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Racial Beliefs, Location and the Causes of Crime

by Thierry Verdier and Yves Zenou

IUI, The Research Institute of Industrial Economics
P.O. Box 5501
SE-114 85 Stockholm
Sweden

Racial Beliefs, Location and the Causes of Crime[*]

Thierry Verdier[†]
CERAS-ENPC, DELTA-ENS and CEPR

Yves Zenou[‡]
IUI, University of Southampton and GAINS

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Abstract: This paper provides a unified explanation for why blacks commit more crime, are located in poorer neighborhoods and receive lower wages than whites. If everybody believes that blacks are more criminal than whites -even if there is no basis for this- then blacks are offered lower wages and, as a result, locate further away from jobs. Distant residence increases even more the black-white wage gap because of more tiredness and higher commuting costs. Blacks have thus a lower opportunity cost of committing crime and become indeed more criminal than whites. Therefore beliefs are self-fulfilling.

Running Head: Location and Crime

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[†]DELTA-ENS, 48 boulevard Jourdan, 75014 Paris, France. E-mail: verdier@delta.ens.fr

[‡]Corresponding author. IUI, The Research Institute of Industrial Economics, Box 5501, 114 85 Stockholm, Sweden. E-mail: yvesz@iui.se

1 Introduction

In this paper, we propose a model based on location, wages and beliefs to explain why, after controlling for human capital differences, criminality is higher among blacks and even higher when they reside in ghettos. The aim of this paper is thus to show that both location and beliefs matter for explaining the high crime rate among blacks in cities.

It is well documented that blacks are on average more criminals than whites, even after controlling for the usual determinants of crime such as education. For example, in the U.S., the proportion of black men 20 to 29 years old directly in trouble with the law (in jail or prison or on probation or parole) reached 23 percent in 1989 (Case and Katz, 1991). Freeman (1994) shows that, in 1993, the number incarcerated was 1.9 percent of the male work force, but among blacks, the number incarcerated was 8.8 percent of the work force and 25.3 percent under supervision relative to the work force. For black men aged 18-34, the ratios to the work force were 12.7 percent incarcerated and 36.7 percent under supervision.

It is also well documented that, within cities, crime is highly concentrated in a limited number of areas. For instance, in U.S. metropolitan areas, after controlling for education, crime rates are much higher in central cities than in suburbs. Between 1985 and 1992, crime victimizations averaged 0.409 per household in central cities, while they averaged 0.306 per household in suburbs (Bearse, 1996, Figure 1).[1] More generally, U.S. central cities have higher crime and unemployment rates, higher population densities and larger relative black populations than their corresponding suburban rings (South and Crowder, 1997, Table 2).

Thus, even after controlling for human capital (education) and other idiosyncratic characteristics (such as age for example), one still observes that crime rates are higher for blacks than for whites and that they are unevenly distributed within cities (see for example Freeman, 1999). Social interaction models, stating that individual behavior depends not only on individual incentives but also on the behavior of peers and neighbors, are a natural way of explaining the concentration of crime by area. An individual is more likely to commit crime if his/her peers commit crime than if they do not (Glaeser, Sacerdote

[1] Grogger and Willis (2000, Table 2) also show that central cities are more crime-ridden than suburbs for most crimes. For instance, the mean murder rate in central cities is five times greater than that in the suburbs and for property crimes they differ by a factor of two or three.

and Scheinkman, 1996).[2]

We adopt here a different route by focusing on beliefs and location. The belief-based equilibrium idea and the self-fulfilling prophecy in which negative beliefs about an identified group lead to a bad outcome for this group has been extensively used in models of statistical discrimination (see e.g. Acemoglu, 1995, Coate and Loury, 1993, Framer and Terell, 1996, Moro and Norman, 2003, Piketty, 1998). The mechanics of our model that generates differential outcomes for blacks and whites is very close to the one used in these models. What is new here is the interpretation of the various variables and the role of location. In particular, if the primitives of the economy are such that our model possesses a unique equilibrium, then without location (or more generally space), one cannot generate multiple equilibria.

Let us be more precise about this mechanism. Our model ties locational segregation, crime and racial inequality in a unified framework. The key feature is that each piece of the puzzle could be explained on its own but, by constraining ourselves to use a parametric specification, we show that they can only stand together. For example, one could easily write a "statistical discrimination" model of crime without location but this would not, in our model, generate a "discriminatory" equilibrium without location. One could also write a location model without racial inequality, such that criminals locate far away from jobs but this would not explain why crime is not symmetric across races. What is interesting here is that (under some parametric assumptions), it is only when one combines the two pieces that an asymmetric equilibrium is possible.

Let us now describe our model. Blacks and whites are *ex ante* identical. They all have the same distribution of aversion to crime u, which is assumed to be uniformly distributed. There is (statistical) discrimination in the labor market since firms pay to each worker the average productivity of his/her group. Assuming that (non-convicted) crime hurts productivity, then groups with higher crime rates receive lower wages. We also assume that workers residing further away are less productive (more tired) than those living closer to jobs. If all workers believe that blacks are more criminal than whites, then blacks will segregate themselves from whites because their ability to pay for land will be lower due to anticipated lower wages (labor discrimination). Since blacks are segregated and live further away from jobs, the wage gap between blacks and whites is even larger because of spatial discrimination. As a

[2] For an overview on the spatial aspects of crime, see Zenou (2003).

result, blacks become more criminal than whites because of lower labor market opportunities. The loop is closed and beliefs are self-fulfilling. *It is therefore our contention that, after controlling for human capital differences, location and beliefs play a major role in explaining the enormous over-representation of blacks in criminal activities.*

2 The model

There are two types of individuals, blacks (B) and whites (W), who only differ by the color of their skin. In other words, the two types are differentiated only by a characteristic $i \in \{B, W\}$ that is publicly observable by all agents (workers and firms) in the economy. This characteristic is totally unrelated to any fundamental parameter of the economy. For simplicity, we normalize the size of each population to 1. Workers of both types $\{B, W\}$ are heterogeneous in their incentives to commit crime so that they have different aversion to crime u (or alternatively crime productivity). Regardless of location and type, we assume that this parameter u is independently identically distributed (i.i.d.) across individuals according to a uniform distribution $F(u) = u$ on the interval $[0, 1]$.

All agents, workers and firms, are assumed to be risk neutral. The city, in which both firms and workers are located, is monocentric, i.e., all firms are exogenously located in the Business District (BD hereafter), linear, closed and all land is owned by absentee landlords.[3] The BD is the place where all firms are located. Observe that our model can capture the case of both US and European cities depending on the location of the BD (in the city-center or in the suburbs). However, as it will become clear below, *what really matters here is the distance to jobs.*

There is a continuum of workers (blacks or whites) uniformly distributed along the linear city who endogenously decide their optimal residence between the BD and the city fringe. They all consume the same amount of land (normalized to 1 for simplicity) and the density of residential land parcels is taken to be unity so that there are exactly x units of housing within a distance x of the BD. Workers go to the BD to work (commuting costs) and thus bear a total cost tx at a distance x from the BD (where t is the commuting cost per

[3] We assume for simplicity throughout that land is a perfect substitute for housing, so that both are equivalent. This can be relaxed by adding a housing sector as for example in Muth (1969). This will complicate the analysis but not alter our main results.

unit of distance).

The timing of the model is as follows. In the first stage, all individuals choose their location in the city without knowing their type u but anticipating (with rational expectations) the average total population of criminals of type $i = B, W$. In the second stage, types (or honesty parameters) are revealed and individuals decide to commit crime or not. The assumption that types are revealed only after location choices has been made to take into account the relative inertia of the land market compared to the crime and labor markets. Obviously, individuals make quicker decisions in terms of crime or labor than in terms of residential location. As we will see below (see the end of section 3.1), this assumption is made to simplify the analysis and relaxing it do not alter the main results of this paper. In stage 3, honest and non-convicted workers participate in the labor market and, in stage 4, consume the composite good.

Observe that in the second stage, workers are stuck to their initial locations (decided in the first stage) and cannot relocate themselves. They then decide to become criminal or not by taking into account the fact that, the further away they reside from jobs, the higher is the opportunity cost of being far away from legal activities. Since there is full employment, what matters is the net wage, i.e. the wage net of commuting costs.

In our model, criminality is unobserved by employers (unless individuals are caught and convicted) so that employers must decide how much to pay the convicted as well as the unconvicted workers. When a worker engages in crime, regardless of his/her type, he/she can be caught and convicted with some exogenous probability $\alpha \in]0,1[$. The direct reward from crime is Π and the public penalty, when convicted, is P. On top of that he/she is sent to prison and therefore cannot participate to the labor market. We denote by $\theta_i(x)$ the proportion of individuals of type $i = B, W$ at distance x from the center who commit crime and by $\overline{\theta}_i$, the average total population of criminals of type $i = B, W$. Since there is a continuum of workers, this variable is unaffected by any individual's decision.

We are now able to describe the different markets at work, namely labor, crime and land markets.

2.1 The labor market

The type of crime we have in mind is the following. Individuals are working during the day and are *drug dealers* during their spare time (evenings and week-ends).

Employers compete with each other for workers but firms can only observe the total fraction of convictions for both types i of individuals and the location x of each worker, and do not observe neither criminality nor marginal product. The two following assumptions about the production function are crucial here.

First, we assume that crime affects net productivity so that non-convicted criminals are less productive than non-criminal workers. One way of justifying this assumption is to put forward the morale issue. People committing crime (drug dealers) are more incline to be dishonest at their workplace (think for example of employee theft) and more likely to overcome the fear and pangs of conscience of a first offense. In other words, someone with a history of crime is less reluctant to steal than someone who has never committed a crime (see e.g. Dickens et al., 1989, Rasmusen, 1996, and Freeman, 1999).[4] Another way of justifying this assumption is to consider that crime activities have negative externalities on the production process. Indeed, because of parallel violent illegal activities, a criminal, especially a drug dealer, has a higher probability to be physically injured, or even killed. If he/she is killed, then the firm will support turnover costs to replace the worker. If the worker is injured, he/she will obviously not be very efficient when working. Furthermore, drug dealers consume themselves drugs and alcohol and have thus a reduced productivity. Fagan and Freeman (1997) review a number of studies that find that even experienced drug dealers hold legal jobs, possibly to tide themselves over during period when the drug business is especially dangerous.

Second, we also assume that distance to jobs is harmful to productivity. This assumption captures the fact that workers who have longer commuting trips are more tired and are thus less able to provide higher levels of effort (or productivity) than those who reside closer to jobs. This implies that commuting costs include more than just money and time costs. It also includes these negative effects of a longer commute such as non-work-related fatigue.[5]

[4] Employee thefts is quite common in companies. For example, according to Arnold (1985), employee theft is believed to transfer between \$15 and \$56 billion per year from businesses to their workers and to account for between 5% and 30% of business failures each year. Similar figures are obtained by Lipman and McGraw (1988) and Shepard and Duston (1988).

[5] Distance to jobs could be very painful in large U.S. Metroplitan Statistical Areas because of the lack of good public transportation (see e.g. Pugh, 1998). For instance, the New York Times of May 26, 1998, was telling the story of Dorothy Johnson, a Detroit inner-city black female resident who had to commute to an evening job as a cleaning lady in a suburban office. By using public transportation, it took her two hours whereas, if she could afford a car, the commute would have taken only 25 minutes.

Moreover, this assumption can also capture the fact that workers who reside further away from jobs have less flexible working hours. For example, in some jobs (e.g. working in a restaurant), there are long breaks during the day (typically between 2 pm and 6 pm in restaurants). The worker who lives next door can go back home and relax whereas the others, who live far away, cannot rest home. This obviously also affects workers' productivity.

Let us now investigate the implications of these two assumptions on the wage setting. The latter is affected by: *Labor discrimination* (statistical discrimination) which implies that the offered wage is type specific and negatively depends on $\overline{\theta}_i$, the average total population of criminals of type $i = B, W$; *Workers' location* since productivity (or effort) is inversely related to distance to jobs. Therefore, assuming that an honest or non convicted worker offers inelastically 1 unit of labor, in its more general form the wage is as follows:

$$w_i = w(x, \overline{\theta}_i) \qquad \text{with} \qquad \frac{\partial w_i}{\partial x} < 0 \qquad \text{and} \qquad \frac{\partial w_i}{\partial \overline{\theta}_i} < 0$$

In order to have a tractable model, let us be more specific about the wage formation (this does not change any of our results). Our two assumptions above are captured by the fact that the productivity of an honest worker residing in x is $m - \beta x + y$ with $y > 0$ while that of a non convicted criminal residing in x is $m - \beta x$. In this context, since employers compete with each other for workers (perfect competition) and only observe the total fraction $\alpha\overline{\theta}_i$ of convictions and the location of each worker, the offered wage on the market w_i is type's i specific and will be equal to the average productivity of that worker. The probability that a worker of type i is honest is $(1 - \overline{\theta}_i)/(1 - \alpha\overline{\theta}_i)$, and the probability that a worker of type i is a non-convicted criminal is $\overline{\theta}_i(1 - \alpha)/(1 - \alpha\overline{\theta}_i)$. Hence the wage is equal to:

$$\begin{aligned} w_i &= w(x, \overline{\theta}_i) = \left(\frac{1 - \overline{\theta}_i}{1 - \alpha\overline{\theta}_i}\right)(m - \beta x + y) + \left(\frac{\overline{\theta}_i(1 - \alpha)}{1 - \alpha\overline{\theta}_i}\right)(m - \beta x) \\ &= m - \beta x + \left(\frac{1 - \overline{\theta}_i}{1 - \alpha\overline{\theta}_i}\right) y \end{aligned} \tag{1}$$

As expected, the wage rate of an individual of type i depends positively on m and y, the productivity parameters and negatively on x the distance to jobs. An increase in the average crime rate $\overline{\theta}_i$ (as perceived by all agents) reduces w_i since the probability to face a 'low productive' criminal is increased for each employer. Finally, the probability of conviction α has a positive effect on wages. Indeed, when more criminals are on average convicted, the quality of the labor market pools increases from the firm's viewpoint. This, in turn, pushes up the wage rate paid to these workers.

2.2 Crime

Even though jobs, firms and workers have a location in the city, crime is assumed not to be localized. This means for example that people commit crimes outside of the city. In the case of drug dealers, it implies that criminals sell drugs to people outside the city. In this context, a worker of type (i, x, u), i.e. a worker of type $i = B, W$ located at a distance x from the BD with crime aversion $u \in [0, 1]$, must decide to be a criminal or not. The expected payoff of a criminal is given by:

$$V_i^C(x, u) = \alpha (\Pi - P) + (1 - \alpha) (\Pi + w_i - tx) - R(x) - u \tag{2}$$

where $R(x)$ is the equilibrium land rent at a distance x from the BD. In this formulation, non-convicted criminals participate in the labor market so that they commit crimes while employed -doubling up their legal and illegal work $(\Pi + w_i)$. Observe that the expected payoff (2) negatively depends on $\overline{\theta}_i$ the average crime rate of population of type $i = B, W$ since wages are reduced when $\overline{\theta}_i$ increases. Observe also that $w_i - tx$ is the net wage, i.e. the wage net of commuting costs. In this context, if a worker is caught and put to prison, he/she bears no commuting costs while still paying the land rent. We assume however that, even in prison, individuals still pay the land rent because they keep their housings.[6] The expected payoff of a non criminal is equal to:

$$V_i^{NC}(x, u) = w_i - tx - R(x)$$

Therefore a worker of type (i, x, u) chooses to be criminal if and only if $V_i^C(x, u) > V_i^{NC}(x, u)$. So the value of u making an individual of type (i, x, u) indifferent between crime and non crime is $\widetilde{u}(x, \overline{\theta}_i)$ and is given by:

$$\begin{aligned} \widetilde{u}(x, \overline{\theta}_i) &= \Pi - \alpha P - \alpha (w_i - tx) \\ &= \Pi - \alpha P - \alpha m - \alpha \left(\frac{1 - \overline{\theta}_i}{1 - \alpha \overline{\theta}_i} \right) y + \alpha(\beta + t)x \end{aligned} \tag{3}$$

[6] We can easily relax this assumption and assume that, when criminals are caught, they do not pay anymore the land rent. It should be clear that this will not change any of our results since everything will be divided by an exogeneous parameter $1 - \alpha$. We keep this assumption in order to simplify the algebra.

Thus, $\theta_i(x,\overline{\theta}_i)$, the equilibrium crime rate of workers of type (i,x) is:

$$\theta_i(x,\overline{\theta}_i) = \theta(x,\overline{\theta}_i) = F\left(\Pi - \alpha P - \alpha m - \alpha\left(\frac{1-\overline{\theta}_i}{1-\alpha\overline{\theta}_i}\right)y + \alpha(\beta+t)x\right) = \widetilde{u}(x,\overline{\theta}_i) \tag{4}$$

In order to avoid dealing with the relatively uninteresting case in which all workers of at least one group (black or white) are criminals, we constrain the parameters to be such that:

$$\textit{Assumption } H1: \qquad \alpha y < \Pi - \alpha P - \alpha m < 1 - 2\alpha(\beta+t)$$

It can easily be checked that under assumption $H1$, the crime rate is always strictly interior, i.e. $\widetilde{u}(x,\overline{\theta}_i) \in (0,1)$ for all $(x,\overline{\theta}_i) \in [0,2]\times[0,1]$. We have the following straightforward result[7]

$$\begin{array}{cccc} \dfrac{\partial\theta(x,\overline{\theta}_i)}{\partial x} > 0 & \dfrac{\partial\theta(x,\overline{\theta}_i)}{\partial\overline{\theta}_i} > 0 & \dfrac{\partial\theta(x,\overline{\theta}_i)}{\partial\Pi} > 0 & \dfrac{\partial\theta(x,\overline{\theta}_i)}{\partial P} < 0 \\ \dfrac{\partial\theta(x,\overline{\theta}_i)}{\partial\alpha} \lesseqgtr 0 & \dfrac{\partial\theta(x,\overline{\theta}_i)}{\partial m} < 0 & \dfrac{\partial\theta(x,\overline{\theta}_i)}{\partial y} < 0 & \dfrac{\partial\theta(x,\overline{\theta}_i)}{\partial t} > 0 \end{array} \tag{5}$$

The following comments are in order. First, the incentives to commit crime for a particular individual depends (among other things) on the location of that individual in the city. More precisely, everything else being equal, *people living further away from the BD (legal activities) are more likely to become criminals.* The intuition run as follows. Workers who live further away from jobs have less opportunities because of lower net wages and thus are more likely to become criminal. The net wage is lower for two reasons: (i) remote workers are more tired and produce less, (ii) at any given distance x, criminals pay on average smaller transportation costs than honest individuals. In this context, when individuals reside far away from jobs, the incentives to become criminal are higher than when they live closer to the BD because of lower labor market opportunities.

A second interesting feature of (5) is the fact that the actual incentive to be a criminal for an individual of type $i = B, W$, positively depends on the average crime rate $\overline{\theta}_i$ of individuals sharing the same type i in society. In other words, there is *a positive group externality* on crime incentives despite the groups' exogenous characteristics being identical. This is because this characteristic

[7] It is important to keep in mind that we are not in equilibrium so that to compute the results of (5), we have held $\overline{\theta}_i$ constant when varying any generic variable. This allows us to give the basic intuitions of the model.

plays a role in the process of labor market discrimination and the levels of wages w_i offered on that market. The higher the perceived average crime rate of individuals of type i as a group, the lower the wage rate w_i they are offered by employers. This in turn, reduces their individual's incentives to remain honest and therefore positively affect their actual crime rate.[8]

Last, from (5), we obtain a straightforward comparative statics analysis on $\theta_i(x, \overline{\theta}_i)$. It is obviously increasing in the gains of crime Π, decreasing in the penalty level P (as for example in the seminal paper of Becker, 1968), decreasing in productivity parameters (since they increase the opportunity cost of crime). It is also increasing in the unit cost of transportation t. Indeed, when individuals are further away from legal economic activities, the opportunity cost to commit crime is reduced. Finally and interestingly, the impact of the probability of conviction α on the crime rate is a priori ambiguous. First, an increased probability of being arrested reduces the incentives to crime as it increases the expected penalty αP and the expected opportunity cost to work αw_i. It also reduces crime by reducing labor market discrimination and increasing the wage rate w_i (this can be seen from (1)). On the other hand, it reduces the expected costs of transportation to legal activities $\alpha t x$, which in itself makes crime more profitable. Clearly, the closer the individual to the BD, the weaker the last effect, and the more likely, the negative impact of α on crime. There is therefore a difference between enforcement α and punishment P. In our setting, if P increases (for example by increasing the number of years in prison for a given crime), then there are less criminals in the city. On the other hand, if α rises (for example by increasing the number of policemen), then, as shown above, the number of criminals can increase or decrease. In fact, it can be shown that, for $\alpha < 1/2$, the crime rate $\theta_i(x, \overline{\theta}_i)$ is increasing in α for a large enough distance x to legal activities and a high enough expected crime rate $\overline{\theta}_i$.

2.3 The land market

In order to analyze the land market, we can compute the expected utility of a worker of type (i, x, u) before the revelation of u. This is because individuals

[8] This effect, going through discrimination on the labor market, has been illustrated by Rasmusen (1996) in a non spatial context. See also Sah (1991) for a learning crime group externality not related to discrimination on the labor market, as well as other group externalities associated to the technology of repression.

make their residential location decisions before they know their crime ability.[9] We have therefore:

$$
\begin{aligned}
EV_i(x) &= \int_0^{\widetilde{u}(x,\overline{\theta}_i)} V_i^C(x,u)du + \int_{\widetilde{u}(x,\overline{\theta}_i)}^1 V_i^{NC}(x,u)du \\
&= \int_0^{\widetilde{u}(x,\overline{\theta}_i)} \left[\alpha(\Pi - P) + (1-\alpha)\left(\Pi + w_i - tx\right) - u\right] du \\
&\quad + \int_{\widetilde{u}(x,\overline{\theta}_i)}^1 \left[w_i - tx\right] du - R(x) \\
&= \left[\alpha(\Pi - P) + (1-\alpha)\left(\Pi + w_i - tx\right)\right] \theta(x,\overline{\theta}_i) \\
&\quad + \left[w_i - tx\right]\left(1 - \theta(x,\overline{\theta}_i)\right) - \int_0^{\widetilde{u}(x,\overline{\theta}_i)} u\, du - R(x)
\end{aligned}
$$

Note that this expected utility is based on $\overline{\theta}_i$, the average proportion of criminals of type $i = B, W$.

Let us define the land market equilibrium with two types of workers, blacks and whites. The land market is competitive so that all workers take land rents in the city as given. Since all workers of type i are assumed to be identical, it must be that, in equilibrium, they all reach the same (expected) utility level independent of location. If this were not true, then some individual could increase his/her (expected) utility level by imitating the residential choice of an identical individual with a higher (expected) utility. Thus, an incentive to make a new decision would exist, and such a situation could not be an equilibrium. As a result, in equilibrium, *expected utility must be constant in location.* We call the common (expected) utility achieved by workers of type $i = B, W$ in equilibrium, the equilibrium (expected) utility and we denote it by v_i^*.

We are now able to define the bid rent, a concept widely used in urban economics (see e.g. Fujita, 1989). The bid rent indicates the maximum land rent that a worker of type i located at a distance x from the BD is ready to pay in order to achieve the equilibrium utility v_i^*. There are different bid rent functions that satisfy the requirement that the expected utility must be constant in location, and which one we choose is obviously irrelevant for the analysis. However, for each level of expected utility, we can compute what the bid rent must be for an individual of type i residing at a distance x from the

[9] Another interpretation would be to think that the location choice is made by altruistic parents of the current generation before they actually know about the individual crime aversion of their offspring.

BD. We have:

$$\Psi_i(x, v_i^*) = \left[\alpha(\Pi - P) + (1-\alpha)\left(\Pi + w(x,\overline{\theta}_i) - tx\right)\right]\theta(x,\overline{\theta}_i) \quad (6)$$
$$+ \left[w(x,\overline{\theta}_i) - tx\right]\left[1 - \theta(x,\overline{\theta}_i)\right] - \int_0^{\widetilde{u}(x,\overline{\theta}_i)} u\, du - v_i^*$$

where $w(x,\overline{\theta}_i)$ and $\theta(x,\overline{\theta}_i)$ are respectively given by (1) and (4). By differentiating (6), we obtain[10]

$$\frac{\partial \Psi_i(x,v_i^*)}{\partial x} = -\left[1 - \alpha\theta(x,\overline{\theta}_i)\right](\beta + t) < 0 \quad (7)$$

$$\frac{\partial^2 \Psi_i(x,v_i^*)}{\partial x^2} = \alpha(\beta+t)\frac{\partial \theta(x,\overline{\theta}_i)}{\partial x} = \alpha^2(\beta+t)^2 > 0 \quad (8)$$

$$\frac{\partial^2 \Psi_i(x,v_i^*)}{\partial x \partial \overline{\theta}_i} = \alpha(\beta+t)\frac{\partial \theta(x,\overline{\theta}_i)}{\partial \overline{\theta}_i} > 0 \quad (9)$$

Inspection of (7) and (8) shows that the bid-rent function decreases and is convex in x, the distance to the BD. Indeed, when individuals of type i reside further away from the BD, bid rents have to be reduced in order for the utility v_i^* to be the same (and thus constant across locations) since both the proportion of criminals $\theta(x,\overline{\theta}_i)$ and the cost of being away from legal activities increase with distance x. Further inspection shows that, at a given x, an increase in $\overline{\theta}_i$ makes the bid-rent slope less negative (see (8)). This means that low-$\overline{\theta}$ workers (i.e. whites) have steeper bid-rent curves than high-$\overline{\theta}$ workers (i.e. blacks). The intuitive reason is that an extra mile of commuting increases the crime rate more for whites (low-$\overline{\theta}$ group) than for blacks (high-$\overline{\theta}$ group). Therefore, a low-$\overline{\theta}$ worker requires a larger decline in land rent than a high-$\overline{\theta}$ worker to maintain a given utility level.

What is crucial here is that workers of different types $i = B, W$ will locate in different locations because of different $\overline{\theta}_i$. In other words, if all workers (including blacks) believe that $\overline{\theta}_B > \overline{\theta}_W$, then blacks will reside further away from jobs because they (rationally) anticipate that their capacity to bid for land is lower than that of whites. This is the positive group externality described

[10] To obtain (7), we proceed as follows. Differentiating (6) yields:

$$\frac{\partial \Psi_i(x,v_i^*)}{\partial x} = -\left[1 - \alpha\theta(x,\overline{\theta}_i)\right](\beta+t) + \frac{\partial \theta(x,\overline{\theta}_i)}{\partial x}\left[\Pi - \alpha P - \alpha(w(x,\overline{\theta}_i) - tx)\right] - \frac{\partial \widetilde{u}(x,\overline{\theta}_i)}{\partial x}\widetilde{u}(x,\overline{\theta}_i)$$

Now, we know from (4) that $\theta(x,\overline{\theta}_i) = \widetilde{u}(x,\overline{\theta}_i)$. Thus, using the value of $\widetilde{u}(x,\overline{\theta}_i)$ in (3), the two last terms of the RHS of $\frac{\partial \Psi_i(x,v_i^*)}{\partial x}$ cancel out and we obtain (7).

above in which higher $\overline{\theta}$ implies lower wages. As a result, *the location decision is only based on wages* (via $\overline{\theta}$) so that *relatively poorer individuals, who are more likely to be non-white and criminals, are more likely to live in relatively poorer neighborhoods located far away from jobs.*

3 The market equilibrium

We are now able to give a precise definition of the market equilibrium (that takes into account labor, crime and land markets) with rational expectations. In fact, depending on whether beliefs matter or not, two types of equilibria prevail. In the first one, the non-discriminating market equilibrium, there is no discrimination between blacks and whites. In the second one, the discriminating market equilibrium, white workers are perceived by all agents (including blacks) as less criminal than blacks for no economic reasons or intrinsic characteristics (since whites are not more productive than blacks) but because of beliefs. In other words, pure exogenous reasons (i.e. that are not related to the fundamentals of the economy) affect the behavior of all agents who behave like their beliefs and thus 'prophecies' become self-fulfilling.

3.1 Definitions of market equilibria

A market equilibrium requires solving the land market equilibrium, the labor market equilibrium and the crime market equilibrium. Since the first equilibrium is more complex to define, let us explain in more details the way it is derived. We will then give the definition of a market equilibrium.

Let us start with the land market equilibrium with discrimination in which blacks and whites are treated differently. We have: $\overline{\theta}_B \neq \overline{\theta}_W$, which implies that $w_B \neq w_W$ and thus $\Psi_B(x, v_B^*) \neq \Psi_W(x, v_W^*)$, where $\Psi_i(x, v_i^*)$, $i = B, W$ is defined by (6).

We assume that the land that is not occupied for residential use is used for agriculture and there is no vacant land in the city. Then, by denoting by R_A the agricultural land rent, by $n_i(x)$ the distribution of workers of type i at distance x, that is, the mass of workers of type i between distance x and $x + dx$ is $n_i(x)dx$, and by $L(x)$ the land distribution in the city, that is, the amount of land available for housing between distance x and $x + dx$ is $L(x)dx$, we have the following definition (Fujita, 1989):

Definition 1 *A land market equilibrium with discrimination consists of a pair of utility levels v_i^*, $i = B, W$, and a land rent curve $R(x)$ such that, at each $x \in [0, +\infty)$:*

$$(i)\ \ R(x) = \max\left\{\max_i \Psi_i(x, v_i^*), R_A\right\},$$

$$(ii)\ \ R(x) = \Psi_i(x, v_i^*) \text{ if } n_i(x) > 0,$$

$$(iii)\ \ n_B(x) + n_W(x) = L(x) \text{ if } R(x) > R_A.$$

Condition (i) means that the market rent curve $R(x)$ is the upper envelope of the equilibrium bid rent curves $\Psi_i(x, v_i^*)$ of all worker types $(i = B, W)$ and the agricultural rent line R_A. This ensures that no type i individual can achieve a utility level higher than v_i^*, $i = B, W$, and no farmers can make positive profit. Condition (ii) ensures that if some workers of type i reside at distance x, they actually achieve the equilibrium utility v_i^*. Condition (iii) means that if the land rent at x exceeds the agricultural land rent, all land there must be used for housing. Conditions (i), (ii) and (iii) together imply that whenever the equilibrium land rent exceeds the agricultural land, the land is used by the workers with the highest equilibrium bid rent. In other words, these conditions guarantee that each location is occupied by a highest-bidding activity.

The following remarks are in order. First, since we assume that all workers (whatever their type) consume one unit of land and the size of each population of workers (black or white) is equal to 1, then the city fringe is always equal to 2. Second, we did not write the market clearing condition for land since it is always satisfied by assumption. Indeed, since we assume that, at each location, there is one unit of land available, and since each worker consumes one unit of land, then at each $x \in [0, 2]$, the total demand for land is always equal to the amount of land existing there. Third, the population constraints that ensure that every worker resides somewhere in the city are also always satisfied since housing consumption has been normalized to 1. Fourth, since the city is linear and each population's size has been normalized to 1, $n_B(x)$, $n_W(x)$ and $L(x)$ have constant values. Finally, because bid rents are *well behaved* (essentially $\Psi_i(x, v_i)$ is continuous and decreasing in both x and v_i; see Fujita,1989), in equilibrium the market rent curve $R(x)$ is continuously decreasing up to the city fringe 2.

Definition 1 is quite general and allows for many equilibria with all sorts of possible group differentials. In this paper, we focus on equilibria where (a)

the land rent paid by the more criminal group is equal at the boundary to zero and (b) the land rent paid by the two groups is the same at distance 1 from the BD. Assumption (a) and the fact that all individuals in group $i = B, W$ receive the same utility v_i^* pin down the land rent paid by the more criminal group everywhere else while assumption (b) pins down the rent paid by the less criminal group.

We are now able to write the definition of the discriminating market equilibrium. We have:

Definition 2 *A Discriminating Market Equilibrium (DME) with rational expectations (Figure 1) is a 7-tuple* $(v_W^*, v_B^*, R(x), \overline{\theta}_W^*, \overline{\theta}_B^*, w_W^*(x), w_B^*(x))$ *such that:*

$$\Psi_W(1, v_W^*) = \Psi_B(1, v_B^*) \tag{10}$$

$$\Psi_B(2, v_B^*) = 0 \tag{11}$$

$$R(x) = \begin{cases} \Psi_W(x, v_W^*) & \text{for} \quad x \leq 1 \\ \Psi_B(x, v_B^*) & \text{for} \quad 1 < x \leq 2 \\ 0 & \text{for} \quad x > 2 \end{cases} \tag{12}$$

$$\overline{\theta}_W^* = \int_0^1 \theta(x, \overline{\theta}_W^*) dx \tag{13}$$

$$\overline{\theta}_B^* = \int_1^2 \theta(x, \overline{\theta}_B^*) dx \tag{14}$$

$$w_W^*(x) = m - \beta x + \left(\frac{1 - \overline{\theta}_W^*}{1 - \alpha \overline{\theta}_W} \right) y \tag{15}$$

$$w_B^*(x) = m - \beta x + \left(\frac{1 - \overline{\theta}_B^*}{1 - \alpha \overline{\theta}_B} \right) y \tag{16}$$

where $\theta(x, \overline{\theta}_i)$ *is defined by (4).*

Equations (10) and (11) reflect equilibrium conditions in the land market (see Figure 1). Equation (10) says that, in the land market, there is racial discrimination so that at the frontier $x = 1$, the bid rent offered by individuals of type W is equal to the bid rent offered by individuals of type B. Equation (11) in turn says that the bid rent of a black worker must be equal to zero at the city fringe. Equation (12) defines the equilibrium land rent as the upper envelope of the equilibrium bid rent curves of all workers' types and the agricultural rent line. Equations (13) and (14) reflect the fact the discriminating equilibrium should be self fulfilling in the sense that the expected crime rate perceived by all agents for someone of type $i = B, W$ has to be equal to the average spatial crime rate in the city of individuals of that group $i = B, W$. Finally, the last two equations (15) and (16) define the wages of blacks and whites respectively (labor market equilibrium).

Let us now define the non-discriminating market equilibrium in which blacks and whites are totally identical in the eyes of everybody so that $\overline{\theta}_B = \overline{\theta}_W = \overline{\theta}^*$, which implies that $w_B = w_W = w(x, \overline{\theta}^*)$ and thus $\Psi_B(x, v_B^*) = \Psi_W(x, v_W^*) \equiv \Psi(x, v^*)$ (blacks and whites reach the same equilibrium utility level v^*). In this case,

$$\begin{aligned}\Psi(x, v^*) &= \left[\alpha(\Pi - P) + (1-\alpha)\left(\Pi + w(x,\overline{\theta}) - tx\right)\right]\theta(x,\overline{\theta}) \\ &\quad + \left[w(x,\overline{\theta}) - tx\right]\left(1 - \theta(x,\overline{\theta})\right) - \int_0^{\widetilde{u}(x,\overline{\theta})} u\,du - v^*\end{aligned}$$

It is easy to see that $\Psi(x, v^*)$ is continuous and decreasing in both x and v. We focus on equilibria where the land rent paid by the worker living at the boundary is equal to zero. By using the same arguments as for the discriminating equilibrium, we have:

Definition 3 *A Non Discriminating Market Equilibrium (NDME) with rational expectations (Figure 2) is a 4-tuple* $(v^*, R(x), \overline{\theta}^*, w^*(x))$ *such that:*

$$\Psi(2, v^*) = R_A = 0 \tag{17}$$

$$R(x) = \begin{cases} \Psi(x, v^*) & for \quad x \leq 2 \\ R_A = 0 & for \quad x > 2 \end{cases} \tag{18}$$

$$\overline{\theta}^* = \int_0^2 \theta(x, \overline{\theta}^*)\frac{dx}{2} \tag{19}$$

$$w^*(x) = m - \beta x + \left(\frac{1 - \overline{\theta}^*}{1 - \alpha\overline{\theta}^*}\right) y \tag{20}$$

where $\theta(x, \overline{\theta})$ *is defined by (4).*

In the non-discriminating market equilibrium, there is no discrimination between individuals of type $i \in \{B, W\}$ and all markets (labor, crime and land markets) interact with each other. Equation (17) says that in the land market, the rent paid at the limit of the city of size 2 has to be equal to the outside rent normalized to 0 (see Figure 2). Equation (18) defines the equilibrium land rent as the upper envelope of the equilibrium bid rent curves and the agricultural rent line. Equation (19) says that, under rational expectations, the expected crime rate perceived by all agents has to be the average spatial crime rate in the city. Finally, the last equation (20) defines the non-discriminatory wage.

From equations (17) and (19), one obtains the equilibrium level of indirect utility v^* of urban dwellers and the equilibrium average crime $\overline{\theta}^*$ as a function of the different exogenous parameters (α, Π, P, t, y, m). Indeed, from (17) and (19) and using the fact that: $\widetilde{u}(2,\overline{\theta}^*) = \Pi - \alpha P - \alpha[w(2,\overline{\theta}^*) - 2t]$, we have:

$$\begin{aligned} v^* &= \frac{\widetilde{u}(2,\overline{\theta}^*)^2}{2} + w(2,\overline{\theta}^*) - 2t \\ &= \frac{\widetilde{u}(2,\overline{\theta}^*)^2}{2} - \frac{\widetilde{u}(2,\overline{\theta}^*)}{\alpha} + \frac{\Pi - \alpha P}{\alpha} \end{aligned} \tag{21}$$

and

$$\overline{\theta}^* = \Pi - \alpha P - \alpha m - \alpha \left(\frac{1-\overline{\theta}^*}{1-\alpha\overline{\theta}^*} \right) y + \alpha(\beta + t) \tag{22}$$

Now, by plugging (22) into (20), we determine the equilibrium wage rate. By using this value, we then easily obtain v^*, $\overline{\theta}^*$ and the land rent equilibrium $R(x)$ (using (6) evaluated at v^*). Observe that the exact location of black and white workers is indeterminate since all individuals obtain the same utility level v^* whatever x. Observe also that crime and land rents are spatially differentiated according to the functions $\theta(x,\overline{\theta}^*)$ and $\Psi(x,v^*)$ but are not differentiated according to race.

On the other hand, a discriminating market equilibrium is when there is discrimination in the labor, crime and land markets, based on the characteristic $i \in \{B, W\}$. Thus, according to (9), blacks reside far away from jobs and whites at the vicinity of the business district since blacks are more criminal than whites and thus less attracted to the center. Once again, what matters here is the distance to jobs.

Thus, in the discriminating market equilibrium, from (10) and (11) and by using the fact that: $\widetilde{u}(x,\overline{\theta}_i^*) = (\Pi - \alpha P - \alpha w(x,\overline{\theta}_i^*) - tx)$, we have:

$$v_B^* = \frac{\widetilde{u}(2,\overline{\theta}_B^*)^2}{2} - \frac{\widetilde{u}(2,\overline{\theta}_B^*)}{\alpha} + \frac{\Pi - \alpha P}{\alpha} \tag{23}$$

$$v_W^* = v_B^* + \left[\frac{\widetilde{u}(1,\overline{\theta}_W^*)^2}{2} - \frac{\widetilde{u}(1,\overline{\theta}_W^*)}{\alpha} \right] - \left[\frac{\widetilde{u}(1,\overline{\theta}_B^*)^2}{2} - \frac{\widetilde{u}(1,\overline{\theta}_B^*)}{\alpha} \right] \tag{24}$$

$$\overline{\theta}_B^* = \Pi - \alpha P - \alpha m - \alpha \left(\frac{1-\overline{\theta}_B^*}{1-\alpha\overline{\theta}_B^*} \right) y + \frac{3\alpha(\beta + t)}{2} \tag{25}$$

$$\overline{\theta}_W^* = \Pi - \alpha P - \alpha m - \alpha \left(\frac{1-\overline{\theta}_W^*}{1-\alpha\overline{\theta}_W^*} \right) y + \frac{\alpha(\beta+t)}{2} \tag{26}$$

Now, by plugging (25) and (26) into (15) and (16), we determine the equilibrium wage rates. Then, by using these values, we easily obtain v_B^*, v_W^*, $\overline{\theta}_B^*$, $\overline{\theta}_W^*$ and the land rent equilibrium $R(x)$ (using (6)).

In our model, the wage difference between blacks and whites is one of the key elements that explains higher crime rate among blacks. Indeed, this difference implies that blacks and whites segregate themselves in such a way that blacks are far away from jobs. This, in turn, increases even more the wage gap between blacks and whites since wages are location dependent. As a result, blacks who have less opportunities than whites become more criminals.

[*Insert Figures* 1 *and* 2 *here*]

3.2 Existence and uniqueness of market equilibria

We would like to see first if the non-discriminating market equilibrium and the discriminating market equilibrium exist and are unique. We have:[11,12]

Proposition 1 *Assume $H1$ holds. Then, (i) there exists a unique Non Discriminating Market Equilibrium, and (ii) a unique Discriminating Market Equilibrium.*

We have the following comments. First, Proposition 1 tells us that under the reasonable assumption that crime rates are always interior solutions in the urban area, there exists multiple equilibria in terms of crime, location and labor markets. There are in fact two types of equilibria: the non discriminating one in which the characteristic $i = B, W$ is irrelevant to the nature of the equilibrium and the discriminating equilibrium in which, on the contrary, the characteristic of being black or white plays a fundamental role in the pattern

[11] All proofs of propositions are given in the Appendix.

[12] Assumption $H1$ is a sufficient condition that guarantees that the function $\Theta(\overline{\theta})$ defined in the Appendix crosses the horizontal axis only once and thus each market equilibrium (whether it is discriminating or not) is unique. If this assumption is not satisfied, then the function $\Theta(\overline{\theta})$ may cross the horizontal axis more than once and, as a result, other market equilibria of each type (discriminating and not discriminating) may emerge. However, some of these equilibria (whether it is discriminating or not) are such that workers of at least one group are all criminals (i.e. corner solution). Since we want to avoid corner solutions, assumption $H1$ is made to guarantee only interior solutions.

of allocation of resources. The discrimination showed by this last equilibrium is rationally self-fulfilling. Because everybody expects individuals of type i to act differently from individuals of type $j \neq i$ in terms of crime, working and location choices, they actually behave differently and the initial expectations are confirmed ex post.

Second, it is worth emphasizing that an important aspect of the analysis is the fact that the discrimination process is reinforced through the interplay of the three channels: labor, crime and housing and each market reinforces and magnifies the other. This is true for both equilibria but it is even more important in the discriminating market equilibrium. Indeed, the labor market affects both crime and housing through wages since when wages are higher, crime is reduced and individuals tend to reside closer to the business district. Crime affects wages through productivity (the higher the proportion of criminals of a given group, the lower the group productivity and thus wages) and location through mainly group externalities (when the proportion of criminals of type i is high, individuals tend to be more criminals and thus to locate further away to the business district). Location affects crime through productivity (longer commutes imply lower effort) and commuting costs but affects only indirectly the labor market through crime.

Finally, it is important to point out that the timing of the model (i.e. the fact location is chosen before the type is known) is not crucial to obtain these results but greatly simplify the analysis. Indeed, if we had assumed that location, crime and labor choices were simultaneous, then, in the discriminating equilibrium, we would have had to deal with a continuum of bid rents (since each type u would then have a different bid rent) instead of two bid rents (black and white). Even though it would have been quite tedious, this type of problem can easily be solved. However, because of racial beliefs shared by everybody, we would have still obtained the fact that, on average, blacks would have been more criminal than whites and locate farther away from jobs.

3.3 The role of location in crime decision

The existence of the Discriminating Market Equilibrium is strongly associated with the *spatial* nature of 'access' to legal activities. To check that, consider the extreme case in which space does not matter (i.e. $\beta + t = 0$ or $x = 0$). Then the critical value of crime aversion, $\widetilde{u}(x, \overline{\theta}_i)$, does not depend on the location choice, x, anymore and is given by:[13]

$$\widetilde{u}(x, \overline{\theta}_i) = \widetilde{u}(\overline{\theta}_i) = \Pi - \alpha P - \alpha m - \alpha \left(\frac{1 - \overline{\theta}_i}{1 - \alpha \overline{\theta}_i} \right) y \tag{27}$$

On the other hand, the proportion of criminal being, $\overline{\theta}_i$, is a function of $\widetilde{u}(\overline{\theta}_i)$:

$$\overline{\theta}_i = F\left[\widetilde{u}(\overline{\theta}_i)\right] \tag{28}$$

where $F(\cdot)$ is a c.d.f. An equilibrium is when these two equations are simultaneously satisfied.

In this paper, we impose a special functional form on $F(\cdot)$ by assuming a uniform distribution of u on the interval $[0, 1]$ so that (28) can be written as:

$$\overline{\theta}_i = \widetilde{u}(\overline{\theta}_i) \tag{29}$$

It is then easy to see that, for this special functional form of $F(\cdot)$ (uniform distribution), by solving simultaneously (27) and (29), there exists a unique $\overline{\theta}^*$ such that $\theta(\overline{\theta}^*) = \overline{\theta}^*$ (see Figure 3a)[14] and, therefore, there cannot exist a Discriminating Market Equilibrium satisfying (13) and (14) with $\overline{\theta}_B^* \neq \overline{\theta}_W^*$. The only equilibrium is trivially non discriminating with the same crime rate $\overline{\theta}^*$ and the same equilibrium wage w^* for all workers.

In fact, introducing location introduces another dimension since $\widetilde{u}$ does not only depend on $\overline{\theta}_i$ but also on x. If one compares Figure 3a (uniform distribution without space) with Figures 4a and 4b (uniform distribution with space, in which $\widetilde{u}(\overline{\theta}_i)$ is integrated over x), it is easy to see that space by separating black and white workers creates an additional curve and, as a result, allows another equilibrium to emerge, namely the discriminating market equilibrium. It is also easy to see that the spatial curve(s) is (are) in fact an upward shift of the non-spatial curve. Indeed, in the non-discriminating market equilibrium (Figure 4a), the non-spatial curve (i.e. $\widetilde{u}(\overline{\theta})$ without space) is shifted upward by a constant equal to $\alpha + \beta$ whereas in the discriminating market equilibrium (Figure 4b), it is shifted upward by $(\alpha + \beta)/2$ for whites and by $3(\alpha + \beta)/2$ for blacks. Assumption $H1$ guarantees that such this upward shift is not too high so that solutions are only interior.[15]

[13] It is easy to verify that $\widetilde{u}(\overline{\theta}_i)$ is an increasing and convex function.

[14] In this paper, we only focus on interior solutions for crime rate. This is guaranteed by assumption $H1$, which, in particular, imposes that $\Pi - \alpha P - \alpha m < 1$.

[15] When this shift is too high, i.e. $\beta + t$ is very large, then $H1$ does not hold anymore and other equilibria in which workers of at least one group are all criminals may emerge.

The economic intuition of this result runs as follows. If all workers believe that $\overline{\theta}_B > \overline{\theta}_W$, then this generates a wage difference $w_W - w_B > 0$. When space does not matter (all workers reside in the same location), the wage difference is not large enough to sustain the initial beliefs on crime rates and we end up with a unique Non-Discriminating Market Equilibrium with $\overline{\theta}_B^* = \overline{\theta}_W^* = \overline{\theta}^*$. However, when space and location are taken into account, beliefs can be sustained in equilibrium because space, by segregating blacks and whites, creates a second effect of discrimination (spatial discrimination) that amplifies the first one (labor discrimination) so that the wage gap between blacks and whites is large enough to allow $\overline{\theta}_B > \overline{\theta}_W$ to be true in equilibrium. This remark is also true if there were no labor discrimination (even with space) since negative beliefs could not be enforced in equilibrium. The mechanism is however different since, in that case, no wage discrimination implies no spatial segregation between blacks and whites. It should thus be clear that both labor discrimination and distant locations are crucial to understand why, in this model, blacks are more criminal than whites.

It should also be clear that our uniform assumption about u (crime productivity) is crucial to highlight the role of location in our model. Indeed, because of this assumption, it is only space (through the distance to jobs) that can generate multiple equilibria. If instead, we had assumed a general c.d.f. $F(\cdot)$, then multiple equilibria could have been generated without space. Indeed, if we now simultaneously solve (27) and (28), then, as shown in Figure 3b, one can actually generically obtain as many equilibria as one wants.

This is one of the crucial features of this paper. By assuming a uniform distribution, we highlight the role of location in crime decision and we show how location affect discrimination.

[*Insert Figures* 3 *and* 4 *here*]

Finally, one could argue that, since employers know where workers live, an alternative of our spatial discrimination (in which $w = w(x, \overline{\theta})$, with $\partial w / \partial x < 0$ and $\partial w / \partial \overline{\theta} < 0$) would be that firms condition wages on location, i.e. $w = w(\theta(x))$, with $\partial w / \partial x = (\partial w / \partial \overline{\theta})(\partial \overline{\theta} / \partial x) < 0$. Let us show that, with a uniform distribution of u, a discriminating market equilibrium cannot be sustained. Beliefs imply that, at each x, $\theta_B(x) > \theta_W(x)$, which leads to $w_B(x) < w_W(x)$. However, because a worker is now defined by his/her location and not by his/her type (like in our model), a segregated equilibrium in which blacks and whites are separated (this is the crucial element to sustain negative beliefs in equilibrium) can never exist. Indeed, if a black worker resides further away from jobs, he/she will always be able to move closer to jobs (steeper bid rents) because changing location changes also the way he/she is perceived by the others and thus allows him/her to obtain the same wage as a white residing in the same location. In our model, this feature is not possible because a black worker living further away from jobs cannot move closer to jobs. The reason is that he/she will still be evaluated with respect to $\overline{\theta}_B$ and not with respect to his/her location x. Another alternative is to have a double redlining, i.e. $w = w(x, \theta(x))$. By using the same argument, it is easy to see that multiple equilibria cannot be generated because the only urban equilibrium configuration will be a mixed one.

To summarize, our message is as follows. Suppose the primitives of the economy are such that our model possesses a unique equilibrium. One sufficient condition is that the distribution over disutility of crime is uniform. Then, without space, the present model cannot display discrimination, but if location decision is introduced so that distance to jobs is positive for every worker, then in addition to the unique symmetric equilibrium there is also an equilibrium where one group (black workers) engages more crime, locates further away from the business district, and, being on average less productive, receives lower wages which fulfills the location and crime decisions. The present paper focuses on the model with uniform distribution of disutility for crime precisely to illustrate the crucial aspect of location. This aspect is related to models like the one of Coate and Loury (1993), which with enough linearity, obtain a unique symmetric equilibrium and thus cannot generate discrimination. Two other papers (Moro and Norman, 2002, and Mailath, Samuelson and Shaked, 2000) have also shown that it is possible to write models displaying equilibria with groups specializing in different "sectors" even if there is a unique symmetric equilibrium. The contribution here is to provide another example of such a model that predicts other testable predictions (especially the links between race, crime and location).

Since location is the central element of our model, let us now investigate the empirical results on the links between race, crime and location. Using 206 census tracts in city of Atlanta and Dekalb county and a state-of-the-art job accessibility measure, Ihlanfeldt (2001, 2002) demonstrates that modest improvements in the job accessibility of male youth, in particular blacks, cause marked reductions in crime, especially within category of drug-abuse violations. Indeed, the elasticity of the neighborhood density of drug crime with respect to the number of jobs held by 16-24 year old males without college degrees is 0.361 within the average high crime neighborhood. Since the average high-crime neighborhood contains 200 jobs that are held by young, less-educated males, an elasticity of 0.361 implies that 20 additional jobs will decrease the neighborhood's density of drug crime by 3.61%. Ihlanfeldt (2001, 2002) also shows that inter-neighborhood differences in job accessibility play an important role in explaining the higher crime found in poor neighborhoods. For example, 21 percent of the difference in neighborhood density of drug crime between poor and non-poor neighborhoods can be attributed to the inferior accessibility found within poor neighborhood.

Finally, introducing space could yield interesting policy implications. Indeed, in our model, a transportation policy is easy to trace. For example, subsidizing the commuting cost t of blacks will facilitate their access to legal activities and thus reduce their crime rate. In fact, in our model, this policy acts through two channels. It affects the slope of the bid rent of blacks (see (7)) and thus their location. It also affects the decision of being criminal since $\widetilde{u}(x,\overline{\theta}_i)$ and thus $\theta(x,\overline{\theta}_i)$ are positively related to t (see (5)). Therefore, if t is only reduced for blacks, then in the DME, blacks become less criminals compared to the case when their commuting cost is higher. There is an *indirect effect* through location since an important reduction in t can make them residing closer to legal activities and thus be less criminals. There is also a *direct effect* in which, even if blacks are far away from legal activities, they become less criminals because the opportunity cost to commit crime is reduced.

4 Comparisons and welfare implications

It is now useful to compare the allocation outcomes in the non-discriminating market equilibrium and the discriminating market equilibrium.

Proposition 2 *When they are discriminated against,*

(*i*) *blacks are on average more criminal and earn lower wages than when they are not discriminated;*

(*ii*) *blacks are on average more criminal and earn lower wages than whites, i.e.,* $\overline{\theta}^*_W < \overline{\theta}^* < \overline{\theta}^*_B$ *and* $w^*_B < w^* < w^*_W$.

(*iii*) *blacks live further away from legal activities than whites and pay lower land rents.*

Furthermore, the average urban crime rate in the discriminating market equilibrium is always larger than the average crime rate in the non-discriminating market equilibrium, i.e. $(\overline{\theta}_W^* + \overline{\theta}_B^*)/2 > \overline{\theta}^*$.

The following comments are in order. First, this result is consistent with the spatial mismatch hypothesis (Kain, 1968) in which the increasing distance between the location of ghettos and jobs has a dramatic impact on wages, unemployment and crime. Empirical tests of this hypothesis suggest that bad job access indeed worsens labor-market outcomes, confirming the spatial mismatch hypothesis. Our model provides an additional link between crime and job accessibility since, in the Discrimination Market Equilibrium, blacks who live further away are on average more criminal than whites because they have less labor market opportunities. This result is on average since the disutility to commit crime u is uniformly distributed among workers so that a black worker with a very high u is less likely to become criminal than a white with a very low u, even though if the former lives in a poor black neighborhood and the latter in a rich white neighborhood.

Second, in the discriminating market equilibrium, blacks pay lower land rents than whites because their ability to pay is lower. Indeed, since they are on average more criminal than whites, they are ready to locate further away from legal activities where land is cheaper.[16]

Third, comparing the two different equilibria, it is clear that when everybody thinks that blacks are more criminals than whites, they become more criminals and therefore earn lower wage (because of lower productivity) compared to the non-discriminating market equilibrium, in which all agents believe that blacks do not differ from whites. Figure 5 illustrates this feature and the fact that $\overline{\theta}_W^* < \overline{\theta}^* < \overline{\theta}_B^*$. It is easy to see from this figure that distant locations from legal activities imply more crime but, when discrimination prevails, crime rates diverge between blacks and whites. Note that in the discriminating market equilibrium, the urban crime rate is larger than in the non-discriminating market equilibrium. The increase in the average crime rate of black individuals more than compensates the reduction of the whites' crime rate.

[*Insert Figure* 5 *here*]

The following proposition provides some welfare comparisons between the non-discriminating market equilibrium and the discriminating market equilib-

[16] This result is in fact well documented empirically. For example, Thaler (1978) and Gray and Joelson (1979) find that housing prices are negatively related to crime rates.

rium.

Proposition 3 *When there is enough wage or crime discrimination (i.e. y sufficiently large so that $w_W^* - w_B^* > \alpha(\beta + t)$), then: $v_B^* < v^* < v_W^*$.*

Not surprisingly, Proposition 3 shows that the discriminated black workers are worse off in the discriminating market equilibrium than in the non-discriminating market equilibrium. More interestingly, it also shows that whenever discrimination is large enough, white workers are better off in the discriminating market equilibrium. Indeed, in the discriminating market equilibrium, the wage rate of blacks is reduced compared to the one in the non-discriminating market equilibrium whereas it is increased for whites (this is referred to as the direct wage effect). This implies that the capacity of bidding for land rents (the level of bid rents) decreases for blacks whereas it increases for whites (this is referred to as the bid rent capacity effect). However, in the discriminating market equilibrium, whites have to bid away blacks at the outskirts of the city so that the competition in the land market is fiercer than in the non-discriminating market equilibrium. The overall effect is in favor of whites since both the direct wage effect and bid rent capacity effect are strong enough to outweigh the increased competition in the land market. This shows that we cannot Pareto rank the two types of equilibria since whites prefer when blacks are discriminated against whereas obviously blacks prefer the other equilibrium. In a model where employers cannot observe qualifications but only a signal, Moro and Norman (2002) find a similar result since they show that blacks and whites are treated differently in equilibrium due to informational externalities and that whites benefit from discrimination because it solves the information problem.

5 Comparative statics

Differentiation of the equilibrium equations related to the non-discriminating market equilibrium and the discriminating market equilibrium provides useful comparative statics on crime, wages and welfare. Let us focus on the most interesting results. The following comparative statics analysis illustrates how the three markets (land, labor and crime) reinforce each other and give rise to a *magnification effect* of the exogenous variables on the equilibrium crime rate and the equilibrium wage rate. We have indeed:[17]

[17] The proof of Proposition 4 is given in Verdier and Zenou (2000) or is available upon request.

Proposition 4 *In any equilibrium,*

- *when the booty* Π *or the spatial access cost* t *rises, the resulting increase in the equilibrium crime and wage rates for each type of worker is larger than the direct increase in crime and wage rates, holding constant the average crime rate of that type of individual.*

- *when the penalty* P *or the productivity parameters* m *or* y *rises, the resulting decrease in the equilibrium crime and wage rates for each type of worker is lower than the direct decrease in crime and wage rates, holding constant the average crime rate of that type of individual.*

- *the effect of the probability detection* α *is ambiguous.*

Proposition 4 shows that discrimination in crime and wages is reinforced by the interactions of the three markets (crime, labor and land), and the complete effect (positive or negative) of a generic variable on the equilibrium crime rate and the equilibrium wage rate is always larger than the direct impact of this same variable. Consider for instance the case when Π increases. At any x, individuals become more criminals. This is therefore a direct effect based on reward and captured by the increase of the equilibrium crime rate holding constant the average crime rate of one type of individuals. Now, this direct effect on the crime market will also affect both labor and land markets. Indeed, in the labor market, employers reduce wages because they perceive these workers as more criminals and in the land market, the level of land rent decrease because workers anticipate their wage reduction. Because of these two effects (lower wages and lower land rents), workers are even more criminals and the average crime rate increases. This intuition runs for all the results in Proposition 4. It is thus because we have considered the complete interactions of these three markets and because workers rationally anticipate these interactions that we obtain these magnification results.

The magnification effects have interesting policy implications. They suggest that one should take into account the full interactions of the three markets (labor, crime and land) in order to understand fully the impact of a policy instrument. Indeed, any policy that only focuses on one market will systematically underestimate the full impact on crime rates, housing and wages. Similarly, a change in one instrument directly affecting one market will also have implications for variables directly related to another market, feeding back, in turn, to the first market. For instance, an increase in penalty rates P has a direct impact on crime rates but also indirect effects on wages and land rents. This, in turn, will feed back on the crime market, amplifying the initial impact on crime rates. Similarly, a policy change in the cost t, which is in fact related to the spatial degree of "access" to legal activities, has not only effects on the land rent but also on crime and wage rates. This, in turn, will feed back on the land market. We believe that these results should be taken into account when transportation and urban space related policies are implemented.

Finally, in the discriminating market equilibrium, we can also have the following interesting comparative statics on the extent of discrimination in crime and wages:[18]

Proposition 5

- *The difference in crime rates between blacks and whites* $\theta_B^* - \theta_W^*$ *increases with* Π *and* t *and decreases with* P *and* m.
- *The difference in wages between blacks and whites* $w_W^* - w_B^*$ *increases with* Π *and* t *and decreases with* P *and* m.

Consequently, our analysis predicts that greater crime opportunities Π and lower penalty rates P should be associated with larger inequalities between blacks and whites with respect to crime rates and wages. Similarly, when space matters more (i.e. larger "transportation" cost t), crime and wage rates between blacks and whites will increasingly diverge. Finally crime rates and wages inequalities between blacks and whites should be countercyclical with economic activity (as captured by the productivity parameter m). In other words, our model predicts that, in booms, one should observe less differences in crime rates and less inequality between blacks and whites compared to slumps where these differences should be amplified.

The general message of these results is that, through all these channels and across urban areas, wages inequality between blacks and whites should be positively associated to the differences in crime rates. Using a search-matching model, Burdett, Lagos and Wright (2003) find similar results by showing the positive impact of inequality on crime.[19]

[18] The proof of Proposition 5 is given in Verdier and Zenou (2000) or is available upon request.

[19] Several empirical studies confirm this result. For example, Grogger (1998) finds that wage differentials explain a substantial component of the racial differential in crime participation. More precisely, he found that 6 percentage points of the 13.7 percentage point differential in crime participation rates is attributable to differences in wages between blacks and whites.

6 Conclusion

In this paper, we have emphasized the importance of the interaction between labor, crime and land markets in explaining the high crime rates among blacks who live in ghettos. If, even though the group exogenous characteristics are identical, everybody (including blacks) believes that blacks are more criminals than whites, then all agents will behave accordingly and blacks would be on average more criminals than whites. In the labor market, this implies that blacks are less productive and thus earn lower wages than whites because crime hurts workers' productivity. In the land market, this implies that blacks reside in ghettos located far away from legal activities. Now, because blacks earn lower wages and live in ghettos, they are more induced to commit crimes and are indeed more criminals than whites. There is thus a vicious circle in which blacks cannot escape because both location and race reinforce each other to imply high crime rates among blacks living in cities.

A simple way of extending this paper would be to introduce a dynamic overlapping generation model. In this context, it would only suffice that, in the first period, everybody believes that blacks are more criminals than whites, then, even with no prejudices in all other periods, blacks would be stuck in bad locations, earn lower wages and therefore be more criminals. This would suggest therefore that history matters to explain the high crime rates among blacks.

Appendix

A.1. *Proof of Proposition* 1

(i) *Non Discriminating Equilibrium*

The non discriminating equilibrium condition becomes

$$\begin{aligned} \overline{\theta}^* &= \int_0^2 \theta(x, \overline{\theta}^*) \frac{dx}{2} \\ &\Leftrightarrow \; \Pi - \alpha P - \alpha m - \alpha \left(\frac{1-\overline{\theta}^*}{1-\alpha\overline{\theta}^*} \right) y + \alpha(\beta + t) = \overline{\theta}^* \end{aligned}$$

Let the following function $\Theta(\overline{\theta})$ be:

$$\Theta(\overline{\theta}) = \Pi - \alpha P - \alpha m - \alpha \left(\frac{1-\overline{\theta}}{1-\alpha\overline{\theta}} \right) y + \alpha(\beta + t) - \overline{\theta}$$

It is easy to verify that $\Theta(\overline{\theta})$ is a strictly convex and smooth function. Under assumption $H1$, $\Theta(0) = \Pi - \alpha P - \alpha m - \alpha y + \alpha(\beta + t) > 0$ and $\Theta(1) = \Pi - \alpha P - \alpha m + \alpha(\beta + t) - 1 < 0$. Therefore, by continuity of $\Theta(\overline{\theta})$, there exists a non discriminating equilibrium crime rate $\overline{\theta}^* \in (0, 1)$ such that $\Theta(\overline{\theta}^*) = 0$. Let us show by contradiction that it is unique. Consider $\overline{\theta}_0$ the smallest value of $\overline{\theta}$ such that $\Theta(\overline{\theta}_0) = 0$. Consider that there exists another value $\overline{\theta}_1 \in]\overline{\theta}_0, 1[$ such that $\Theta(\overline{\theta}_1) = 0$ and take the smallest value of such a $\overline{\theta}_1$. The smoothness of $\Theta(\overline{\theta})$ obviously implies that $\Theta'(\overline{\theta}_0) < 0$ and $\Theta'(\overline{\theta}_1) > 0$. The convexity of $\Theta(\overline{\theta})$ in turn implies that

$$\Theta(1) > \Theta(\overline{\theta}_1) + \Theta'(\overline{\theta}_1)[1 - \overline{\theta}_1] = \overline{\theta}_1 + \Theta'(\overline{\theta}_1)[1 - \overline{\theta}_1] > 0$$

which contradicts the fact that $\Theta(1) < 0$. As a result, there exists a unique a non discriminating equilibrium crime rate $\overline{\theta}^* \in (0, 1)$ such that $\Theta(\overline{\theta}^*) = 0$.

(ii) *Discriminating Equilibrium.*

The discriminating equilibrium conditions become:

$$\overline{\theta}_W^* = \int_0^1 \theta(x, \overline{\theta}_W^*)dx \qquad \text{and} \qquad \overline{\theta}_B^* = \int_1^2 \theta(x, \overline{\theta}_B^*)dx$$

which are equivalent to:

$$\Pi - \alpha P - \alpha m - \alpha \left(\frac{1 - \overline{\theta}_W^*}{1 - \alpha \overline{\theta}_W^*} \right) y + \frac{\alpha(\beta + t)}{2} = \overline{\theta}_W^*$$

and

$$\Pi - \alpha P - \alpha m - \alpha \left(\frac{1 - \overline{\theta}_B^*}{1 - \alpha \overline{\theta}_B^*} \right) y + \frac{3\alpha(\beta + t)}{2} = \overline{\theta}_B^*$$

Let the following function $\Theta_W(\overline{\theta})$ and $\Theta_B(\overline{\theta})$ be:

$$\Theta_W(\overline{\theta}) = \Pi - \alpha P - \alpha m - \alpha \left(\frac{1 - \overline{\theta}}{1 - \alpha \overline{\theta}} \right) y + \frac{\alpha(\beta + t)}{2} - \overline{\theta}$$

and:

$$\Theta_B(\overline{\theta}) = \Pi - \alpha P - \alpha m - \alpha \left(\frac{1 - \overline{\theta}}{1 - \alpha \overline{\theta}} \right) y + \frac{3\alpha(\beta + t)}{2} - \overline{\theta}$$

Because of assumption $H1$, $\Theta_W(0) = \Pi - \alpha P - \alpha m - \alpha y + \alpha(\beta + t)/2 > 0$ and $\Theta_W(1) = \Pi - \alpha P - \alpha m + \alpha(\beta + t)/2 - 1 < 0$. Similarly $\Theta_B(0) = \Pi - \alpha P - \alpha m - \alpha y + 3\alpha(\beta + t)/2 > 0$ and $\Theta_B(1) = \Pi - \alpha P - \alpha m + 3\alpha(\beta + t)/2 - 1 < 0$. Using the same argument as in (i), it is easy to show that there exists a unique

$\overline{\theta}_W^*$ (resp. $\overline{\theta}_B^*$) $\in (0,1)$ such that $\Theta_W(\overline{\theta}_W^*) = 0$ (resp. $\Theta_B(\overline{\theta}_B^*) = 0$). Therefore there exists a unique discriminating equilibrium $(\overline{\theta}_B^*, \overline{\theta}_W^*, v_B^*, v_W^*)$. ■

A.2. *Proof of Proposition* 2. It is easy to see that:

$$\Theta_W(\overline{\theta}) < \Theta_B(\overline{\theta})$$

and

$$\Theta(\overline{\theta}) = \frac{1}{2}\left[\Theta_W(\overline{\theta}) + \Theta_B(\overline{\theta})\right]$$

Hence, the first result *(i)* that compares the average equilibrium crime rates in the NDME and the DME follows. The second result *(ii)* comparing the equilibrium wages follows immediately from the fact that wages for a particular group are decreasing in the equilibrium average crime rate of individuals of that group. Thus $\overline{\theta}_W^* < \overline{\theta}^* < \overline{\theta}_B^*$ implies that $w_B^* < w^* < w_W^*$. The third result *(iii)* stems directly from (9). Finally, for the last result, we have:

$$\Theta'(\overline{\theta}) = -1 + \frac{\alpha(1-\alpha)y}{(1-\alpha\overline{\theta})^2}$$

which implies that $\Theta''(\overline{\theta}) > 0$ and thus $\Theta(.)$ is convex. Moreover it is easily checked that :

$$\Theta(\overline{\theta}) = \frac{1}{2}\Theta_W(\overline{\theta}) + \frac{1}{2}\Theta_B(\overline{\theta})$$

and

$$\alpha(\beta + t) = \Theta_B(\overline{\theta}) - \Theta_W(\overline{\theta}) \tag{31}$$

which implies:

$$\Theta\left(\frac{\overline{\theta}_W^* + \overline{\theta}_B^*}{2}\right) < \frac{1}{2}\Theta(\overline{\theta}_W^*) + \frac{1}{2}\Theta(\overline{\theta}_B^*) = \frac{1}{2}\Theta_B(\overline{\theta}_W^*) + \frac{1}{2}\Theta_W(\overline{\theta}_B^*)$$

since $\Theta_B(\overline{\theta}_B^*) = 0$ and $\Theta_W(\overline{\theta}_W^*) = 0$. Furthermore, from (31), $\Theta_B(\overline{\theta}_W^*) = \alpha t$ and $\Theta_W(\overline{\theta}_B^*) = -\alpha(\beta + t)$. Hence

$$\Theta\left(\frac{\overline{\theta}_W^* + \overline{\theta}_B^*}{2}\right) < 0 = \Theta(\overline{\theta}^*)$$

and thus

$$\frac{\overline{\theta}_W^* + \overline{\theta}_B^*}{2} > \overline{\theta}^*$$

■

A.3. *Proof of Proposition* 3. Consider the function $\Omega(X) = \frac{X^2}{2} - \frac{X}{\alpha}$, where $X \in [0,1]$. Then clearly this function is convex, decreasing in X. Using (21), (23) and (24), we have:

$$\begin{aligned} v^* &= \Omega\left(\widetilde{u}(2,\overline{\theta}^*)\right) + \frac{\Pi - \alpha P}{\alpha} \\ v_B^* &= \Omega\left(\widetilde{u}(2,\overline{\theta}_B^*)\right) + \frac{\Pi - \alpha P}{\alpha} \\ v_W^* &= v_B^* + \Omega\left(\widetilde{u}(1,\overline{\theta}_W^*)\right) - \Omega\left(\widetilde{u}(1,\overline{\theta}_B^*)\right) \end{aligned} \tag{32}$$

Since from Proposition 2, $\overline{\theta}^* < \overline{\theta}_B^*$, then $\widetilde{u}(2,\overline{\theta}^*) < \widetilde{u}(2,\overline{\theta}_B^*)$ and $v^* > v_B^*$. This proves the first result.

We also have:

$$v_W^* - v^* = \Omega\left(\widetilde{u}(2,\overline{\theta}_B^*)\right) - \Omega\left(\widetilde{u}(2,\overline{\theta}^*)\right) + \Omega\left(\widetilde{u}(1,\overline{\theta}_W^*)\right) - \Omega\left(\widetilde{u}(1,\overline{\theta}_B^*)\right)$$

The convexity of $\Omega(X)$ then yields:

$$\Omega\left(\widetilde{u}(1,\overline{\theta}_W^*)\right) - \Omega\left(\widetilde{u}(2,\overline{\theta}_W^*)\right) > -\Omega'\left(\widetilde{u}(2,\overline{\theta}_W^*)\right)\left[\widetilde{u}(2,\overline{\theta}_W^*) - \widetilde{u}(1,\overline{\theta}_W^*)\right]$$

and

$$\Omega\left(\widetilde{u}(2,\overline{\theta}_B^*)\right) - \Omega\left(\widetilde{u}(1,\overline{\theta}_B^*)\right) > \Omega'\left(\widetilde{u}(1,\overline{\theta}_B^*)\right)\left[\widetilde{u}(2,\overline{\theta}_B^*) - \widetilde{u}(1,\overline{\theta}_B^*)\right]$$

Observing now that $\widetilde{u}(2,\overline{\theta}_W^*) - \widetilde{u}(1,\overline{\theta}_W^*) = \widetilde{u}(2,\overline{\theta}_B^*) - \widetilde{u}(1,\overline{\theta}_B^*) = \alpha(\beta + t)$, we easily obtain:

$$\begin{aligned} \Omega\left(\widetilde{u}(1,\overline{\theta}_W^*)\right) - \Omega\left(\widetilde{u}(2,\overline{\theta}_W^*)\right) &> -\Omega'\left(\widetilde{u}(2,\overline{\theta}_W^*)\right)\alpha(\beta+t) \\ \Omega\left(\widetilde{u}(2,\overline{\theta}_B^*)\right) - \Omega\left(\widetilde{u}(1,\overline{\theta}_B^*)\right) &> \Omega'\left(\widetilde{u}(1,\overline{\theta}_B^*)\right)\alpha(\beta+t) \end{aligned}$$

Furthermore, since from Proposition 2, $\overline{\theta}_W^* < \overline{\theta}^*$, then $\widetilde{u}(2,\overline{\theta}_W^*) < \widetilde{u}(2,\overline{\theta}^*)$ and $\Omega(\widetilde{u}(2,\overline{\theta}^*)) < \Omega(\widetilde{u}(2,\overline{\theta}_W^*))$. Finally, we have:

$$\begin{aligned} v_W^* - v^* &> \Omega\left(\widetilde{u}(1,\overline{\theta}_W^*)\right) - \Omega\left(\widetilde{u}(2,\overline{\theta}_W^*)\right) + \Omega\left(\widetilde{u}(2,\overline{\theta}_B^*)\right) - \Omega\left(\widetilde{u}(1,\overline{\theta}_B^*)\right) \\ &> \left[-\Omega'\left(\widetilde{u}(2,\overline{\theta}_W^*)\right) + \Omega'\left(\widetilde{u}(1,\overline{\theta}_B^*)\right)\right]\alpha(\beta+t) \end{aligned}$$

and

$$-\Omega'\left(\widetilde{u}(2,\overline{\theta}_W^*)\right) + \Omega'\left(\widetilde{u}(1,\overline{\theta}_B^*)\right) = \widetilde{u}(1,\overline{\theta}_B^*) - \widetilde{u}(2,\overline{\theta}_W^*) = w_W^* - w_B^* - \alpha(\beta+t)$$

Hence

$$v_W^* - v^* > 0 \text{ when } w_W^* - w_B^* > \alpha(\beta + t)$$

It is then easy to check that when y increases, $w_W^* - w_B^*$ increases. ■

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Figure 1: Land Rents in the Discriminating Market Equilibrium

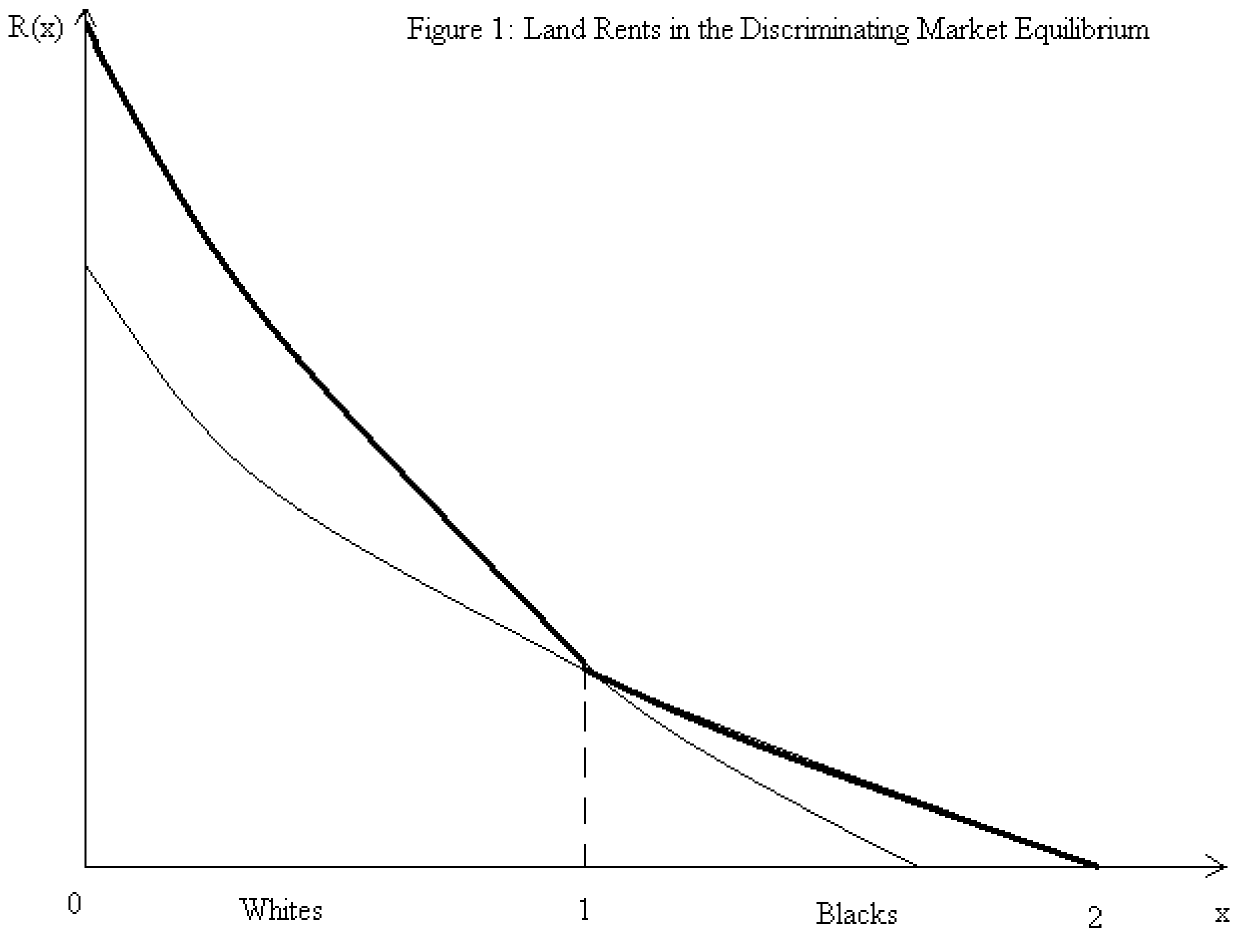


Figure 2 : Land Rents in the Non Discriminating Market Equilibrium

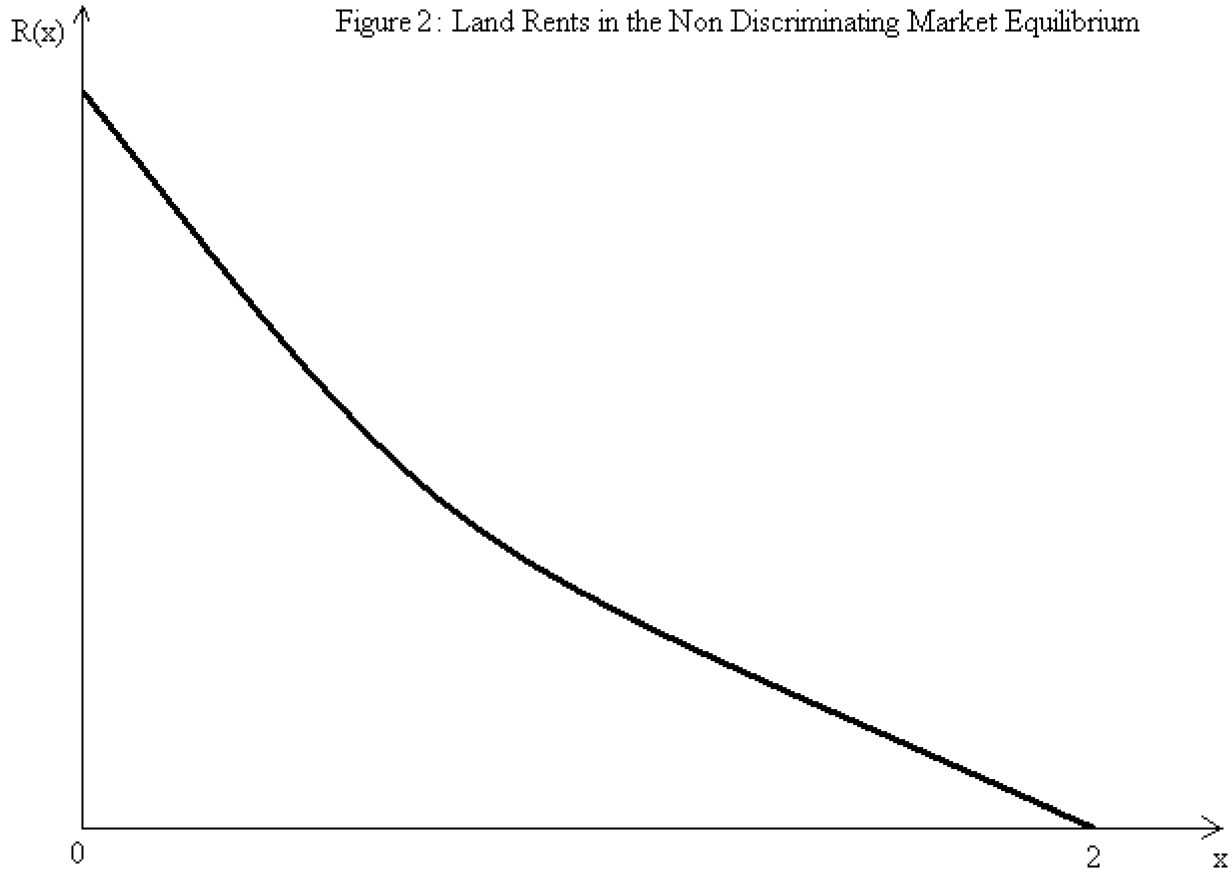
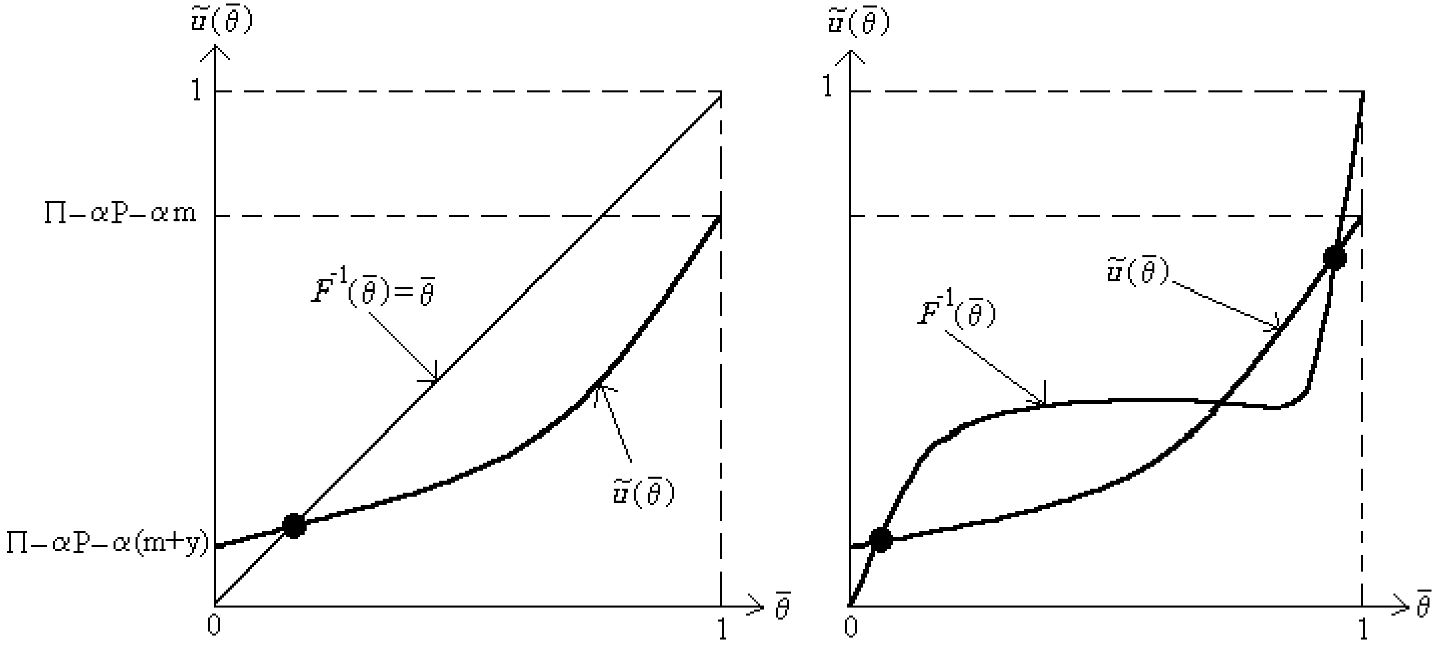
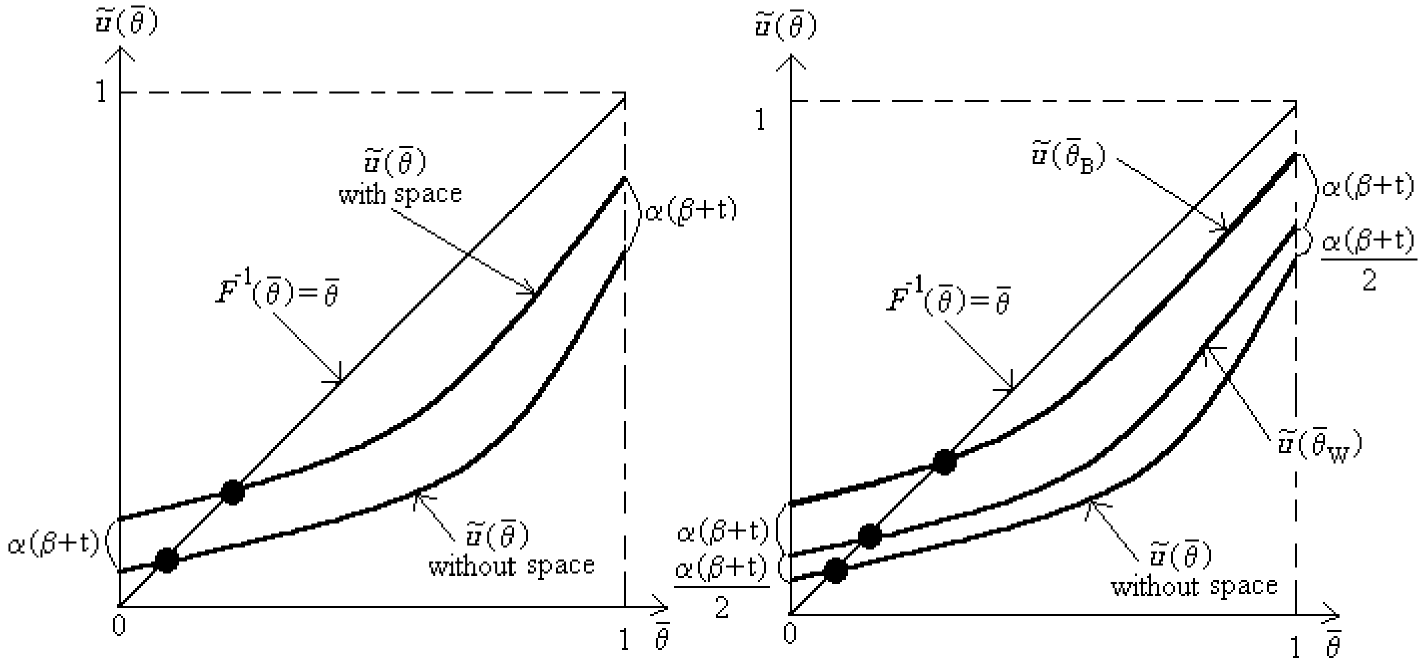


Figure 3: Equilibrium Analysis without Space



a) The Case of a Uniform Distribution of u b) The Case of a General Distribution of u

Figure 4: Equilibrium Analysis with and without Space and a Uniform Distribution of u



a) The Non Discriminating Market Equilibrium

b) The Discriminating Market Equilibrium

Figure 5: The Proportion of Criminals According to Location and Race