < \underline{y} \\ 0 & \text{, otherwise} \end{cases} \tag{2.9}$$

for the rest of the study, I will ignore the second line of (2.9) for the sake of simplicity.

Precisely, the result stated in (2.9) is not completely realistic. It states that all the individuals endowed higher than the threshold level are not criminals, and vice versa. As stated above, criminal activity is determined by numerous factors. However, to model the economic aspect of crime, it is compulsory to create this kind of an environment. (2.9) captures only the average effects of economic conditions.

Aggregate economic value of criminal attempts, which is integration of αs is calculated as:

$$V = \int_0^n \alpha(i)di = n\underline{y} - \int_0^n y(i)di = n\underline{y} - Y(n) \tag{2.10}$$

where $n \in [0, N]$ is the number of criminals and $Y(n)$ denotes the aggregate income of criminals without criminal income. Note that, n also reflects (the number of) crime since each criminal can commit one crime only in this setting.

2.2 Income Function

I define pre-tax income function explicitly as follows:

$$w(i) = Ae^{\beta i} \tag{2.11}$$

where A is the lowest pre-tax income level in the economy. I set A as $A = \frac{W\beta}{e^{\beta}-1}$, in order to track the effects of changes in inequality and aggregate income, where $W = \int_0^N w(i)di$ denotes aggregate pre-tax income. In this setting, any increase in individual's income via change in inequality changes rest of the individuals' income levels to compensate the change in aggregate income caused by the individual income change, and the aggregate income is kept constant. Also, a change in the aggregate income is distributed amongst the individuals so that the inequality level does not change. Hence, we have $\frac{\partial W}{\partial \beta} = 0$. Graphical representation of this income distribution function is given in Figure 1 and Figure 2 for different W and β values.

I proceed by setting $N = 1$. By doing this, i turns into i^{th} income percentile and n becomes reflecting crime rate in the economy. Now, since $i \in [0, 1]$, we can easily derive Lorenz curve and Gini coefficient for pre-tax income as function of β only.

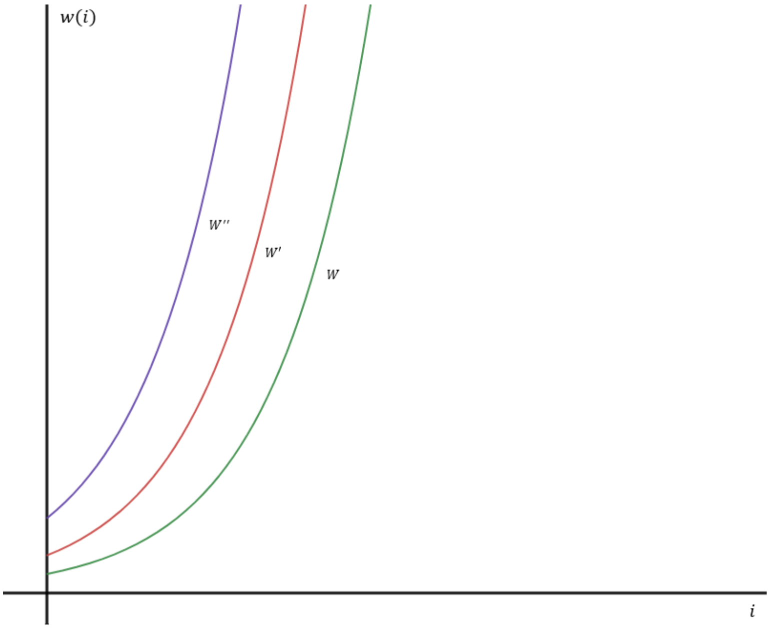

Figure 1. Income distribution functions with constant β and $W < W' < W''$

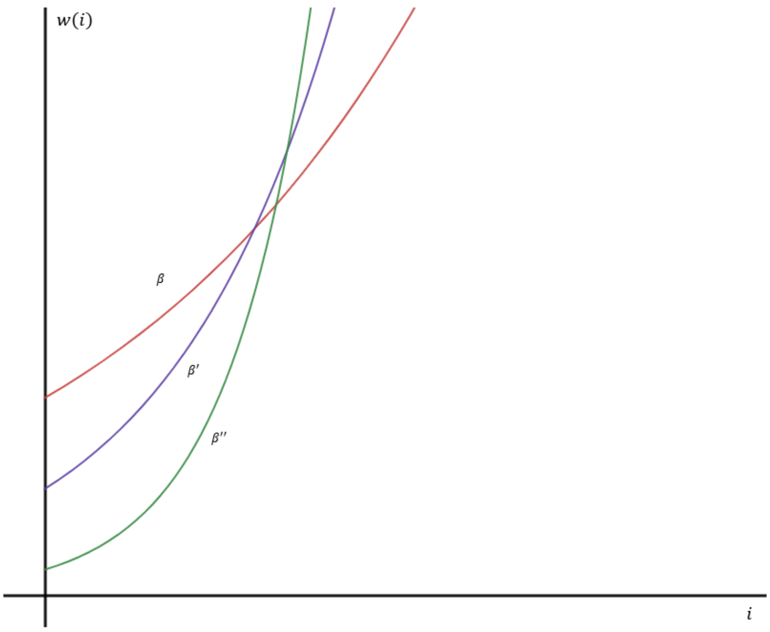

Figure 2. Income distribution functions with constant W and $\beta < \beta' < \beta''$

Let $L(i)$ be the Lorenz curve's function. Then,

$$L(i) = \frac{1}{W}\int_0^i w(x)dx = \frac{A}{\beta W}(e^{\beta i} - 1) = \frac{W\beta}{W\beta}\frac{e^{\beta i} - 1}{e^{\beta} - 1} = \frac{e^{\beta i} - 1}{e^{\beta} - 1} \tag{2.12}$$

Let, now, $\mathbb{L}$ denote the are under the Lorenz curve. Then,

$$\mathbb{L} = \int_0^1 L(i)di = \frac{1}{\beta} - \frac{1}{e^{\beta} - 1} \tag{2.13}$$

From the definition of Gini coefficient, $Gini = 1 - 2\mathbb{L}$, I derive Gini coefficient, denoted by γ, as function of β only as:

$$\gamma = 1 - \frac{2}{\beta} + \frac{2}{e^{\beta} - 1} \tag{2.14}$$

with $\gamma'(\beta) > 0$, $\gamma(0) = 0$, and $\lim_{\beta \to \infty} \gamma(\beta) = 1$. Let, us, now see how the individual income changes in inequality:

$$\frac{\partial w(i)}{\partial \beta} = A'(\beta)e^{\beta i} + Aie^{\beta i} = Ae^{\beta i}\left(i + \frac{A'(\beta)}{A}\right) \tag{2.15}$$

and since $A'(\beta) < 0$

$$\begin{cases} \frac{\partial w(i)}{\partial \beta} < 0 & i < -\frac{A'(\beta)}{A} \\ \frac{\partial w(i)}{\partial \beta} \geq 0 & i \geq -\frac{A'(\beta)}{A} \end{cases} \tag{2.16}$$

Note that $-\frac{A'(\beta)}{A} = -\frac{1}{\beta} + \frac{e^{\beta}}{e^{\beta}-1} = 1 - \mathbb{L} = \frac{1+\gamma}{2}$, we can rearrange (2.16) as:

$$\begin{cases} \frac{\partial w(i)}{\partial \beta} < 0 & i < \frac{1+\gamma}{2} \\ \frac{\partial w(i)}{\partial \beta} \geq 0 & i \geq \frac{1+\gamma}{2} \end{cases} \tag{2.17}$$

(2.17) simply states that, when market, or pre-tax, inequality rises, an individual placed in percentile higher than some certain percentile determined by market Gini coefficient is better off, and vice versa.

I, now, express post-tax income function in the way presented by Heathcote et al. (2017) as follows:

$$y(i) = (1 - \lambda)w(i)^{1-\tau} \tag{2.18}$$

Here, both λ and τ determine the marginal and average net tax rate, where τ is the only determinant of tax progressivity. I use the tax progressivity parameter only for examining the properties of post-tax income distribution and investigate the relationship between crime, value of crime, and income heterogeneity. Since progressivity degree is not a main focus in this study, I will drop it by setting $\tau = 0$ in the government's problem, so λ will be the marginal net tax rate constant over all individuals. From the following derivations, for a given level of τ, we see that post-government inequality parameter turns into $\beta(1-\tau)$, and the derivations made above could have been replaced by using this term, so the use of this term instead of β would not change anything. Thus, there is no loss of generality by setting $\tau = 0$, and for simplicity, I follow this way.

Let, $\hat{L}(i)$ be the post-tax Lorenz curve function, and let $\hat{\mathbb{L}}$ be the area under the post-tax Lorenz curve, where $\hat{\gamma}$ denotes post-tax Gini coefficient. Then, where $\int_0^1 y(i)di$ and $K = (1-\lambda)A^{1-\tau}$ denotes the post-tax minimum income level,

$$\hat{L}(i) = \frac{1}{Y}\int_0^i y(x)dx = \frac{e^{\beta(1-\tau)i}-1}{e^{\beta(1-\tau)}-1} \tag{2.19}$$

and

$$\hat{\mathbb{L}} = \int_0^1 L(i)di = \frac{1}{\beta(1-\tau)} - \frac{1}{e^{\beta(1-\tau)}-1} \tag{2.20}$$

and then,

$$\hat{\gamma} = 1 - \frac{2}{\beta(1-\tau)} + \frac{2}{e^{\beta(1-\tau)}-1} \tag{2.21}$$

Hence, by letting $\hat{\beta}$ denote post-tax inequality with a given tax progressivity level, there all of the results derived for the pre-tax income and inequality above hold for the post-tax income and inequality, too.

Let $\tau = 0$. Then, pre-tax and post-tax inequalities the equal. Now, to see how crime rate and the value of criminal activity change in inequality, I need to derive crime rate, explicitly. To do this, recall (2.9) and see that $\alpha(n) = 0$. Using this fact, we can define n as $n = y^{-1}(\underline{y})$. Explicitly:

$$n = \frac{1}{\beta}\big(log\underline{y} - logK\big) \tag{2.22}$$

$$\frac{\partial n}{\partial Y}=-\frac{\partial K}{\partial Y}\frac{1}{\beta K}=-\frac{1}{\beta}\frac{\beta}{e^{\beta}-1}\frac{e^{\beta}-1}{\beta Y}=-\frac{1}{\beta Y}<0 \tag{2.23}$$

Then, crime rate decreases in income. Taking the derivative of crime rate with respect to inequality parameter yields:

$$\frac{\partial n}{\partial \beta}=-\frac{1}{\beta^2}\big(log\underline{y}-logK\big)-\frac{\partial K}{\partial \beta}\frac{1}{\beta K}=-\frac{1}{\beta}\left(n+\frac{A'(\beta)}{A}\right) \tag{2.24}$$

Then,

$$\begin{cases} \frac{\partial n}{\partial \beta}\geq 0 & n\leq \frac{1+\gamma}{2} \\ \frac{\partial n}{\partial \beta}< 0 & n> \frac{1+\gamma}{2} \end{cases} \tag{2.25}$$

Accordingly, crime rate can decrease in inequality when some of the criminals get better off when inequality rises. Note that, the result in the second line of (22) is a local result which holds around a certain neighborhood of the initial n. Since $\frac{1+\gamma}{2}$ is increasing in β while n is decreasing in β, after some certain value of β, n becomes lower than $\frac{1+\gamma}{2}$ and the relationship turns out the one stated in the first line. A global result here would state that for sufficiently small income, crime rate decreases in inequality first and becomes an increasing function of it after some certain inequality level. (2.25) is illustrated in Figure 3 and Figure 4, below.

In Figure 3, the initial inequality and crime rate are β and n, respectively. Crime rate here is lower than $\frac{1+\gamma}{2}$, thus when inequality increases from β to β', there exist some individuals between n and $\frac{1+\gamma}{2}$ whose income get worse off, and the number of criminals increase. On the other hand, in Figure 4, initial crime rate is larger than $\frac{1+\gamma}{2}$, which means that there are some criminals who become richer when inequality rises, so they stop being criminal and crime rate decreases.

To see how the economic value of criminal activity derived in (2.10) changes in aggregate income, I take derivative of it with respect to aggregate income which yields:

$$\frac{\partial V}{\partial Y}=\frac{1}{e^{\beta}-1}\left(1-\frac{\underline{y}}{K}\right)<0 \tag{2.26}$$

since $\underline{y} \leq K$ means no crime. When it comes to the inequality, we see that:

$$\frac{\partial V}{\partial \beta} = Y(n)\left(\frac{1+\gamma}{2} + \frac{1}{\beta}\right) \tag{2.27}$$

Thus, the economic value of criminal activity is a strictly increasing function of inequality, unlike crime rate.

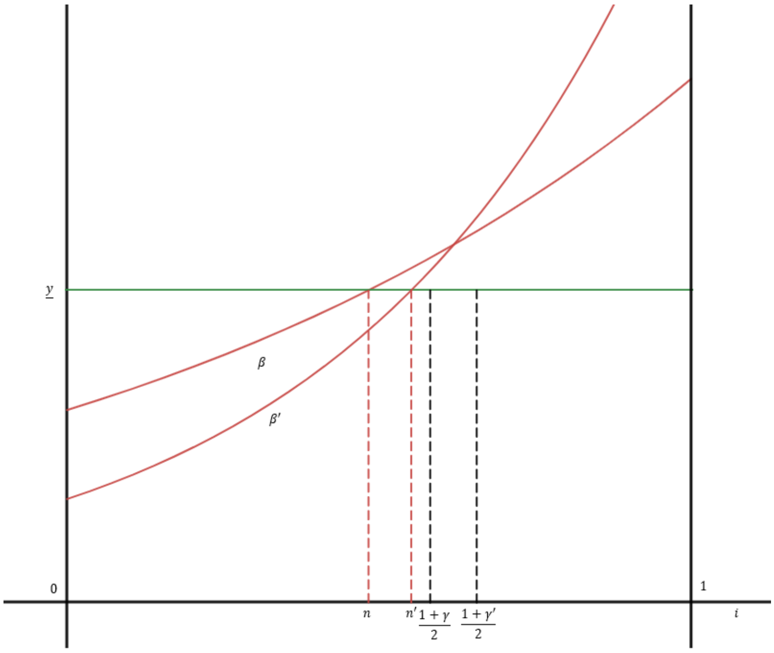

Figure 3. Graphical representation of the first line of (2.25)

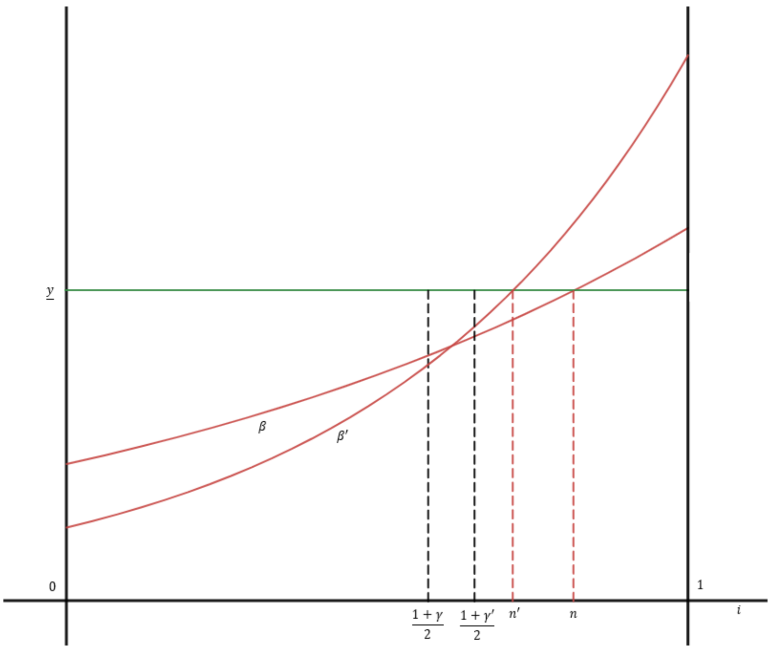

Figure 4. Graphical representation of the second line of (2.25)

2.3 The Government's Problem

The government minimizes the aggregated welfare loss from criminal attempt. One thing, here, is that the government does not solve an expected maximization/minimization problem. One can think that, government should minimize the expected harm from the criminal activity, as encountered in the existing literature. However, I find this inconvenient, according to the philosophy behind the concept "state". Public order and safety in a society is not about the realization of a criminal attempt, but about the existence of the attempt's itself. Thus, what a government does when maximizing public safety is to minimize the loss to be realized in case of a successful attempt. Hence, I go with a deterministic problem. Second point is about the redistributive effect of crime. When a criminal steals an amount from another individual, social wealth is redistributed. In the literature, the government usually solves an expected social welfare maximization problem while the redistribution effect of crime is taken into account. However, this, also, is not convenient since this means nothing but legalizing mafia-like activity in wealth redistribution. As aforementioned, the government, in this study, minimizes aggregate welfare loss to be realized in case of successful attempts. If an individual does not suffer from criminal activity, she consumes the amount $y(i)$, hence, the utility level she obtains is $u(y(i)) = log(y(i))$. In case of a successful criminal attempt, the individual i obtains $u(y(i) - c(i))$, where $c(i)$ is the amount that i loses. We can assume that

$$c(i) = V\frac{y(i)}{Y} \tag{2.28}$$

then, the potential amount that i consumes in case of a successful attempt equals $h(i)$ denotes the potential harm of criminal attempt to an individual is

$$log\left(y(i)\left(1 - \frac{V}{Y}\right)\right) = logy(i) + log\left(1 - \frac{V}{Y}\right) \tag{2.29}$$

the difference between the utility in case of no criminal attempt and in case of a successful attempt, then, represents the potential harm of criminal attempt. Denoting that harm for individual i by $h(i)$, we get:

$$h(i) = logy(i) - \left[logy(i) + log\left(1 - \frac{V}{Y}\right)\right] = -log\left(1 - \frac{V}{Y}\right) \tag{2.30}$$

and the aggregate potential harm of criminal activity is

$$\mathcal{H} = \int_0^1 h(i)di = \int_0^1 -log\left(1 - \frac{V}{Y}\right)di = -log\left(1 - \frac{V}{Y}\right) \tag{2.31}$$

The government minimizes the potential harm from criminal activity, $\mathcal{H}$. Note that, it is nothing but minimizing the term $\frac{V}{Y}$. Then, the government solves the following problem:

$$\begin{aligned} &\min_{s,\lambda} \frac{V}{Y} = \frac{n\underline{y} - Y(n)}{Y} \\ &\text{st} \quad \lambda W \geq s : \mu \end{aligned} \tag{2.32}$$

Then, first order conditions are as follows:

FOC with respect to s:

$$-\frac{\frac{\partial V}{\partial s}}{Y} = \frac{-\left[\frac{\partial n}{\partial s}\underline{y} + \frac{\partial \underline{y}}{\partial s}n - \frac{\partial Y(n)}{\partial n}\frac{\partial n}{\partial s}\right]}{Y} = \mu \tag{2.33}$$

FOC with respect to λ:

$$\frac{\frac{\partial V}{\partial s}Y - \frac{\partial Y}{\partial \lambda}V}{Y^2} = \frac{1}{Y^2}\left(\frac{\partial n}{\partial \lambda}\underline{y}'(s) + W(n) - (1-\lambda)w(n)\frac{\partial n}{\partial \lambda}\right) = \mu W \tag{2.34}$$

From the first fundamental theorem of calculus $\frac{\partial Y(n)}{\partial n} = y(n)$, and since $\underline{y} = y(n) = (1-\lambda)w(n)$, (2.33) and (2.34) can be simplified as:

$$\frac{-n\underline{y}'(s)}{Y} = \mu \tag{2.35}$$

$$\frac{1}{Y^2}\left(W(n)Y + VW\right) = \mu W \tag{2.36}$$

(2.36) can be rewritten as:

$$\frac{1}{Y}\left(W(n)+\frac{V}{1-\lambda}\right)=\frac{1}{Y}\left(\frac{(1-\lambda)W(n)+V}{1-\lambda}\right)=\mu W \tag{2.37}$$

and we have,

$$\frac{Y(n)+V}{Y}=\frac{Y(n)+n\underline{y}-Y(n)}{Y}=\frac{n\underline{y}}{Y}=\mu Y \tag{2.38}$$

Then, combining (2.35) and (2.38) we get:

$$\frac{\underline{y}'(s)}{\underline{y}}+\frac{1}{Y}=0 \tag{2.39}$$

Since $Y=(1-\lambda)W=W-s$, we have:

$$F\equiv\frac{\underline{y}'(s)}{\underline{y}}+\frac{1}{W-s}=0 \tag{2.40}$$

We can derive the relationships between safety expenditure, income and inequality by applying the implicit function theorem to F. It is easy to see that there is no relationship between inequality and safety expenditure since derivative of F with respect to β is zero. On side,

$$\frac{\partial F}{\partial s}=\frac{\partial}{\partial s}\frac{\underline{y}'(s)}{\underline{y}}+\frac{1}{Y^2} \tag{2.41}$$

$$\frac{\partial F}{\partial W}=-\frac{1}{Y^2}<0 \tag{2.42}$$

Note that $\frac{\underline{y}'(s)}{\underline{y}}=\frac{-\pi'(s)}{\phi\pi^2}$ and $\frac{\partial}{\partial s}\frac{\underline{y}'(s)}{\underline{y}}=-\frac{\pi'(s)}{\pi(1-\pi)}$. Since $\pi=1-exp\{\sigma s\}$, we have

$$\frac{\partial F}{\partial s}=-\frac{\partial}{\partial s}\frac{\sigma}{\pi}+\frac{1}{Y^2}=\sigma\frac{\pi'(s)}{\pi^2}+\frac{1}{Y^2}>0 \tag{2.43}$$

hence, we have

$$\frac{\partial s}{\partial W}=-\frac{\frac{\partial F}{\partial W}}{\frac{\partial F}{\partial s}}>0 \tag{2.44}$$

These results states that income inequality does not affect public safety expenditure even if higher inequality causes increase in the value of criminal activity, and the harm from criminal activity. A possible intuitive explanation to this result is that the government intervenes the criminal activity caused by changes in inequality by changing redistribution policy. Since it is possible to make a change in tax progressivity by keeping taxes and expenditures constant, this does not generate an increase in criminal activity by reducing the value of crime caused by an increase in inequality. On side, we see that higher income yields higher public order and safety expenditure. I do discourse on progessivity and redistribution since the subject of this study is the relationship public safety expenditures, income and income inequality, and I leave it to further research.

Also, one should note that the structure here classifies all the individuals below the threshold income level as criminals, which is not that realistic. However, this unrealistic setting is convenient to get the link between the economic parameters and criminal activity, and for simplicity I choose to go with this environment. Yet, I provice an alternative, more realistic approach in appendix showing that the use of that approach would not change the results obtained from the original approach.

CHAPTER 3

EMPIRICAL ANALYSIS

3.1 Data

In order to check the model's results a panel data consisting of 54 countries and 3 years is collected. Data source for Gini index and per-capita income is WID (World Inequality Database), for safety expenditure it is IMF Fiscal Monitor, for length of land border it is CIA World Factbook, length of coastline data is collected from World Resources Institute, and the rest is collected from World Bank's World Development Indicators.

Descriptive statistic of the variables are presented in the Table 1 below.

Table 1. Descriptive statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
safetypc	162	476.5247.47	345.4004	52.90298	1944.238
incomepc	162	29019.9	23630.43	2589.111	101488.8
gini	162	.5006263	.0775209	.3760672	.7464856
age	162	38.59444	5.072007	24.7	46.3
popdens	162	38.59444	2755.002	3.010574	19805.69
landkm	162	2784.636	4400.865	0	22147
coastkm	162	10210.54	29409.52	0	202080

safetypc: per-capita safety expenditure, incomepc: per-capita income, gini: market Gini coefficient, age: median age, popdens: population density, landkm: length of land border in km, coastkm: length of coastline in km

3.2 The Econometric Model

The model to be estimated explicitly is:

$$logsafetypc_{i,t} = \beta_0 + \beta_1 gini_{i,t} + \beta_2 (logincomepc \times gini)_{i,t} + \beta_3 logincomepc_{i,t} + \beta_4 age_{i,t} + \beta_4 popdens_{i,t} + \beta_5 loglandkm_{i,t} + \beta_6 logcoastkm_{i,t} + \sum_{t=2014}^{2015} \gamma\delta_t + \varepsilon_{i,t} \quad (3.1)$$

where

$$\varepsilon_{i,t} = u_i + \omega_{i,t} \quad (3.2)$$

where $t \in \{2013, 2014, 2015\}$. u_i stands for unobserved characteristics of country i, and $\omega_{i,t}$ is the error term. Variables $logkm$ and $logcoast$ are the natural logarithms of length of land border and length of coastline, respectively(Each variable is re-centered by adding 1 to each of them before taking the natural logarithm). From the theoretical model, what is expected to be seen is that $\beta_1 = \beta_2 = 0$ and $\beta_3 > 0$. The interaction term is used to capture possible differences To select the model to be implemented from pooled OLS, fixed effects and random effects estimators, I, first, go with comparing fixed effects and random effects estimators by using Hausman test statistics. Null hypothesis in Hausman test cannot be rejected, concluding that random effects estimator is more efficient than fixed effects. Hausman test results are provided in Table 2.

Table 2. Hausman test statistics

	FE	RE	Difference	S.E
gini	-9.688432	.440585	-10.12902	8.838173
incomegini	4.827764	1.810751	3.017013	1.941054
logincomepc	-.0742963	.7825751	-.8568714	.622742
popdens	.0005715	.0000219	.0005497	.0001867
2014	-.0058845	-.0052431	-.0006414	.0013008
2015	.0122747	.0129494	-.0006747	.0098286

Test:	Ho: difference in coefficients not systematic
$\chi^2(4)$ =	3.39
Prob>χ^2 =	0.6405

I provide Breusch and Pagan Lagrangian multiplier test for random effects in Table 3, which concludes that random effects should be implemented. To avoid potential issues that can arise due to the collinearity between income and Gini coefficient, I also conduct a residual regression, where first Gini coefficient is regressed on the other explanatory variables, and then this regression's predicted residuals is used in place of Gini coefficient. All regression outputs are provided in Table 4.

Table 3. Breusch and Pagan Lagrangian multiplier test statistics

	Var	sd = sqrt(var)
logsafetypc	.7755726	.880666
e	.0060029	.0774782
u	.0533012	.2308705

Test: var(u) = 0
$\underline{\chi}^2(01)$ = 103.90
Prob>$\underline{\chi}^2$ = 0.000

3.3 Regression Outputs

Table 4. Regression outputs

logsafetypc	(1)	(2)	(3)	(4)
logincomepc	0.815***	0.785***	0.813***	0.822***
	(0.05)	(0.26)	(0.05)	(0.05)
gini	0.973	0.394		
	(0.68)	(5.84)		
incomegini		0.060		
		(0.58)		
residual			1.197*	-3.930
			(0.64)	(6.49)
incomeresidual				0.530
				(0.64)
age	0.010	0.010	0.001	0.001
	(0.01)	(0.01)	(0.01)	(0.01)
popdens	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
loglandkm	0.016	0.016	0.026	0.026
	(0.04)	(0.04)	(0.04)	(0.04)
logcoastkm	0.009	0.010	0.024	0.030*
	(0.02)	(0.02)	(0.02)	(0.02)
constant	5.228***	5.272***	7.924***	8.921***
	(0.56)	(0.34)	(1.06)	(0.53)
# of observations	162	162	141	141

* p<0.1, ** p<0.05, *** p<0.01
(1): Results from RE with Gini; (2): Results from RE with Gini and interaction; (3): Results from RE with residuals in place gini; (4): Results from RE with residuals and interaction. The dependent variable is natural logarithm of per-capita safety expenditures, the variable *logsafetypc*, in all models. *residual* is the predicted residuals from regressing Gini on the other explanatory and control variables. *age*, *popdens*, *loglandkm*, *logcoastkm* stand for median age, population density, length of land border and length of coastaline, where *incomegini* and *incomeresidual* are the interaction terms. Corrected standard errors are reported in parentheses.

As expected from what the theoretical model states, coefficient of Gini is not statistically significant where per capita income has a positive significant effect on per rapita safety expenditure. When we conduct a regression using residuals in place of Gini for robustness check, the results are the same.

CHAPTER 4

CONCLUSION

This thesis investigates how the optimal government response to crime is shaped by national income and inequality. The literature on this issue is already well organized. There are plenty of studies that investigate the relationship between income, inequality, crime and while their results can differ from each other. These studies set a government problem where the government maximizes a social welfare involving criminal activity. The result that the existing literature mainly suggests is that the government's public safety expenditure is an increasing function of inequality and income.

In this thesis, I argue that the government's motivation behind fighting against crime is not about its expected realization. This kind of an approach turns the direct effect of criminal attempt into redundant. Hence, I go with an optimization where the government minimizes the potential damage of criminal attempts to the society, which is defined as the aggregate utility loss from the criminal attempts in case all the attempts are successfully realized. Also, the utility term here does not include criminal activity gain to deter its redistributive effects.

To do the analysis, I create an endowment economy environment in which there is a given distribution of endowments, which is called income. I first create and solve an individual expected utility maximization problem which yields the optimal value of criminal attempt choice, taking government policy as given. Then, I introduce an explicit income function which is a function of individuals and state the properties of that function. Using the solution to the individual maximization problem and the income function, I define crime and the economic value of crime in terms of pre-tax and post-tax income, and pre-tax and post-tax inequality, and show how they act in these variables. As the last, I write down the government's problem. Solution to the government's problem states that public safety expenditure increases in higher income, but it is not related with inequality.

Then, to see whether these results are in line with the data, I conduct a panel-data analysis with 54 countries and 3 years. The relevant tests suggest using random effects model and the result of the random effect model is in line with what the theoretical model states. For robustness, I also conduct another random effects model analysis in which I first regress Gini on the other explanatory and control variables, then obtain the residuals from that regression and repeat the original regression by using the residuals in place of Gini coefficient in order to avoid the issues that can arise due to the collinearity between Gini coefficient and income, and show that results of this regression are similar to results obtained from the original regression.

APPENDIX

THE ALTERNATIVE APPROACH

Let $\mathcal{T} = \{d, c\}$ be the type set where d and c denote decent type and criminal type, respectively. In this environment, optimum value of criminal activity for i_τ, the individual i of type τ is:

$$\alpha(i_\tau) = \begin{cases} \underline{y} - y(i_\tau) & , \tau = c \text{ and } \underline{y} > y(i_\tau) \\ 0 & , otherwise \end{cases} \tag{1}$$

Type of an individual is a private information. Hence, the government does not now whether an individual is a criminal or not. Yet, it can observe each individual's probability of being criminal type, $p_i = Pr(i_\tau = i_c)$. Let $\mathcal{P} = \{p_i\}_i$, and define $\theta(i) : \mathcal{I} \to \mathcal{P}$, the function showing the probability of being criminal for individual i. Assume that $\theta(i)$ is a continuous function. So, what the government does now is to replace the value of criminal activity with the expected value of criminal activity. The expected value of criminal activity is expressed as:

$$EV = \int_0^n \theta(i)\alpha(i)di \tag{2}$$

Since both α and θ are continuous on the interval $[0, n]$, from the mean value theorem, there exist a $\zeta \in [0, n]$ such that

$$EV = \theta(\zeta) \int_0^n \alpha(i)di = \theta(\zeta)V \tag{3}$$

and $\theta(\zeta)$ does not depend on s, λ, β and W. Hence, the use of the objective function with the expected value of criminal activity would not change the results obtained in the original model concluding that even though there were exogenous parameters determining criminal activity, as long as economic environment stands as a determinant, the results would be the same.

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