Queen's Economics Department Working Paper No. 1233

Accounting for the Racial Property Crime Gap in the US: A Quantitative Equilibrium Analysis

Marco Cozzi
QueenŠs University

Department of Economics
Queen's University
94 University Avenue
Kingston, Ontario, Canada
K7L 3N6

1-2010

Accounting for the Racial Property Crime Gap in the US: A Quantitative Equilibrium Analysis*

Marco Cozzi, Queen's University

December 2009

Abstract

This paper studies the effects of both labor market conditions and asset poverty on the property crimes involvement of American males. Since the mid 60's the property crimes arrest rate has been four times higher for black males if compared to white ones. Another set of stylised facts show for the first demographic group lower educational levels and worse labor market outcomes, with the African Americans supplying less hours of labor, gaining lower wages, experiencing both higher unemployment duration and rates. At the same time, more than 30% of black households had a negative net worth. A dynamic general equilibrium model is developed, exploiting these facts to quantitatively assess the race crime gap, that is the difference in crime explained by the difference in observables. The model is calibrated relying on US data and solved numerically. The model captures well relevant dimensions of the crime phenomenon, such as the inmates composition by race, employment status and education. Simulation results show that the observed poverty and labor market outcomes account for as much as 90% of the arrest rates ratio. Finally the model is used to compare two alternative policy experiments aimed at reducing the aggregate crime rate: increasing the expenditure on police seems to be cost effective, when compared to an equally expensive lump-sum subsidy targeted to the high school dropouts.

JEL Classification Codes: K42, D58, D52, D99, J15.

Keywords: Property crimes, Computable General Equilibrium, Incomplete Markets, Race, Unemployment, Wealth Inequality.

***Aknowledgements:** *I am especially grateful to Antonio Merlo, Nicola Pavoni, and Gianluca Violante for their valuable input. Moreover, I benefited from several comments and suggestions by Gianluca Femminis, Giovanni Gallipoli, Daniela Iorio, Andrea Mattozzi, Claudio Michelacci, Marina Pavan, Josep Pijoan-Mas, Víctor Ríos-Rull, Andrew Scott, and seminar participants in Tilburg, UCL, CEA meeting in Toronto, SCE meeting in Washington (DC), and EEA meeting in Amsterdam. All errors are mine. E-mail: mcozzi@econ.queensu.ca.*

1 Introduction

In the US a striking fact about property crimes is the high participation of one minority group: the African American males. For example, data from the Bureau of Justice Statitics show that in 1996 the property crimes arrest rate (per 1.000 males) was equal to 5,35 for white males and 24,0 for black ones. In the same year 2% of the US white population was under correctional supervision, while the same figure for blacks was 8.9%. Such drastic gaps can be explained in several ways. If, for some reasons, legitimate economic opportunities are correlated with demographic traits, the group facing the worse situation can resort to crime more often, to partially overcome the economic disadvantage, as discussed in Bound and Freeman (1992) and Anderson (1999). Alternatively, peer effects and social interactions among people belonging to the same demographic group can influence heavily criminal choices, as proposed by Sah (1991) and Glaser, Sacerdote and Scheinkman (1996). Finally, it can be claimed that the criminal justice system has practices which are discriminatory with respect to minorities, a hypothesis tested for example in Knowles, Persico and Todd (2001) and Hernandez-Murillo and Knowles (2004).

This paper takes the first point of view, assessing the importance of both labor market conditions and asset poverty in accounting for the observed racial crime gap. In an environment with no peer effects or discriminatory criminal justice, this contribution quantitatively evaluates to what extent worse legal opportunities can be considered responsible for the high crime involvement of black American males. An equilibrium model of rational crime participation is developed to study the impact of more diffuse poverty, higher unemployment rates, lower educational achievements, lower wages and lower labor supply on the crime behavior of black males in the US. The analysis considers only property crimes, or the class of crimes that are more likely to be motivated by an economic evaluation of the potential gains, i.e. the value of the stolen goods, and costs, i.e. the chances of being apprehended together with the severity of the punishment.[1] The theoretical model extends Becker (1968) framework to a dynamic environment, along the lines of Flinn (1986) and Imrohoroglu, Merlo and Rupert (2004). It then exploits the information related to the labor market characteristics to quantitatively assess the differences in crime behaviors between agents facing different legitimate opportunities, namely blacks and whites.

An infinitely lived agents model is developed, allowing for several layers of heterogeneity: race (synthesized by the labor market opportunities), education, employment status and asset holdings.

[1] In order to focus on crimes that are mainly driven by economic forces, violent crimes are neglected altogether. Property crimes (defined as the sum of burglaries, larcenies, motor vehicle thefts and robberies) reported to the police and included in the FBI Uniform Crime Reports have historically accounted for more than 90% of total known crimes in the US.

Each dimension of heterogeneity is a channel that gives different incentives to commit a property crime: these are studied altogether and, by means of counterfactual analysis, one at a time. Given the richness of the model, an analytical solution cannot be obtained: the model is calibrated relying on US data and solved numerically.

Simulation results show that the observed poverty and labor market outcomes account for as much as 90% of the arrest rates ratio. The model captures well relevant dimensions of the crime phenomenon, such as the inmates composition by race, employment status and education. The equilibrium features of the analysis allow to perform counterfactual analysis with an endogenous response of the individuals to different public policies. The calibrated model is used to compare two alternative policy experiments aimed at reducing the aggregate crime rate: increasing the expenditure on police seems to be cost effective, when compared to an equally expensive lump-sum subsidy targeted to the high school dropouts.

The following section surveys the literature related to this paper.

1.1 Related Literature

This paper is related to at least two strands of literature, the first one being the studies on the economics of race and the labor market, the second one being the economics literature on crime.

As for the economic analysis of the different labor market conditions according to race, the empirical literature in particular is vast. Here the focus will be on the black-white differentials only.[2] Some of the most relevant contributions are Altonji and Blank (1999), Donohue and Heckman (1991) and Neal and Johnson (1996).[3]

Altonji and Blank (1999) provide extensive empirical evidence on the differentials by race in the US labor market in the recent past. They discuss and test the theories of discrimination developed in the literature, suggesting that some discrimination is indeed at work. However, from this survey, it seems safe to conclude that there is no consensus on the magnitude of this phenomenon.

Donohue and Heckman (1991) study how the economic status of blacks relative to whites has been improving from the 40's to the late 60's, eventually stagnating from the mid 70's. The authors explain the more recent lack of convergence in the economic outcomes of the two demographic groups with the decline in the relative wages paid to unskilled versus skilled workers that has occurred in that

[2] We can justify this choice by noting that in the US hyspanic people show labor market outcomes which are halfway from the blacks and whites. Also their involvement in property crimes is in this middle position. Moreover, blacks and whites account for more than 90% of the prison population.

[3] This list is by no means exaustive. For a more comprehensive one see the references included in the papers mentioned here.

period of time.

Finally, Neal and Johnson (1996) find that the discrimination in the labor market is very limited, once among the determinants of wages a control for workers' skills (i.e. the AFQT test) is included. They argue that the wage gap reflects mainly a skill gap, in turn determined by different family backgrounds and school environments, that is by premarket factors.

In this respect, notice that the model will be silent on the origins of the labor market differentials by race. In this sense, it can be considered consistent with both a difference in the quantity of human capital and a discrimination behavior determining the different labor market conditions.

As for the literature on crime, it is possible to distinguish between the mainly empirical contributions and the mainly theoretical ones. From an empirical point of view, there have been quite a few studies assessing the effects of unemployment rates on property crimes. The effect has been found to be consistently positive, even though some studies claim that it is small in size.[4] The empirical evidence discussed in Lochner (2004) and Lochner and Moretti (2004) shows that the bulk of property crimes are committed by people with poor educational achievements, with the high school dropouts being the most crime prone group. As for the role of race as a determinant of property crimes, the findings appear to be more controversial. More in detail, some studies find a significant effect of belonging to a minority, e.g. Grogger (1998) and Witte and Tauchen (1994), some other studies do not find any significant effect, e.g. Lochner (1999), and some others find a significant impact of race on the participation in criminal activities depending on the specification adopted, e.g. Kelly (2000) and Levitt (1996). Notice that a potentially important variable that is missing in all these studies is a measure of individual wealth.

Both the theoretical and quantitative research on the economics of crime have been particularly active in the recent years. Some contributions of interest are Burdett, Lagos and Wright (2003), Glaser, Sacerdote and Scheinkman (1996), Imrohoroglu, Merlo and Rupert (2000), Imrohoroglu, Merlo and Rupert (2004), Persico (2002) and Verdier and Zenou (2004).

Burdett, Lagos and Wright (2003) extend the standard search theoretic framework to allow for criminal activities. They study the effect of crime on both unemployment and inequality, showing that the possibility of committing a crime has non trivial effects on both variables.

In Glaser, Sacerdote and Scheinkman (1996) social interactions are introduced in order to explain the high variance of crime rates in cities and over time. They specify and estimate a model where agents imitate the behavior of people living close to them. Their estimates suggest the presence of social interactions.

The contribution of Imrohoroglu, Merlo and Rupert (2000) studies the endogenous determination

[4] See for instance the papers by Witte and Tauchen (1994) and Raphael and Winter-Ebmer (2001).

of crime, redistribution and police expenditure in a majority voting political economy framework. They analyze how these variables are affected by changes in the income distribution and the criminal apprehension technology. Their framework accounts for the correlation among redistribution, police expenditure and property crimes observed in the US data.

Imrohoroglu, Merlo and Rupert (2004) study in a OLG model which factors account for the oscillating behavior of the US property crime rate observed in the mid 70's to mid 90's years. They show that the aging of the population, the stronger economy and the higher apprehension probability explain the drastic drop in the aggregate crime rate that took place in the 90's.

Persico (2002) studies the effect of racial profiling by police in the search for criminals. This study shows that a fair system, that is a system that audits different racial groups with the same intensity, can lead to a lower amount of crime if compared to an unfair system.

To conclude with, Verdier and Zenou (2004) demonstrate how stereotypical beliefs on crime involvement together with location in a city can lead to a discriminatory equilibrium, with the minority group committing more crimes, living further away from productive activities and earning lower wages. The mechanism at work in this economy is of the self-fulfilling type.

As a final remark, notice that none of these papers deals with race, poverty, labor market conditions and property crimes in a quantitative framework, which is the focus of this paper.

The rest of the paper is organized as follows. Section 2 discusses some stylized facts related to crime behaviors and labor market conditions for the male population in the US. The theoretical model is presented in section 3, while section 4 is devoted to the definition of the equilibrium concept used in the model: the recursive stationary competitive equilibrium. Section 5 presents the calibration used in the simulations. Section 6 provides the main results and predictions of the baseline model, including the comparison of two policy experiments and the discussion of counterfactual analysis. Section 7 concludes. The algorithm used for the solution of the model and some computational details are described in appendix A. A further discussion of the data can be found in appendix B.

2 Empirical Evidence

In this section we document and discuss some stylized facts about property crime involvement in the US.

Figure (1) plots the time series of the property crimes arrest rates by race from 1965 to 2001. These data are collected by the Federal Bureau of Investigations and are expressed as the number of property crimes arrests for 100.000 individuals belonging to that race. From the figure we can see

that both races have shown similar trends over time, possibly suggesting that a) the police did not change its apprehension strategy, b) people of different races respond to the same incentives as far as property crimes are concerned. However, the levels are drastically different: for whites, the arrest rate has been oscillating from 300 to 650, while for blacks from 1.464 to 3.180. Even though there seems to be a slow convergence taking place, figure (2) tells us that the arrest rate ratio is still above 4.

[Figure (1) about here]

[Figure (2) about here]

Figure (3) merges data taken from the U.S. Department of Justice, Bureau of Justice Statistics, and the U.S. Census Bureau. This figure plots the property crime rates reported to the police in the year 2000 in each American state versus the share of black people living in those states.[5] This graph can only suggest a positive correlation between the two variables. States with higher black people shares also tend to have higher property crime rates, the sample correlation being equal to 0.49 if Washington DC is included in the sample and to 0.34 if it is excluded.[6] Obviously, this simple plot cannot imply any causal link from one variable to the other. One more feature suggested by the plot is the presence of a fairly high degree of non linearity in the data. A linear regression with a common specification in the literature displays an R^2 equal to 0.4, with race being significant across several specifications.[7]

[Figure (3) about here]

Another source of information on the differentials in crime participation between blacks and whites in the US is the *National Crime Victimization Survey* (*NCVS*).[8] Table 1 shows a variable included in

[5] For a detailed definition of property crimes see appendix B.

[6] This relation appears to be stable over time. Moreover, the sample including DC could provide a better representation of this phenomenon, being DC a metropolitan aerea. Indeed, data from the Bureau of Justice Statistics show that the vast majority of property crimes are perpetrated in metropolitan areas, while data from the Current Population Survey show that in 1996 black households lived mostly in metropolitan areas with at least one million of residents (the precise figure is 60%, versus only 45% of white households). See appendix B for the corresponding plot using data from the US cities with a population of at least 200000 people.

[7] The dependent variable is the property crime rate and the regressors are the per capita income, the male unemployment rate, the share of people between 16 and 24 years old, the per capita justice expenditure, the percentage of people below the poverty line, the share of black residents, the percentage of high school dropouts and a constant.

[8] See appendix B for more details on this survey.

the *NCVS*. This provides information about robberies: a sample of persons victim of a robbery were asked to identify the race of the criminals attacking them. Table 1 refers to robberies carried out by a single offender.

The Table shows an interesting pattern: irrespective of the decline in the number of total robberies over time, black individuals were recognized to be the offenders in a robbery far more often than people belonging to other races. Moreover, not only these figures do not simply reflect the share of black people in the population (around 12%), but also they represent the highest rate.

[Table 1 about here]

So far only indirect evidence of the crime involvement of African Americans has been provided. Two longitudinal studies, the *NLSY79* and the *NLSY97*, represent a source of more direct evidence: the young people randomly selected in the samples were asked whether they participated into criminal activities and, if so, in which crimes.

As for the *NLSY79*, the original sample consisted of 14-22 year-old people and the questionnaire included only in the year 1980 a self administered section with questions on crime involvement. These data show that no clear racial pattern arises. However, subsequent cross validation studies suggested that black respondents underreported their crime participation, Freeman (1999).[9]

As for the *NLSY97*, the original sample consisted of 12-16 year-old people. In each round the questionnaire has included self administered questions on the crime involvement of the respondent. Table 2 reports the data for the year 2001.[10] Similarly to the *NLSY79* black youths did not report to participate into property crimes strikingly more often than white youths, even though they tend to show a slightly higher involvement, as Table 2 shows.

[Table 2 about here]

A possible interpretation of this result calls for the short labor market experience of the youths in the *NLSY97*.

Finally, on a more indirect ground, from the Survey of Inmates in State and Federal Correctional Facilities, 40.4% of the prison population in 1997 convicted because of property crimes consisted of

[9] A detailed description of the criminal activities by race of the *NLSY79* respondents is contained in Grogger (1998), table 2 pag. 769.

[10] The year 2001 was selected in order for all the people in the sample to be old enough to participate in the labor market.

black males, while they represented only 11.4% of the male population.[11] It would be possible to argue that the judicial system is racially biased, as in Donohue and Levitt (2001): this is not the line of research pursued here. In this work it is assumed that the judicial system is fair, or that it is blind to race. Irrispective of his race, every criminal faces the same probability of being caught.

[Figure (4) about here]

The empirical evidence presented above focuses on the crime involvement of the two main racial groups in the US. Next, some stylized facts about both the economic conditions and the labor market outcomes for the same racial groups are presented.

Figure (4) reports the time series for the unemployment rates of white and black males 20 years old and over (data are from the Bureau of labor Statistics) in the period 1976-2003. The top line represents the black unemployment rate. What is striking in the graph is the stable relationship between the two unemployment rates. Black males have suffered an unemployment rate which has always been at least twice as much as the corresponding figure for white males.[12] Beside the higher incidence of unemployment, black males have consistently had also longer average unemployment spell. Figure (5) plots the time series for both the average and median unemployment durations, expressed in weeks. Another sharp difference between blacks and whites is related to the rewards in the labor market. As reported in Altonji and Blank (1999), data from the March 1996 CPS show that there was a substantial gap in annual earnings: white males earned on average $36,169, while black males earned as little as $23,645. Obviously, part of these gaps are explained by the different educational achievements of the two groups. In 1996, 14.56% (20.17%) of white (black) males did not have a high school degree, 58.37% (65.14%) had at least a high school degree but did not had a college one and 27.06% (14.68%) had at least a college degree. These facts suggest that black males have experienced worse labor market conditions and outcomes in the recent past. On a different perspective, relying on data from the Survey of Consumer Finances, Wolff (1998) has provided evidence on the racial wealth disparities: the average asset holdings of white households has been around five times higher than the corresponding figure for black households in the last 20 years. Large wealth differentials might be due to differences in inheritances, as studied by Altonji and Doraszelski (2005), or by different rates of enterpreneurship, as discussed in Fairlie and Meyer (1996). Moreover, Wolff (2000) shows that in

[11] According to the US Bureau of Justice, in 1995 more than 90% of the prison and jail population consisted of males. This suggests to drop women from the relevant population, in order to focus on the main forces driving the decisions of becoming a criminal.

[12] Notice that considering the unemployment rates by education groups does not alter the picture.

1995 31.3% black households had a negative value for the net worth, while the percentage for white households was 15%.

[Figure (5) about here]

From this set of empirical facts it is possible to argue that African Americans face very different incentives to commit a property crime if compared to the white population. The next section develops a theoretical model aimed both at exploiting these stylized facts and explaining the higher involvement of African Americans in illegitimate activities. Notice that the concept of race adopted is extremely naive. It is a characteristic which is perfectly observable by all economic agents at no costs and relates only to different legitimate opportunities.

3 The Baseline Model

In this section we propose a dynamic general equilibrium model of crime, along the lines of Imrohoroglu, Merlo and Rupert (2004), with infinitely lived heterogeneous agents.[13] It extends the framework proposed by Huggett (1993) and Aiyagari (1994) to include an endogenous crime choice, agents belonging to two different races (i.e. Blacks/Whites), three levels of education (i.e. high school dropouts, high school degree and college or higher degree), a self-financing unemployment insurance benefits scheme and a self-financing judicial system. The model is framed in an incomplete markets environment. More specifically, agents in the economy face three idiosyncratic risks: 1) being unemployed, 2) being victim of a property crime, and 3) going to jail if involved in property crimes. The former is assumed to be uninsurable, the second is insurable in a competitive market and the latter is not, since it is the outcome of a public policy.[14] As for the former assumption, it is a well know fact that felons convicted because of a property crime were more likely to be unemployed at the time of the offense. Together with the usual arguments motivating incomplete markets, this state dependent outcome suggests that people cannot fully insure against the unemployment risk.[15] Time is discrete and the economy lasts forever.

[13] Other GE models of crime are developed in Fender (1999), Furlong (1987), Grossman (1995), Sala-i-Martin (1992). An interesting partial equilibrium contribution is Davis (1988).

[14] The assumption of insurability of property crimes is made mainly to keep the notation simple. In previous versions of the model we assumed that alle risks were uninsurable, obtaining results with no relevant differences.

[15] An alternative explanation could be linked to ability. People of low ability could be more likely to be unemployed hence they could self select into criminal activities, showing at the same time high incarceration and unemployment rates. For the latter kind of argument to go through, the concept of ability adopted should be a kind of ability rewarded by the labor market, but not necessarily linked to the criminal ability. Otherwise less able criminals would spend more time in jail, making crime economically less attractive.

3.1 Demographics

The economy is populated by infinitely lived agents whose measure is normalized to one.[16] Agents are ex-ante heterogenous with respect to both their race and their educational achievement. Race is denoted with $ra \in \mathcal{RA} = \{wh, bl\}$ while education level is denoted with $ed \in \mathcal{ED} = \{hsd, hs, col\}$. More in detail, agents of different race/education pairs differ in the probability and duration of employment opportunities, exogenous labor supply $h_{ra,ed}$ and labor efficiency units $\varepsilon_{ra,ed}$. The parameter $\psi_{ra,ed}$ represents the share of (ra, ed) workers. Obviously the shares must add up to one, that is $\sum_{ra,ed} \psi_{ra,ed} = 1$. There is no population growth and the $\psi_{ra,ed}$ do not change over time. As mentioned before, in this framework race boils down to exogenous labor market related characteristics and endogenous asset distributions. Notice also that at this stage there is no feedback from the criminal market to the labor market.

3.2 Preferences

Agents' preferences are assumed to be represented by a time separable utility function $U(.)$. Agents' utility is defined over stochastic consumption sequences $\{c_t\}_{t=0}^{\infty}$: their aim is to choose how much to consume (c_t), how much to save in an interest bearing asset (a_{t+1}) and how many property crimes to commit (cr_t) in each period of their lives, in order to maximize their objective function.[17] The agents problem can be defined as

$$\max_{\{c_t, a_{t+1}, cr_t\}_{t=0}^{\infty}} U(c_0, c_1, ...) = \max_{\{c_t, a_{t+1}, cr_t\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t u(c_t)$$

where E_0 represents the expectation operator over all the possible histories generated by the employment opportunity shocks $(s \in \mathcal{S} = \{e, u\})$, the probability of apprehension if crimes are committed (π_a) and the probability of being a victim of property crimes carried out by other agents (π_v); $\beta \in (0, 1)$ is the subjective discount factor. We assume that $u(.) : \mathcal{C} \to \mathbb{R}$, the period utility function, is strictly increasing, strictly concave and satisfies the Inada conditions. Notice that there is no direct disutility neither from work nor from incarceration, hence labor supply is fixed.

[16] The infinitely lived agents assumption is made to give both the wealth distribution and the exogenous borrowing limits a sharper role, without resorting to arbitrary assumptions on the initial wealth distribution, assumptions that would be needed in a standard OLG framework.

[17] With some abuse of notation, in the sequential representation of the problem we dropped the history of shocks (h^t) as an argument of the choice variables. The process for consumption should read $\{c_t(h^t)\}_{t=0}^{\infty}$ and similarly for savings and property crimes.

3.3 Endowments

Agents are all born with the same asset endowment a_0.[18] In every period they can be employed (e) or unemployed (u). If employed they supply inelastically a constant fraction of their time endowment ($h_{ra,ed}$). The stochastic employment opportunities follow a two state first order Markov process. The transition function of the employment opportunity state is represented by the race/education dependent matrices $\Pi_{ra,ed}(s,s') = [\pi_{ra,ed}(i,j)]$, where each element $\pi_{ra,ed}(i,j)$ is defined as $\pi_{ra,ed}(i,j) = \Pr\{s_{t+1} = j | s_t = i\},\ i,j = \{e,\ u\}$.[19] Finally, every agent is endowed with exogenous efficiency units denoted as $\varepsilon_{ra,ed}$.

3.4 Property Crimes

Every agent can engage in property crimes in every period of his life, irrespective of his employment opportunity. The modeling strategy related to the crime choice generalizes **?**. There exists a criminal technology, $y(cr)$, that maps the number of crimes into criminal earnings. We assume that committing crimes corresponds to stealing a constant fraction η of the average non-asset income in the economy $\overline{y}$ times the number of crimes cr. That is, we assume that $y(cr) = \eta\overline{y}cr$. Notice that $y'(cr) > 0$ and $y(0) = 0$, that is the technology is linear and people who decide not to be involved in property crimes get zero illegal income. A crime attempt is always successful. However, with probability $\pi_a(cr)$ criminals are caught and incarcerated at the beginning of the period, while with probability $(1 - \pi_a(cr))$ they remain free and can use the additional economic resources $\eta\overline{y}cr$, obtained through theft. For simplicity assume a linear relationship for the probability of apprehension $\pi_a(cr) = \pi_a cr$, with $0 \leq \pi_a \leq 1$ being a parameter. Notice that committing crimes does not entail any direct cost, neither monetary nor in terms of time; the only cost is the opportunity cost of being apprehended. With endogenous probability π_v (which in equilibrium corresponds to the aggregate crime rate) an agent is victim of a crime and loses $\eta\overline{y}$ units of his income.[20] Notice that we assume that an agent can be victimized at most once in a period of time. Moreover, both the criminal earnings function and the apprehension technology are the same for every agent in the economy.

[18] Notice that the specific initial value does not play any role, since the analysis will focus on stationary equilibria, which do not depend on the initial condition.

[19] Hereafter the prime symbol $\prime$ denotes future variables.

[20] This assumption is justified from the data contained in the NCVS: somewhat surprisingly, there is a zero correlation between the victim's income and the amount stolen.

3.5 Government

The role of the government in this economy is twofold.

On the one side it runs the unemployment insurance benefits scheme, by taxing the labor income of the employed workers at rate τ_U and subsidizing the unemployed workers at the replacement rate ϕ. ϕ is a policy parameter exogenously given, while τ_U is set residually to ensure a self-financing scheme.

On the other side, the government runs the legal system, providing the apprehension technology that allows to detect and punish a fraction $\pi_a cr$ of the crimes committed. The justice system is costly and we assume that there is a cost $\overline{J}$ per arrest made.

Detected criminals are immediately incarcerated: while in prison they all consume a constant level $\overline{c}_a$. $\overline{J}$ consists of both inmates consumption and other expenditures (e.g. judicial expenditures), which are financed through a proportional labor income tax τ_J paid by all the agents in the economy. Also τ_J is set such that the scheme is self-financing.

3.6 Technology

The production side of the model is extremely simple. There is a constant returns to scale technology of the Cobb-Douglas form, which relies on aggregate capital K and labor L to produce the final output Y.[21]

$$Y = F(K, L) = BK^{\alpha}L^{1-\alpha}.$$

Capital depreciates at the exogenous rate δ and firms hire capital and labor every period from competitive markets. From the first order conditions of the firm we obtain the expression for the net real return to capital r and the wage rate per efficiency unit w:

$$r = \alpha B \left(\frac{L}{K}\right)^{1-\alpha} - \delta, \tag{1}$$

$$w = (1-\alpha) B \left(\frac{K}{L}\right)^{\alpha}. \tag{2}$$

[21] Since the analysis will focus on steady-states only, time indexes are omitted, for the sake of notational clarity.

3.7 Other market arrangements

The final good market is competitive. Moreover, every agent must satisfy an exogenous borrowing limit, denoted by $d \geq b_{ra}$. Notice that we allow for borrowing limits to be race dependent. Finally, it is not possible to insure against the unemployment shock, while all agents buy a property crime insurance at price p_I.

3.8 Timing

The timing of the model is assumed to be the following: 1) The idiosyncratic unemployment shocks are realized and observed by the agents; 2) Production takes place, with the employed people working for a wage and with the unemployed receiving the subsidy; 3) The crime, consumption and saving decisions are taken; 4) A random fraction of criminals are caught and immediately incarcerated; 5) Inmates get out of jail.

Notice that by assumption the implied model period length corresponds to the average time spent in prison by a criminal: hence, the population eligible to work is stationary and equal to 1 in every period.

4 Equilibrium

In this section we first define the problems of the employed and unemployed workers in their recursive representation, then we provide a formal definition of the equilibrium concept used in this model. Notice that the vector representing the individual state variables is defined as $x = (ra, ed, a, s)$, whose entries are race $ra \in \mathcal{RA} = \{wh, bl\}$, education level $ed \in \mathcal{ED} = \{hsd, hs, col\}$, individual asset holdings $a \in \mathcal{A} = [d, \infty)$ and employment status $s \in \mathcal{S} = \{e, u\}$. The optimal value functions are defined as $V_i(a, s)$, where for notational simplicity $i \in \mathcal{RA} \times \mathcal{ED}$. The stationary distributions over the vector x are denoted as $\mu_i(a, s)$.

4.1 Households' Problem

4.1.1 Problem of the unemployed workers

The value function for the unemployed workers of a given race/education pair i and with asset holding equal to a can be written as:

$$V_i(a, u) = \max_{c, a', cr} \{Eu(c) + \beta E \textstyle\sum_{s'} \pi_i(u, s') V_i(a', s')\} \tag{3}$$

More in detail

$$V_i(a,u) = \max_{a',cr} \{[1-\pi_a(cr)]\, u((1+r)\,a + (1-\tau_J)\,\phi w h_i \varepsilon_i + y(cr) - a' - p_I) +$$

$$\pi_a(cr) u(\overline{c}_a) + \beta \textstyle\sum_{s'} \pi_i(u,s') \{[1-\pi_a(cr)]\, V_i(a',s') + \pi_a(cr) V_i(a,s')\}\}$$

$$s.t.$$

$$a_0 \ given, \ c \geq 0, \ a' \geq d, \ cr \geq 0$$

Notice that we have substituted the explicit expression for the current expected utility $Eu(c) = [1-\pi_a(cr)]\, u(c) + \pi_a(cr) u(\overline{c}_a)$, the expected continuation values and the individual budget constraint $c + a' + p_I \leq (1+r)\,a + (1-\tau_J)\,\phi w h_i \varepsilon_i + y(cr)$.

4.1.2 Problem of the employed workers

The value function for the employed workers can be written as:

$$V_i(a,e) = \max_{c,a',cr} \{Eu(c) + \beta \textstyle\sum_{s'} \pi_i(e,s')\, V_i(a',s')\} \tag{4}$$

More in detail,

$$V_i(a,e) = \max_{a',cr} \{(1-\pi_a(cr))\, u((1+r)\,a + (1-\tau_U-\tau_J)\, w h_i \varepsilon_i + y(cr) - a' - p_I) +$$

$$\pi_a(cr) u(\overline{c}_a) + \beta \textstyle\sum_{s'} \pi_i(e,s') \{[1-\pi_a(cr)]\, V_i(a',s') + \pi_a(cr) V_i(a,s')\}\}$$

$$s.t.$$

$$a_0 \ given, \ c \geq 0, \ a' \geq d, \ cr \geq 0$$

Notice that the individual budget constraint in this case reads $c + a' + p_I \leq (1+r)\,a + (1-\tau_U-\tau_J)\, w h_i \varepsilon_i + y(cr)$.

Is it worth stressing the assumption that if a criminal is detected he is immediately convicted. To avoid prisons to act as a forced savings mechanism, we assume that the legal resources of a criminal are seized and destroyed by the government. It follows that convicted felons cannot rely on their earned legal income for their consumption/saving plans. More precisely, in this case, savings are equal to the current asset level, or $a' = a$.

It is now possible to define the recursive competitive equilibrium. Moreover, the analysis will be restricted to steady-states only, that is to prices, endogenous variables and distributions over the state variables which are stationary over time.

4.2 Recursive Stationary Equilibrium

Definition 1 *For a given set of policies* $\{\phi; \overline{c}_a\}$, *apprehension probability* π_a, *cost per arrest* $\overline{J}$, *race/education shares* ψ_i, *labor supplies* h_i *and efficiency units* ε_i, *a recursive stationary equilibrium is a set of individual decision rules* $\{c_i(a,s), a_i'(a,s), cr_i(a,s)\}$, *value functions* $\{V_i(a,s)\}$, *prices* $\{r, w, p_I\}$, *taxes* $\{\tau_U, \tau_J\}$, *average labor income* $\overline{y}$, *aggregate victimization rate* π_v, *cost of criminal justice* J *and stationary distributions* $\{\mu_i(a,s)\}$ *such that:*[22]

- Relative factor prices $\{r, w\}$ solve the firm's problem and satisfy equations (1)-(2).
- Given relative prices $\{r, w, p_I\}$, government policies $\{\phi; \overline{c}_a\}$, taxes $\{\tau_U, \tau_J\}$ and $\{\pi_a, \pi_v, \overline{y}, J, \psi_i, h_i, \varepsilon_i\}$, the individual policy functions $\{c_i(a,s), a_i'(a,s), cr_i(a,s)\}$, solve the households problem (3)-(4) and $\{V_i(a,s)\}$ are the associated value functions.
- The labor market clears:
$$L = \sum_i \psi_i h_i \varepsilon_i \int_A d\mu_i(a,e).$$
- The asset market clears:
$$K = \sum_{i,s} \psi_i \int_A \left\{ \left[1 - \pi_a cr_i(a,s)\right] a_i'(a,s) + \pi_a cr_i(a,s) a \right\} d\mu_i(a,s).$$
- The final good market clears:

[22] $c_i(a,s) : A \times S \to R_+$ denotes the consumption functions, $a_i'(a,s) : A \times S \to A$ denotes the saving functions and $cr_i(a,s) : A \times S \to \left[0, \frac{1}{\pi_a}\right]$ denotes the crime functions.

$$F(K,L) = \sum_{i,s} \psi_i \int_A \left[1 - \pi_a cr_i(a,s)\right] c_i(a,s) d\mu_i(a,s) + \delta K + J.$$

- The stationary distributions $\{\mu_i(a,s)\}$ satisfy:

$$\begin{aligned} \mu_i(a',s') \quad = \quad & \sum_s \pi_i\left(s,s'\right) \left\{ \int_{a:a_i'(a,s)=a'} 1 - \pi_a cr_i(a,s) d\mu_i(a,s) + \right. \\ & \left. \int_{a:a=a'} \pi_a cr_i(a,s) d\mu_i(a,s) + \right\}. \end{aligned}$$

In equilibrium the measure of agents of each race in each state is time invariant and consistent with individual decisions.

- The criminal justice expenditure is equal to:

$$J = \overline{J} \sum_{i,s} \psi_i \int_A \pi_a cr_i(a,s) d\mu_i(a,s).$$

- The aggregate crime rate (i.e. the victimization probability) is given by:

$$\pi_v = \sum_{i,s} \psi_i \int_A cr_i(a,s) d\mu_i(a,s).$$

- Average non-asset legitimate income $\overline{y}$ is equal to:

$$\overline{y} = \sum_{i,s} \psi_i h_i \varepsilon_i \int_A y_s d\mu_i(a,s), \text{ with } y_e = \left(1 - \tau_U - \tau_J\right) w, \; y_u = \left(1 - \tau_J\right) \phi w.$$

- The proportional tax rate τ_J is given by:

$$\tau_J = \frac{J}{\sum_{i,s} \psi_i h_i \varepsilon_i \int_A y_s d\mu_i(a,s)}, \text{ with } y_e = w, \; y_u = \phi w.$$

or the revenues from this tax cover for all the criminal justice expenses.

- The unemployment insurance benefits scheme is self-financing:

$$\tau_U = \frac{w \sum_i \psi_i \phi h_i \varepsilon_i \int_A d\mu_i(a,u)}{w \sum_i \psi_i h_i \varepsilon_i \int_A d\mu_i(a,e)}$$

that is the proportional tax rate τ_U is set such that the total expenditure for unemployment benefits are exactly equal to the revenues from taxation.

- The price for the property crime insurance p_I is equal to:

$$p_I = \eta \overline{y} \pi_v$$

Since by assumption the insurance sector is competitive, the price p_I depends only on the probability of being hit by a criminal and the amount stolen.

5 Calibration and Computation

The model is calibrated relying on US data, focusing only on males of age 16 and above in the labor force.

One model period corresponds to the average prison term in the baseline year, or 12.3 months in 1996.[23] Notice that the choice of the model period allows for every person in the economy to be eligible to work in every period of time.

As for preferences, the instantaneous utility function is specified as a Constant Relative Risk Aversion: $u(c_t) = \frac{c_t^{1-\sigma}-1}{1-\sigma}$, with $\sigma = 1.0$.

In order to pin down the efficiency units parameters $\varepsilon_{ra,ed}$, we used the Current Population Survey (CPS) monthly data for 1996. More in detail for each month we run a linear regression with log wages as a dependent variable together with a constant term, a set of education dummies and a dummy for race as regressors.[24] The reference group consisted of the whites high school dropouts. After taking the average of the parameters, from the predicted values of the regression we get the profile for the efficiency units, which is as follows: $\varepsilon_{wh,hsd}$=1.62, $\varepsilon_{wh,hs}$=2.07, $\varepsilon_{wh,col}$=2.42, $\varepsilon_{bl,hsd}$=1.4, $\varepsilon_{bl,hs}$=1.78 and $\varepsilon_{bl,col}$=2.09.

The exogenous labor supply $h_{ra,ed}$ was computed as follows. From the CPS we obtained the average hours worked for each education/race pair. Following the literature on the time use, the average hours worked in the population was set to match the average share of available time devoted to market activities, that is 0.4. Rescaling the hours worked according to this value gives the following parameters $h_{wh,hsd}$=0.369, $h_{wh,hs}$=0.407, $h_{wh,col}$=0.426, $h_{bl,hsd}$=0.355, $h_{bl,hs}$=0.382, and $h_{bl,col}$=0.401.

Again from the 1996 CPS, data related to the unemployment rates by race and education category allow to pin down the entries of the transition matrices $\Pi_{ra,ed}$ for the Markov-chain. We do

[23] The year 1996 was chosen because the observed crime rate was close to the average rate over the period 1970-2000.

[24] Being the model an infinitely lived agents, there is no explicit role for age. However, we estimated an alternative and more common specification which included also age and age squared as regressors. We then computed the efficiency parameters by substituting the relevant average age. The final results were quite similar to the ones in the text.

not allow for state dependence of the unemployment shock, i.e. the probability of future unemployment is the same irrespective of the current occupational status. Figures for unemployment rates in 1996 were $\pi_{wh,hsd}(.,u')$=10.2%, $\pi_{wh,hs}(.,u')$=4.32%, $\pi_{wh,col}(.,u')$=2.18%, $\pi_{bl,hsd}(.,u')$=19.7%, $\pi_{bl,hs}(.,u')$=10.29% and $\pi_{bl,col}(.,u')$=3.82%.

The race/education shares are obtained from the CPS, which gives the following values $\psi_{wh,hsd}$=12.89%, $\psi_{wh,hs}$=51.67%, $\psi_{wh,col}$=23.95%, $\psi_{bl,hsd}$=2.32%, $\psi_{bl,hs}$=7.48% and $\psi_{bl,col}$=1.69%.

In the simulations the exogenous borrowing limit d is set at different levels for the two races. The values are chosen for the model to replicate in equilibrium the share of agents with negative net worth. As reported in Wolff (2000), table 7, in 1995 31.3% black households had a negative value for the net worth, while the percentage for white households was 15%. The values $b_{bl} = -1.151$ and $b_{wh} = -0.655$ allow to replicate these figures. This point deserves further discussion. First, even though there is some evidence of racial discrimination in credit markets, there are no definitive answers on the matter. Furthermore, our calibration strategy goes in the opposite direction of a natural borrowing limit concept, as in Aiyagari (1994). Having black agents lower legitimate earnings, relying on a natural borrowing limit would imply a borrowing limit more stringent for black agents than for whites. Notice, however, that the values for the borrowing limits we are imposing are more stringent than the ones implied by the natural borrowing limit concept.

We normalize the average disposable legitimate earnings $\overline{y}$ to 1. This is done by setting the TFP parameter B equal to 1.047. The actual value in 1996 was $28,513.

Following **?** the exogenous consumption when in jail $\overline{c}_a$ is set at $2,600, i.e. this leads to $\overline{c}_a = 0.0984$.[25]

The policy parameter ϕ, i.e. the replacement rate, is set in order to replicate the actual unemployment benefit scheme operating in the US, i.e. ϕ=0.5.

From the FBI Uniform Crime Reports in 1996 we obtain the number of property crimes cleared with the arrest of the felon. From the NCVS, we compute the total number of property crimes committed in 1996.[26] Accordingly, the apprehension probability per crime is set at $\pi_a = 0.0492$. The parameter related to the earnings from crime is set to $\eta = 0.0439$, to replicate the value of $1,253, the average value of a property crime computed from the Uniform Crime Reports in 1996.

The cost of justice $\overline{J}$ is estimated to be $10,610, i.e. $\overline{J} = 0.3721$. This estimate is obtained as follows. The actual expenditures on judicial, legal activities and corrections for 1996 are weighted by the appropriate percentages of property crimes, i.e. 14.39% for the first two and 31% for the last. This gives a total justice expenditure for property crimes equal to 24 billions. This amount is divided

[25] Notice that in the calibrated economy there will be no agents with a total legitimate income less than $\overline{c}_a$. The lowest value of legitimate disposable income is 0.2.

[26] The NCVS is considered to give more reliable estimates for property crime victimisation of the american households.

by the total number of property crimes cleared with an arrest in 1996, giving the value of \$10,610.[27]

Both for the capital share parameter and the depreciation one, consensus values are used: $\alpha = 0.36$ and $\delta = 0.08$. Finally, we set the subjective discount rate $\beta = 0.958$, to get an equilibrium interest rate in all computations at a value of about 4% on an annual basis.

The complete parameterization of the model is reported in Table 3.[28]

[Table 3 about here]

6 Results

This section starts presenting the optimal policy functions for both black and white agents. Then it moves on to describe the results related to the crime rates.

6.1 Policy Functions

In this simple model we have only three sets of decision rules: the saving functions, the consumption functions and the crime ones. These are considered in turn.

6.1.1 Saving Functions

Figures (6) and (7) show the saving decisions and the 45-degree line for both blacks and whites high school dropouts. One property of these functions is worth noticing: sufficiently poor unemployed individuals are borrowing constrained, while employed ones are not. Another property worth stressing is that these functions are non-decreasing. Unlike in simpler models, this is not guaranteed to hold. Actually, for quite extreme parameterizations, the saving functions become non monotone: they first decrease and then start to increase again. This pattern is due to the interaction between the saving choice and the crime one. The intuition is simple. In the model only individuals with low asset levels choose to commit crimes. This decision provides them with additional resources: part of these are spent to buy the consumption good, part of them are saved. As the individuals get richer, they need to resort less and less on stealing, explaining the decreasing part of the function. As the crime involvement vanishes, a more standard behavior is restored.

[27] Notice that $\overline{c}_a$ is part of $\overline{J}$.

[28] For more details on the computational procedures see the appendix A.

[Figure (6) about here]

[Figure (7) about here]

An interesting comment can be framed in a standard precautionary savings argument. For a given educational level, black individuals know that they will experience bad labor market conditions, as represented by the high unemployment rate. Since they are risk averse, they tend to accumulate assets, in order to smooth consumption over the possible states of the world: by doing this, when a bad shock is realized, they have enough resources to keep the consumption profile sufficiently stable and avoid the borrowing constraint. This buffer stock strategy can lead some blacks to consume less and save more than the whites. However, at the same time, black individuals receive an extremely low labor income that do not allow them to save much. If on the one hand higher unemployment rates increase the incentive to commit a property crime for black individuals, on the other hand they tend to reduce the likelihood of this choice, since agents are induced to save a higher proportion of their income.

It is important to recall that the intersection between the 45-degree line and the saving function for employed agents gives the highest level of assets that in equilibrium the individuals will hold. These intersections occur in regions of the asset space that are not reported in the graphs: this was done only to make the figures visually clear.

Notice that the saving functions qualitative behavior is the same for all education levels, hence we avoid to report them.

6.1.2 Consumption Functions

Figure (8) plots the consumption functions for black individuals who are either high school dropouts or college graduate, for both occupational possibilities. Two things are interesting in this graph. First, for a given educational level, the consumption function of the unemployed is below the employed one, with the distance decreasing in the level of assets. Second, by comparing the consumption functions of the agents with different education, they are unsurprisingly increasing in the education level. What is less obvious is that, for low level of assets, the distance between consumption when employed and unemployed is lower for the high school dropouts. This is again due to the higher involvement in crime of people with a low educational attainment.

[Figure (8) about here]

6.1.3 Crime Functions

[Figure (9) about here]

In this subsection we move to consider the criminal behaviors implied by the model economy. Figure (9) plots the crime decision rules for black unemployed agents. The number of crimes depends heavily on both the educational level and the degree of poverty. Higher educational achievements and higher asset levels imply less crimes. Consider in more detail the most crime prone group: black high school dropouts. Figure (10) depicts their choices. It is interesting to notice that for this demographic group also employed agents resort to crime relatively often.

By comparing figures (10) and (11) we can appreciate some positive predictions of the model. If compared to the whites, black agents do commit more crimes, that is for the same asset level they perpetrate more crimes, and they decide to do so more often, that is their crime functions decrease more slowly.[29]

[Figure (10) about here]

[Figure (11) about here]

6.2 Who Commits Crimes?

Given the optimal policy functions and the stationary distributions we can discuss the predictions of the model as far as the crime rates are concerned. First, we compute the percentage of agents that steal at least \$50 dollars in a period, that is whose income from illegitimate activities is at least 0.00189. As for the black population, almost every high school dropout is involved in property crimes, defined as above. The precise figures are 89.0% for employed people and 90.3% for the unemployed. As for the white high school dropouts, these values are somewhat different, being 68.3% for the employed and 75.7% for the unemployed. In comparison, as for the high school graduates, 8.0% of the black employed and 22.6% of the unemployed are involved in property crimes, while no white employed and

[29] Notice that, as far as crime is concerned, the presence of the *wh* workers in the economy is perceived as a positive externality by the *bl* workers, since *wh* workers receive a higher labour income in equilibrium. This rises the incentives for the *bl* agents to commit crimes. This is why it is crucial to include explicitely different races in the model rather than running separately the model calibrated in turn for the two races. The same comments apply for agents with low education levels when compared to people with higher ones.

1.7% of the unemployed are. Finally, only 2.0% of black college graduates and 0.7% of white college graduates who are unemployed decide to resort to crime. These results are reported in Table 4.

[Table 4 about here]

These results deserve some further discussion. The numbers above highlight how bad labor market conditions and poverty can make criminal activities more appealing, leading black individuals to resort to stealing to overcome the economic disadvantage they are facing in the legitimate activities. This result is consistent with the stylized facts described before, which showed a definitely higher crime involvement for the black population. Moreover, this model shows that is possible to get big differences in criminal behaviors according to race even without relying on a social interaction framework. The combination of the dynamic set-up, the limited legitimate rewards for the dropouts and the temptation induced by well paid workers are the basic ingredients that allow for this result. First, agents with poor labor market prospects accumulate little assets: this is due both to their low income and to the relatively frequent unemployment spells they experience. Poverty is then driving the stealing decisions. If it is possible to name the different labor market conditions with the term *discrimination*, Bertrand and Mullainathan (2004), then it is clear how bad are the dynamic effects implied by it, which would be even greater if we were to introduce a stigma effect for the convicted criminals.

6.3 Model Vs. Data

In order to assess the performance of the model, we compare four variables of interest to the corresponding figures in the FBI and BJS data for 1996. Namely, we consider the ratio of the arrest rates by race, the percentage of inmates by education, the percentage of inmates by employment at the time of the arrest and the percentage of inmates by race. Table 5 reports these variables.

As for the arrest rates by race ratio, the model implies a number very close to the data provided by the FBI: 4.04 versus 4.48. It is worth stressing that the large race crime gap is obtained only from the differences in labor market conditions and asset holding, that is without resorting to any imitation mechanism among agents. The different legitimate conditions account for 90% of the race crime gap observed in the data.

As for the inmates composition by education, the model tracks the data very well. The discrepancies between the model and the data are modest.

Finally, the model performs fairly well in accounting for both the employment status at the time of the arrest and the race of the 1997 prison population.

[Table 5 about here]

6.4 Experiments

This section is devoted to discuss some counterfactual experiments. First, some conceptual exercises are performed, where the heterogeneity between the two races is reduced. Then, two policies implying the same costs are compared.

As for the first set of exercises, the results are found in table 6. The table reports both the race arrest ratio implied by the model under consideration and the percent change in the crime rate with respect to either the baseline model or a model where the two races are identical in every dimension. The exercises are divided into two groups. First, in the top part of the table, we report the results of making the two demographic groups equal in just one aspect. These are the models from 2 to 6. Then, in the bottom part of the table, we report the results of making the two demographic groups identical in every aspect but one. These are the models from 8 to 12.

In both types of exercise, the strongest effect on the criminal behavior is found to be due to the difference in efficiency units. Moreover, the results related to the change in the probability of unemployment are a bit misleading. In these cases the percentage of people with negative assets varies dramatically with respect to the benchmark case, explaining such big responses of the crime rate and the sign of the change.

It is useful to compare our findings to those in Grogger (1998). Relying on an Oaxaca-type decomposition applied to the *NLSY79* data, Grogger (1998) finds that 26% of the racial differential in crime participation rates is due to the black-white wage gap. We find an even stronger effect, since model 9 accounts for 49% of the racial arrest ratio. As seen, the difference in efficiency units directly maps to earnings differential and affects heavily the crime decision. Understanding the determinants of the wage gap is of paramount importance. As remarked before, there are many competing explanations in the literature: the role of pre-market factors, taste discrimination, statistical discrimination and specialization into jobs with lower wage growth. In this version of the model we assumed the efficiency units gap to be exogenous. Considering explicitly the feedbacks from the labor market to the crime one and viceversa seems to be an appropriate way to endogenise the wage differences.

[Table 6 about here]

The second set of counterfactuals is aimed at understanding which public policy is more effective in reducing the aggregate crime rate. More precisely, a comparison between two policies implying the same cost is carried out. The first policy involves an increase in the income for the high school dropouts, that is an improvement for the group with the worst economic condition. In contrast, the second policy increases the likelihood of the punishment through an increase in the police expenditure. Notice that for the policy comparisons to be more informative, the most crime prone groups need to be modeled in a rather detailed way. This is one of reasons why it is very important to consider race explicitly. The results of such experiments are reported in Table 7.

For the first case, starting from the benchmark calibration, we compute the value of the high school dropouts non asset income. Then we give a lump-sum subsidy to all dropouts worth 2.5% of this value. Considering the number of people involved and the monetary value of the subsidy ($481), this policy would imply a cost in per capita terms of $73. Then we solve the model under this new specification. The new model economy implies a decrease in the crime rate equal to 6.8%.

Given the cost of the first policy, we consider another policy opposite in spirit to the first one, i.e. a policy which increases the likelihood of the punishment. Following Imrohoroglu, Merlo and Rupert (2000), we specify an apprehension technology of the form $\pi_a = 1 - G^{-\gamma}$, with G being the public expenditure on police. To use this function, we need to estimate γ. In order to do so, we consider the time series of the real per capita police expenditure and the time series of the property crimes clearance rates.[30] For the clearance rate, as before, we take the number of crimes cleared with an arrest from the UCR and the total number of crimes from the NCVS. Then we rewrite the equation above as $1 - \pi_a = G^{-\gamma} \rightarrow \ln(1 - \pi_{at}) = -\gamma \ln G_t$. Since both series are non stationary, we take first differences and estimate with OLS this equation in growth rates, i.e. $\Delta \ln(1 - \pi_{at}) = -\gamma \Delta \ln G_t$.

The point estimate for γ is 0.04. Finally, increasing the police expenditure in 1996 by $73, from a starting value of $127, we get the new value for π_a=0.052. Then we solve the model with this higher apprehension probability: the crime rate drops by 18.6%.

[Table 7 about here]

The table has an immediate interpretation. In terms of decreasing the aggregate crime rate, the most effective policy is the one that increases the expenditure on police, making a prison term more likely for the criminals.

[30] This series is readily available from 1980 to 1999, see table 1.2 of the 2002 Sourcebook of Criminal Justice Statistics, US Dept of Justice.

7 Discussion and Conclusions

In this paper we proposed a model able to account for the observed differences in crime involvement between black and white American males.

The overall assessment of the model suggests that it succeeds in generating the race crime gap, or the higher involvement in crime of black versus white individuals. Blacks do commit disproportionately more crime in the model: the model accounts for 90% of the race arrest ratio observed in 1996. In addition, on the basis of counterfactual analysis, the race wage gap seems to be the most important factor in shaping the crime differential, a channel already discussed by Grogger (1998) and Machin and Meghir (2003). This paper has argued that if we are to understand the race crime gap it is of paramount importance to understand what forces drive the observed differentials in the labor market.

The next step in the research is to obtain endogenously the labor market differences according to race. It is reasonable to think that, given the dimension of the crime phenomenon in the US, there are significant feedback effects going from the labor market to the crime market and viceversa. This kind of considerations are potentially very important for agents with low educational levels, whose criminal participation is particularly high. If training and hiring costs are non-negligible and if on the job learning is an important component of the worker's productivity, employers will accurately screen the workforce trying to form a match only with those workers that maximize the expected profits of the relationship, with duration playing an important role. Obviously, the incarceration of a worker represents an interruption of the employer/employee relationship. In the hiring process, given the high historical race crime gap, employers could use race as a signal, that is they could statistically discriminate among applicants on the basis of race. According to this story, unemployment, wage and crime differences by race should be persistent. However, this explanation begs for a question: where do the initial differences between races come from?

It goes without saying that the simple firms structure assumed in the current version of the model cannot accommodate such an extension. First, the value of a firm must be non-zero in order for the future to play a non trivial role on the current decisions. Second, the labor market should provide a wage per worker type, rather than a wage per efficiency units.

Furthermore, the model considered here cannot take into consideration some crucial aspects of the crime phenomenon. In first instance, crime is primarily committed by people of young age, Leung (1994), while our framework does not give age any role in determining the crime decisions. A feasible extension, in order to capture in a parsimonious way the life-cycle dimension of the property crime participation, is to specify a perpetual youth model. This way the framework could allow easily for two different and important aspects: 1) temporary stigma effects in the labor market for convicted criminals; 2) changing labor market conditions over the life-cycle.

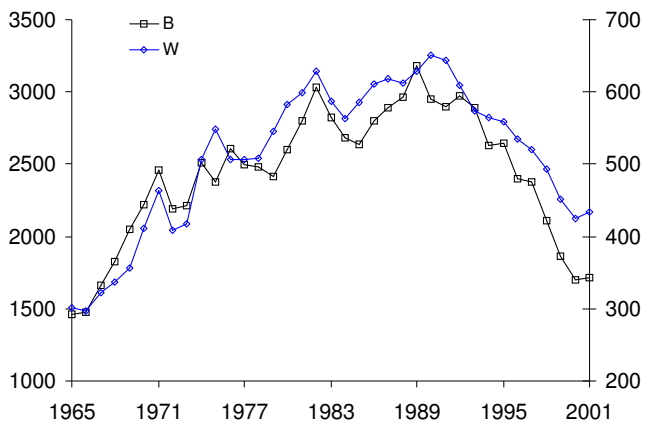

Figure 1: Property crimes arrest rates per 100.000 males by race (Whites, blue line and right scale). Source: Uniform Crime Reports, FBI

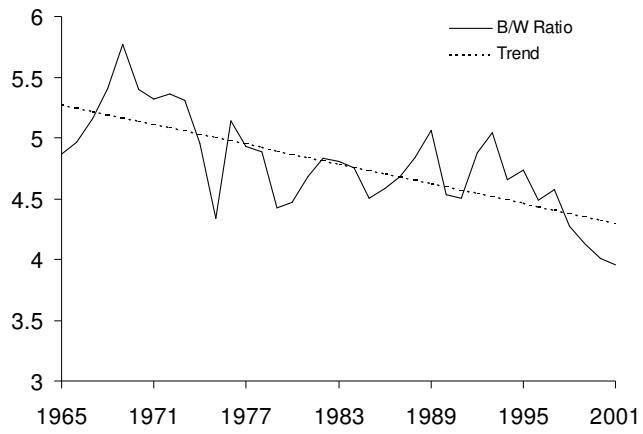

Figure 2: FBI Arrest Rates By Race Ratio

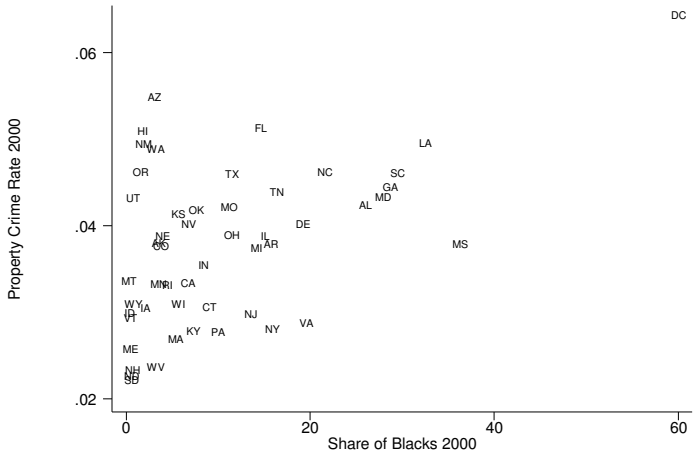

Figure 3: Property Crime Rates and Share of Blacks in the US states, 2000.

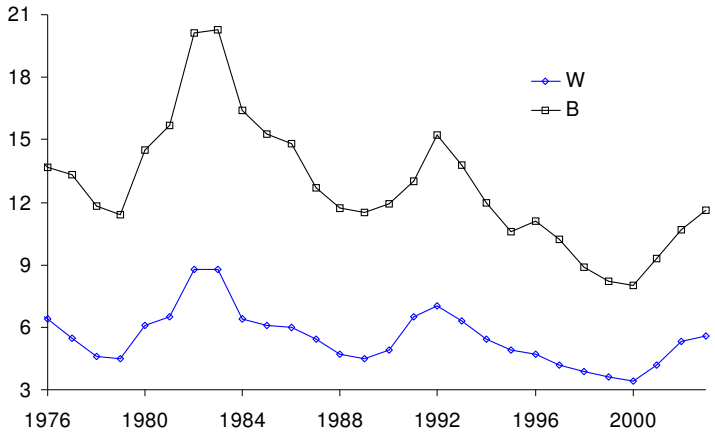

Figure 4: Black (top) and White (bottom) Men (16+) Unemployment Rates

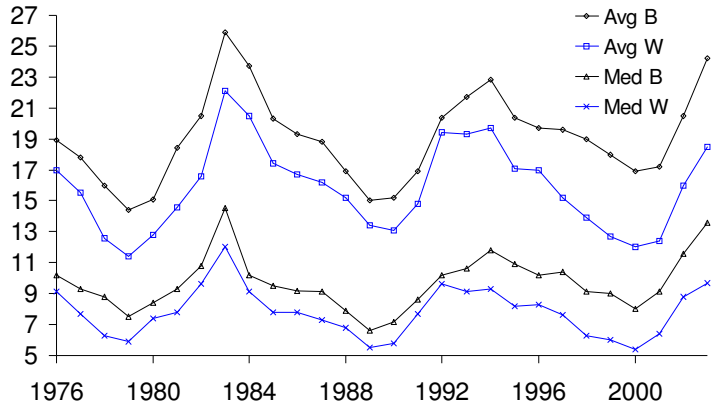

Figure 5: Males Average and Median Unemployment Durations

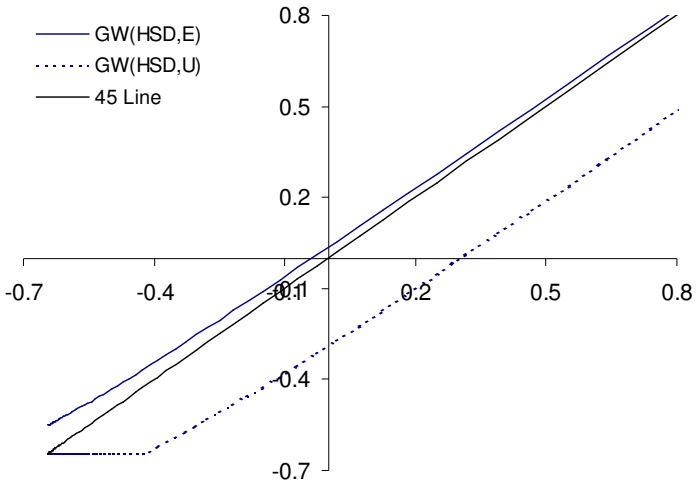

Figure 6: Saving Functions (Whites - Dropouts)

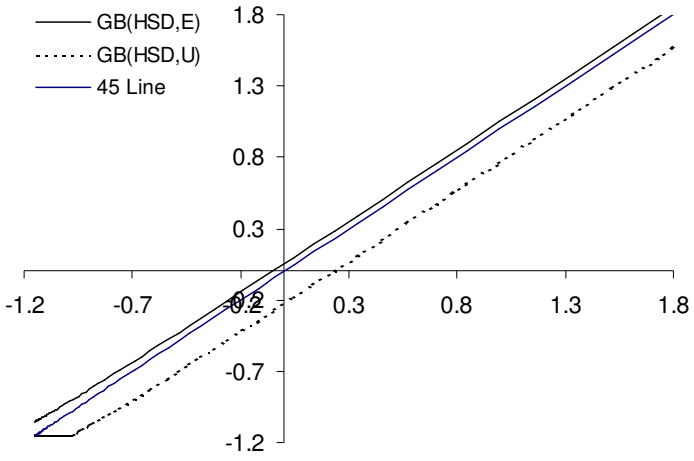

Figure 7: Saving Functions (Blacks - Dropouts)

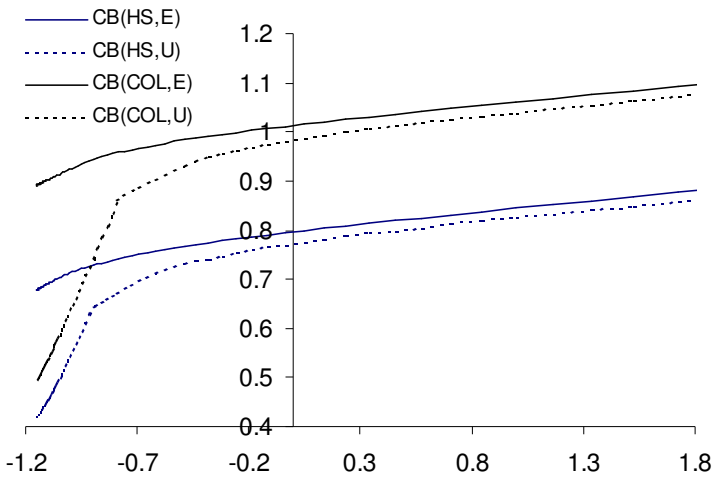

Figure 8: Consumption Functions (Blacks - Dropouts and College)

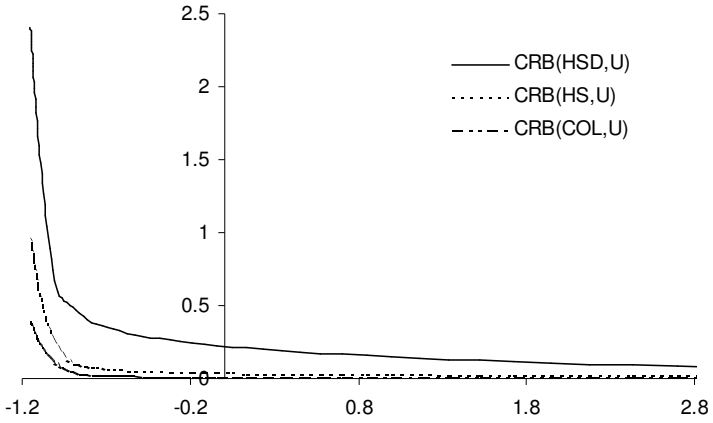

Figure 9: Crime Functions (Blacks - Unemployed)

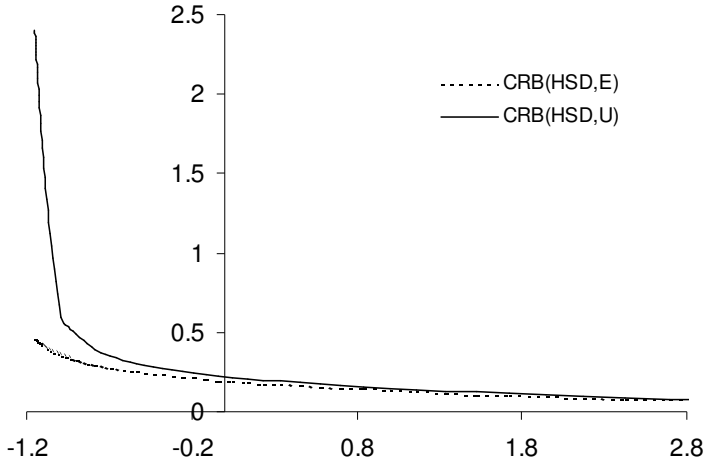

Figure 10: Crime Functions (Blacks - Dropouts)

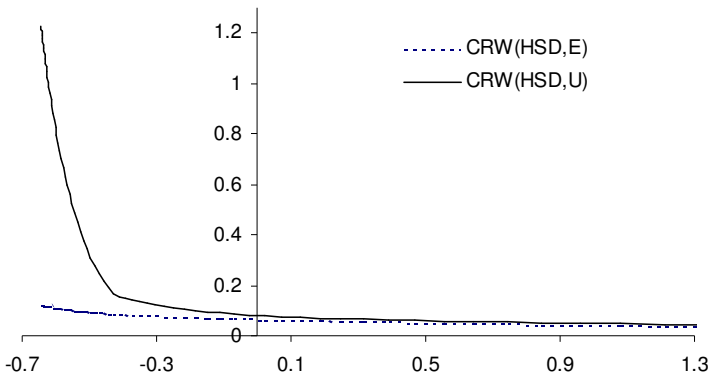

Figure 11: Crime Functions (Whites - Dropouts)

Year	*Robberies*	*Whites (%)*	*Blacks (%)*	*Other*	*N/A*
1996	655800	36.8	51.5	7.5	4.2
1997	565010	38.1	43.0	14.8	4.2
1998	547500	44.3	39.6	10.1	6.0
1999	465430	42.4	46.5	7.0	4.2
2000	407490	37.1	47.7	12.3	2.8
2001	340910	44.9	47.4	6.1	1.6

Table 1: Race of Robbery Offenders - NCVS

	Blacks	*Whites*
Ethnic (rescaled) share in the NLSY97	33.4%	66.6%
Stolen something worth less than $50	29.5%	70.5%
Stolen something worth more than $50	36.0%	64.0%
Other Property Crimes	35.2%	64.8%

Table 2: Property Crimes in the NLSY97 - 2001

Parameter	*Value*	*Target*
Model Period	12.3 *months*	*Average Prison term period*
B	1.047	*Average legitimate non-asset income= 1*
α	0.36	*Standard*
δ	0.08	*Standard*
β	0.958	*Standard*
σ	1.0	*Standard*
$h_{ra,ed}$	*See text*	*Data from CPS*
$\varepsilon_{ra,ed}$	*See text*	*From a regression on CPS data*
$\psi_{ra,ed}$	*See text*	*Data from CPS*
b_{wh}	-0.655	*15.0% of whites with negative net worth*
b_{bl}	-1.152	*31.3% of blacks with negative net worth*
$\overline{c}_a$	0.0984	*Inmates consumption =$2,600*
η	0.0439	*One crime is worth $1,253*
π_a	0.0492	*Data from NCVS and UCR*
$\overline{J}$	0.3721	*Expenditure per arrest =$10,610*
ϕ	0.5	*US unemployment benefits legislation*
$\pi_{ra,ed}(.,u')$	*See text*	*Data from CPS*

Table 3: Calibration

% Committing Crime	*Employed*	*Unemployed*
Blacks - Dropouts	89.0	90.3
Blacks - High School	8.0	22.6
Blacks - College	0	2.0
Whites - Dropouts	68.3	75.7
Whites - High School	0	1.7
Whites - College	0	0.7

Table 4: Shares of Specific Groups Committing Crimes

Variable	*Model*	*Data*
Arrest Rates Ratio (B/W)	4.04	4.48
Inmates Dropouts	54.6%	57.5%
Inmates High School	39.9%	36.3%
Inmates College	5.5%	6.2%
Inmates Employed	86.8%	71.3%
Inmates Unemployed	13.2%	28.7%
Inmates Blacks	44.3%	40.4%
Inmates Whites	55.7%	59.6%

Table 5: Model Vs. Data

Model	*Arrest Ratio*	*Crime Rate Change*
1) *Baseline*	4.04	-
2) *Equal Borrowing Limit*	3.43	-5.15%
3) *Equal Efficiency Units*	1.75	-13.38%
4) *Equal labor Supplies*	3.09	-5.45%
5) *Equal Unemployment*	4.16	+2.17%
6) *Equal Education*	3.28	-4.27%
7) *Everything Equal*	1	-
8) *Different Borrowing Limit*	1.14	+1.57%
9) *Different Efficiency Units*	2.22	+4.93%
10) *Different labor Supplies*	1.31	-0.07%
11) *Different Unemployment*	0.96	-1.69%
12) *Different Education*	1.23	-0.07

Table 6: Counterfactual Experiments

Experiment	*Crime Rate Change*
Lump-sum subsidy to dropouts	-6.8%
Increased apprehension probability	-18.6%

Table 7: Policy Experiments

References

Aiyagari, R. (1994). "Uninsured Idiosyncratic Risk and Aggregate Saving," *Quarterly Journal of Economics,* Vol. 109 (3), 659-684.

Altonji, J. and R. Blank. (1999). "Race and Gender in the labor Market," chapter 48 in *Handbook of labor Economics, Volume 3,* edited by O. Ashenfelter and D. Card. Amsterdam: North Holland.

Altonji, J. and U. Doraszelski. (2005). "The Role of Permanent Income and Demographics in Black/White Differences in Wealth," *Journal of Human Resources*, Vol. 40 (1), 1-30.

Anderson, E. (1999). *The Code Of The Street: Decency, Violence, And The Moral Life Of The Inner City*, New York: W.W. Norton.

Becker, G. (1968). "Crime and Punishment: An Economic Approach," *Journal of Political Economy*, Vol. 76, 169-217.

Bertrand, M. and S. Mullainathan. (2004). "Are Emily and Brendan More Employable than Latoya and Tyrone? Evidence on Racial Discrimination in the Labor Market from a Large Randomized Experiment," *American Economic Review*, Vol. 94 (4), 991-1013.

Bound, J. and R. Freeman. (1992). "What Went Wrong? The Erosion of Relative Earnings and. Employment among Young Black Men in the 1980s," *Quarterly Journal of Economics,* Vol. 107, 202-232.

Burdett, K., R. Lagos and R. Wright. (2003). "Crime, Inequality and Unemployment," *American Economic Review*, Vol. 93, 1764-1777.

Burdett, K., R. Lagos and R. Wright. (2004). "An On-the-job Search Model of Crime, Inequality, and Unemployment," *International Economic Review*, Vol. 45 (3), 681-706.

Davis, M. (1988). "Time and Punishment: An Intertemporal Model of Crime," *Journal of Political Economy,* Vol. 96 (2), 383-90.

DiIulio, J. (1996). "Help Wanted: Economists, Crime and Public Policy," *Journal of Economic Perspectives,* Vol.10 (1), 3-24.

Donohue, J. and J. Heckman. (1991). "Continuous Versus Episodic Change: the Impact of Civil Rights Policy on the Economic Status of Blacks," *Journal of Economic Literature,* Vol. 29 (4), 1603-1643.

Donohue, J. and S. Levitt. (2001). "The Impact of Race on Policing, Arrest Patterns and Crime," *Journal of Law and Economics*, Vol. 44 (2), 367-394.

Ehrlich, I. (1996). "Crime, Punishment, and the Market for Offenses," *Journal of Economic Perspectives,* Vol. 10 (1), 43-67.

Fairlie, R. and B. Meyer. (1996). "Ethnic and Racial Self-Employment Differences and Possible Explanations," *Journal of Human Resources*, Vol. 31 (4), 757-793.

Fender, J. (1999). "A General Equilibrium Model of Crime and Punishment," *Journal of Economic Behavior and Organisation,* Vol. 39 (4), 437-453.

Flinn, C. (1986). "Dynamic Models of Criminal Careers," chapter 9 in *Criminal Careers and Career Criminals*, Volume 2, edited by Blumstein et al. Washington, D.C.: National Academy Press.

Freeman, R. (1999). "The Economics of Crime," chapter 52 in *Handbook of labor Economics, Volume 3,* edited by O. Ashenfelter and D. Card. Amsterdam: North Holland.

Freeman, R. (1996). "Why Do So Many Young American Men Commit Crimes and What Might We Do About It?," *Journal of Economic Perspectives,* Vol. 10 (1), 25-42.

Furlong, W. (1987). "A General Equilibrium Model of Crime Commission and Prevention," *Journal of Public Economics,* Vol. 34, 87-103.

Glaser, E., B. Sacerdote and J. Scheinkman. (1996). "Crime and Social Interactions," *Quarterly Journal of Economics,* Vol.111 (2), 507-548.

Grogger, J. (1998). "Market Wages and Youth Crime," *Journal of Labor Economics,* Vol. 16 (4), 756-791.

Grossman, H. (1995). "Robin Hood and the Redistribution of Property Income," *European Journal of Political Economy*, Vol. 11(3), 399-410.

Hernandez-Murillo, R. and J. Knowles. (2004). "Racial Profiling or Racist Policing? Bounds Tests in Aggregate Data," *International Economic Review*, Vol. 45 (3), 959-989.

Huggett, M. (1993). "The Risk-free Rate in Heterogeneous-agent Incomplete-insurance Economies ," *Journal of Economic Dynamics and Control,* Vol. 17, 953-969.

Kelly, M. (2000). "Inequality and Crime," *Review of Economics and Statistics*, Vol. 82 (4), 530-539.

Knowles, J., N. Persico and P. Todd. (2001). "Racial Bias in Motor-Vehicle Searches: Theory and Evidence," *Journal of Political Economy*, Vol. 109 (1), 203-229.

Imrohoroglu, A., A. Merlo and P. Rupert. (2004). "What Accounts for the Decline in Crime?," *International Economic Review*, Vol. 45 (3), 707-729.

Imrohoroglu, A., A. Merlo and P. Rupert. (2000). "On the Political Economy of Income Redistribution and Crime," *International Economic Review*, Vol. 41 (1), 1-25.

Leung, S. F. (1994). "An Economic Analysis of the Age-Crime Profile," *Journal of Economic Dynamics and Control*, Vol. 18, 481-497.

Levitt, S. (1996). "The Effect of Prison Population Size on Crime Rates: Evidence from Prison Overcrowding Litigation," *Quarterly Journal of Economics,* Vol. 111 (2), 319-351.

Lochner, L. (1999). "Education, Work, and Crime: Theory and Evidence," RCER Working Paper No. 465, 1999.

Lochner, L. (2004). "Education, Work, and Crime: A Human Capital Approach," *International Economic Review*, Vol. 45 (3), 811-843.

Lochner, L. and E. Moretti. (2004). "The Effect of Education on Crime: Evidence from Prison Inmates, Arrests, and Self-Reports," *American Economic Review*, Vol. 94 (1), 155-189.

Machin, S and C. Meghir. (2003). "Crime and Economic Incentives," *Journal of Human Resources*, 39(4): 958-979.

Neal, D. and W. Johnson. (1996). "The Role of Premarket Factors in Black-White Wage Differences," *Journal of Political Economy*, Vol. 104(5), 869-895.

Persico, N. (2002). "Racial Profiling, Fairness and Effectiveness of Policing," *American Economic Review*, Vol. 92 (5),1472-1497.

Raphael, S. and Rudolf Winter-Ebmer. (2001). "Identifying the Effect of Unemployment on Crime," *Journal of Law and Economics*, 44(1), 259-284.

Sah, R. (1991). "Social Osmosis and Patterns of Crime," *Journal of Political Economy*, Vol. 99 (6), 1272-1295.

Sala-i-Martin. (1997). "Transfers, Social Safety Nets, and Economic Growth," *International Monetary Fund Staff Papers*, Vol. 44 (1), 81-102.

Verdier, T. and Y. Zenou. (2004). "Racial Beliefs, Location and the Causes of Crime," *International Economic Review*, Vol. 45 (3), 731-760.

Witte, A. D. and H. Tauchen. (1994). "Work and Crime: An Exploration Using Panel Data," *Public Finance*, Suppl., Vol. 49 (0), 155-67.

Wolff, E. (2000). "Recent trends in wealth ownership, 1983-1998," *Working Paper No. 300*, Jerome Levy Economics Institute.

Wolff, E. (1998). "Recent Trends in the Size Distribution of Household Wealth," *Journal of Economic Perspectives,* Vol.12 (3), 131-150.

Appendix A - Solution Algorithm

The computational procedure used to solve the baseline model can be represented by the following algorithm:

- Generate discrete grids over the asset space $[b_{ra}, ..., a_{\max}]$;
- Get the invariant distributions over s associated with $\Pi_{ra,ed}$;
- Get the equilibrium tax rate on labor income τ_U;
- Get the aggregate labor supply L;
- Guess the aggregate crime rate π_{v0};
- Guess the criminal justice tax rate τ_{J0};
- Compute the insurance price $p_I = \eta\overline{y}\pi_{v0}$;
- Guess on the interest rate r_0;
- Get the capital demand and the wage rate w;
- Get the average non asset legitimate income $\overline{y}$;
- Get the crime functions $cr_{ra,ed}(a,s)$;
- Get the saving functions $a'_{ra,ed}(a,s)$;
- Get the stationary distributions $\mu_{ra,ed}(a,s)$;
- Check asset market clearing; Get r_1;
- Update $r'_0 = \varpi r_0 + (1-\varpi) r_1$ (with ϖ arbitrary weight);
- Iterate until market clearing;
- Check final good market clearing;

- Get the aggregate crime rate π_{v1};
- Update $\pi'_{v0} = \xi\pi_{v0} + (1-\xi)\,\pi_{v1}$ (with ξ arbitrary weight);
- Get the criminal justice tax rate τ_{J1};
- Update $\tau'_{J0} = \zeta\tau_{J0} + (1-\zeta)\,\tau_{J1}$ (with ζ arbitrary weight);
- Iterate until convergence.

Appendix B - Data Description

Description

The data used in this paper come from several different sources.

1. The Uniform Crime Rate (UCR): is developed and maintained by the FBI. It can be obtained from `http://149.101.22.40/dataonline/Search/Crime/State/StatebyState.cfm`. The FBI categories were amended, excluding Arson and considering robberies as a property crime rather than a violent one. More precise definitions follow.

- Robbery - The taking or attempting to take anything of value from the care, custody, or control of a person or persons by force or threat of force or violence and/or by putting the victim in fear.
- Burglary - breaking or entering - The unlawful entry of a structure to commit a felony or a theft. Attempted forcible entry is included.
- Larceny-theft (except motor vehicle theft) - The unlawful taking, carrying, leading, or riding away of property from the possession or constructive possession of another. Examples are thefts of bicycles or automobile accessories, shoplifting, pocket-picking, or the stealing of any property or article which is not taken by force and violence or by fraud. Attempted larcenies are included. Embezzlement, confidence games, forgery, worthless checks, etc., are excluded.
- Motor vehicle theft - The theft or attempted theft of a motor vehicle. A motor vehicle is self-propelled and runs on the surface and not on rails. Motorboats, construction equipment, airplanes, and farming equipment are specifically excluded from this category.

2. National Crime Victimization Survey (NCVS): is the Nation's primary source of information on criminal victimization. Each year, data are obtained from a nationally representative sample of 42,000 households comprising nearly 76,000 persons on the frequency, characteristics and consequences of criminal victimization in the United States. For more information on the methodology of this survey and to download the data see `http://www.ojp.usdoj.gov/bjs/cvict.htm.`

3. National Longitudinal Survey of Youth (NLSY).

- NLSY 79: is a nationally representative sample of 12,686 young men and women who were 14-22 years old when they were first surveyed in 1979. These individuals were interviewed annually through 1994 and are currently interviewed on a biennial basis. For more information on the methodology of these surveys and to download the data see `http://www.bls.gov/nls/nlsy79.htm`

- NLSY 97: consists of a nationally representative sample of approximately 9,000 youths who were 12 to 16 years old as of December 31, 1996. Round 1 of the survey took place in 1997. In that round, both the eligible youth and one of that youth's parents received hour-long personal interviews. Youths continue to be interviewed on an annual basis. For more information on the methodology of these surveys and to download the data see and `http://www.bls.gov/nls/nlsy97.htm.`

4. Current Population Survey (CPS): is a monthly survey of about 50,000 households conducted by the Bureau of the Census for the Bureau of Labor Statistics. The survey has been conducted for more than 50 years. The CPS is the primary source of information on the labor force characteristics of the U.S. population. The sample is scientifically selected to represent the civilian noninstitutional population. Data and codebooks can be downloaded from `http://www.bls.census.gov/cps/cpsmain.htm.`

5. Census: see `http://www.census.gov/population/www/socdemo/race/black.html.`