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CITY STRUCTURE, JOB SEARCH AND LABOUR DISCRIMINATION: THEORY AND POLICY IMPLICATIONS*

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We consider a search-matching model in which black workers are discriminated against and the job arrival rates of all workers depend on social networks as well as distance to jobs. Location choices are mainly driven by racial preferences. There are multiple equilibria and we show that all workers are in general better off in the equilibrium where blacks are close to jobs. We also show that, in cities where black workers reside far away from jobs, the optimal policy is to impose higher quotas or employment subsidies than in cities where they live close to jobs.

Most (American and European) cities exhibit stark and persisting socioeconomic disparities across neighbourhoods and racial groups. In the US in particular, segregated black workers residing in inner cities often face lower wages and higher unemployment rates than other workers residing elsewhere in the city.

Even though the link between urban segregation and the labour market outcomes of ethnic minorities has been extensively debated and studied by social scientists – see, among others, Massey and Denton (1993), Wilson (1996), Cutler and Glaeser (1997), Topa (2001) – we still do not have a clear understanding of this link. It may be because two seemingly unrelated issues are at stake: the location choices of workers in cities and their consequences in the labour market. The objective of the present article is to investigate this link further by proposing a new mechanism based on racial preferences, labour discrimination, job search and social networks.

Indeed, we consider a search-matching model in which black workers are discriminated against and in which the job arrival rates of all workers depend on social networks as well as distance to jobs. Our main focus is the impact of ethnic preferences and location on labour market outcomes.[1] Location choices are driven by the racial preferences of households (both blacks and whites) consciously choosing to trade off proximity to neighbours of similar racial backgrounds for proximity to jobs.

The way the model works is as follows. Suppose that there are two islands, N and S, and two types of individuals, B and W. The Bs prefer S to N and the Ws prefer N to S. There is another complication. Each type prefers to live with its own kind. Now it is

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[1] In fact, few theoretical models have investigated this link. Akerlof (1997) discusses informally a model that has these features while Akerlof and Kranton (2002) propose a theory in which a student's primary motivation is his or her identity and the quality of a school depends on how students fit in a school's social setting. Battu *et al.* (2006) investigate the tension between identity and access to good jobs. Finally, Austen-Smith and Fryer (2005) model peer pressures in education by putting forward the tension faced by individuals between signalling their type to the outside labour market and signalling their type to their peers: signals that induce high wages can be signals that induce peer rejection.

quite possible that there is an equilibrium with *B*s occupying *N* and all *W*s on *S*. For an individual migrant the benefit of living on the right island is more than offset by the cost of having to live with the wrong type. So an inefficient equilibrium may arise. Of course, there is also an efficient equilibrium.

This theoretical article looks at a more elaborate version of this argument, to explain the patterns of racial segregation in housing and unemployment. There may be an equilibrium in which *B*s (the blacks) live distantly from jobs and *W*s (the whites) are close. Some firms discriminate against *B*s by refusing to hire them, so it is more important that *B*s rather than *W*s have a high flows of job offers. This is achieved by living near the (exogenously located) jobs. In this article, all this is solved out, including equilibrium house prices. There are actually two kinds of *B*s, with one group (the status-seeker blacks) more tolerant of living near *W*s than is the other (the conformist blacks). One main result is multiple equilibria. There is an equilibrium (the spatial-mismatch equilibrium) in which *B*s are distant from the jobs (the intolerant *B*s furthest of all). This involves high unemployment for the *B*s, who do not hear about so many jobs due to distance, which effect is augmented by poor social networks. There is also an equilibrium (the spatial-match equilibrium) in which *W*s are distant from the jobs. It is possible that in this equilibrium, despite their distance from jobs, the *W*s have lower unemployment as they are less discriminated against in hiring and also pay higher rents. We demonstrate that, under some reasonable condition, workers are better off in the spatial-match equilibrium than in the spatial-mismatch equilibrium, confirming various empirical studies that show that spatial mismatch is very harmful to blacks; see Ihlanfeldt and Sjoquist (1998) for a detailed survey.

We finally analyse two different policies: affirmative action and employment subsidies to the firms which hire black workers. We show that the impact of both policies depends on city-structure. In particular, we show that *the optimal policy requires imposing higher quotas in cities in which black workers reside far away from jobs than in cities in which they live closer to jobs.*

The remainder of the article is organised as follows. The model is introduced in the first Section. In Section 2, we determine the different urban land-use equilibria and the associated labour-market outcomes. In Section 3, we compare the two equilibria and discuss some important implications of our model. We also propose a set of numerical simulations which illustrates the workings of the model. We then analyse the two above-mentioned policies in Section 4.

1. The Model

Consider a continuum of equally productive workers (blacks and whites)[2] uniformly distributed along a linear and closed city. All land is owned by absentee landlords and all firms are exogenously located in the Business District (BD hereafter). The BD is a unique employment centre located at one end of the linear city. In a centralised city, it corresponds to the Central Business District, whereas in a completely decentralised city,

[2] In this article, we do not focus on differences in education between blacks and whites. On the contrary, we want to compare their labour market outcomes for a given level of human capital. We focus on low-skilled workers.

it represents suburban employment. Workers are risk neutral, optimally decide their place of residence between the BD and the other end of the city, and all consume the same amount of land (normalised to 1 for simplicity). Without loss of generality, the density of residential land parcels is taken to be unity, so that there are exactly x units of housing within a distance x from the BD. As mentioned in our introduction and discussed in detail below, there are three groups: two types of blacks respectively denoted by BS (status-seeker blacks) and BC (conformist blacks), and whites denoted by W. The sizes of these population groups are respectively denoted by $\overline{N}_{BS}$, $\overline{N}_{BC}$ and $\overline{N}_W$, with $\overline{N}_{BS} + \overline{N}_{BC} + \overline{N}_W \equiv 1$, so that the second end of the city is at a distance equal to 1 from the BD. We assume that $\overline{N}_W > \overline{N}_B$, which is the case of most cities ($\overline{N}_B = \overline{N}_{BS} + \overline{N}_{BC}$).

In the labour market, we assume that firms only resort to two types of recruitment methods: by word of mouth, or by advertising in local newspapers. This assumption will have important consequences on the amount of locally available information about jobs in each residential district (see subsection 1.2 below). We also assume that, even though blacks and whites are both low-skill workers and thus have the same level of human capital, they do not compete for the same jobs, and thus their labour markets are separated (or segmented). Indeed, recent evidence suggests that blacks are much likely to be employed at some types of firms that at others (Holzer and Reaser, 2000). For instance, federal contractors are more likely to employ blacks than are non-contractors (Leonard, 1990); larger firms are more likely to employ blacks than small firms (Holzer, 1998); and firms having more black customers are more likely to employ blacks than others (Holzer and Ihlanfeldt, 1998). Also, the employment of blacks in manufacturing has declined dramatically in recent years and recent evidence suggests that most low-educated blacks work in services, such as business and consumer services (Bound and Holzer, 1993). Another way to justify the fact that blacks and whites do not compete for the same jobs is that unskilled jobs are usually performed in teams. Thus, employers prefer to have teams composed of either blacks or whites but not mixed. Finally, it has also been argued that blacks and whites do not specialise in the same type of jobs because of cultural differences (Wilson, 1996).

The timing of the model is as follows. In the first stage, given that all firms are located in the BD, workers optimally choose where to reside in the city. In the second stage, firms specialise in one of the two possible jobs, hiring only black or white workers. What is crucial here is that when a firm decides to specialise in one job, it cannot switch to the other job after some time. For example, if a firm specialises in a service job, then it is reasonable to assume that it cannot switch to a manufacturing job. In the third and last stage, the unemployment and the vacancy rates are determined.

We will first present the different ingredients of the model (racial preferences and utilities, job search activities and unemployment rates). In the next Section, we will determine how many possible urban configuration equilibria can emerge and then, in Section 3, we solve the model backwards. For each urban equilibrium, we first solve the third stage, that is the unemployment and vacancy rates of each type of worker are determined. Then, we calculate how many firms choose each type of job, which gives the level of racial discrimination in the labour market. Finally, we solve each urban land use equilibrium by calculating workers' utilities and land rents.

1.1. *Racial Preferences and Utilities*

In our model, racial preferences play a fundamental role because the desire – or reluctance – to interact with other racial groups can influence the relative location of each community in the city. The present subsection discusses our way of modelling such preferences.

As stated in the introduction, residential segregation occurs because individuals prefer to interact exclusively with other individuals of their own community. This assumption may seem provocative but has both theoretical and empirical foundations. From a theoretical point of view, Loury (2000) observes that 'even a mild desire for people to live near members of their own race can lead to a strikingly severe degree of segregation in the aggregate'. This is indeed a well-known result in the so-called *preference models* in the urban literature; see, for example, Schelling (1971); Galster (1990). In a recent empirical study, Ihlanfeldt and Scafidi (2002) find evidence that racial preferences are a large, if not the main factor that explains housing segregation in Atlanta, Boston, Detroit and Los Angeles. They show that the preferences of blacks and whites for the racial composition of their neighbourhoods account for respectively 65% and 9% of housing segregation in those cities. As the authors observe, this is in accordance with the controversial observation that 'segregation is partly – and for most middle-class Afro-Americans, largely – a voluntary phenomenon'.

In order to keep the model tractable, we assume that groups always form spatially homogenous communities. In other words, we only focus on equilibria in which all the members of a given community live together and do not mix with members of other communities; this is in accordance with real-world cities; see e.g. Table 1 in Borjas (1998).[3] This is because the aim of this article is not to explain why segregation occurs (or why only homogenous communities emerge in equilibrium)[4] but rather to analyse the consequences of urban segregation on labour market outcomes. In this context, all that matters for a white (black) worker in terms of racial preferences is the residential location of the closest black (white) individual.

We now express the utility functions of workers. To do that, let us consider an individual located at x. If this individual is white, we denote by $b_B(x)$ the location of the closest black worker from x. If this individual is a conformist black or a status-seeker black, we denote by $b_W(x)$ the location of the closest white from x. Since communities are assumed to be homogenous, observe that: (*i*) by definition, the location of the closest black (white) individual is the location of the closest border between communities; (*ii*) both $b_B(x)$ and $b_W(x)$ are step functions such that generically $b'_B(x) = 0$ and $b'_W(x) = 0$ wherever these functions are defined and differentiable. This is because two close neighbours share the same closest neighbourhood border. The respective utility functions for a white, a status-seeker black, and a conformist black worker of employment status $j = U, E$, and location x, are then given by:

[3] The racial homogeneity of neighbourhoods is a well documented phenomenon in US cities. In 1979, for example, the average black lived in a neighborhood that was 63.6% black, even though blacks formed only 14.9% of the population (Borjas, 1998). In the 1990 census, the figures were similar (Cutler *et al.*, 1999).

[4] The endogenous formation of segregation has been analysed in the urban economics literature. See the surveys by Fujita (1989, ch.7) and Kanemoto (1980).

$$V_{Wj}(x) = y_j - tx - R(x) + e_W|x - b_B(x)| \tag{1}$$

$$V_{BSj}(x) = y_j - tx - R(x) + e_{BS}|x - b_W(x)| \tag{2}$$

$$V_{BCj}(x) = y_j - tx - R(x) + e_{BC}|x - b_W(x)| \tag{3}$$

where y_j is the exogenous income of a worker with employment status j (y_E and y_U are respectively the wage of the employed and the unemployment benefit, with $y_E > y_U > 0$), t is the commuting cost per unit of distance, $R(x)$ is the land rent at a distance x from the BD and e_i measures racial preferences.

The following comments are in order. First, we have assumed that, irrespective of race, all workers are paid the same (minimum) wage y_E. This is because all workers have the same education level and are equally productive. Second, we have assumed that the unemployed and the employed bear the same commuting cost per unit of distance. This assumption can be justified by considering that, when unemployed, workers still have to go to the BD in order to shop. Even though this assumption is not essential to our model, it simplifies the analysis. Third, in our formulation, the racial externality incurred by a worker of one community is expressed through the distance to the other community. Therefore, as discussed above, *racial preferences are captured through the fact that individuals may want to live far from or close to the other community so as to interact or avoid contact with members of the other group*. We assume that all whites want to live far away from blacks and that some blacks (labelled 'conformist blacks') want to live far away from whites. In our framework, this requires $e_W > 0$ and $e_{BC} > 0$. To the contrary, we assume that there is another group of blacks (labelled 'status-seeker blacks') who would like to live close to whites, implying $e_{BS} < 0$. It is then easy to see that, for status-seeker blacks, utility increases with proximity to the boundary between communities, reflecting the benefit of living close to the other community.

1.2. *Job Search, Social Networks and Arrival Rates*

In the following, we use the subscript $i = B, W$ for blacks and whites, and among blacks, we use the subscript $k = C, S$ to distinguish conformists from status-seekers. Consequently, we shall use the double subscript ik with $ik = W, BC, BS$ to refer to each one of our three groups.

Let us start by presenting the stocks in the labour market. There are $\overline{d}$ jobs in the economy. The total labour force is normalised to 1 and each firm only hires one worker. This implies that:

$$\overline{d} = E + Z \tag{4}$$

$$1 = E + U \tag{5}$$

where E, U and Z are respectively the total number of employed workers, unemployed workers, and vacancies in the economy (since each firm only hires one worker, E is also the total number of filled jobs).

As stated at the beginning of Section 1, because firms choose to specialise, there are only two types of jobs in the economy: one for blacks and one for whites. In other words, some firms will only hire white workers (type W firms) while others will only hire black workers (type B firms).[5] Time is continuous and workers live forever. A vacancy of type $i = B, W$ can be filled according to a random Poisson process. Similarly, unemployed workers of type $i = B, W$ can find a job also according to a random Poisson process. In aggregate, these processes imply that there is a number of contacts (or matches) per unit of time between the two sides of the market that are determined by the following race-specific standard matching function:

$$M_i \equiv M(\overline{\theta}_i U_i, Z_i) \quad i = B, W \tag{6}$$

where U_i and Z_i are respectively the total number of unemployed workers and vacancies of type $i = B, W$ in the economy, and $U_B = U_{BC} + U_{BS}$. Each unemployed worker of type $ik = W, BC, BS$ gathers information about jobs at a rate θ_{ik} (which will be determined below). Accordingly,

$$\overline{\theta}_W = \theta_W \text{ and } \overline{\theta}_B = \frac{\theta_{BC} U_{BC} + \theta_{BS} U_{BS}}{U_{BC} + U_{BS}} \tag{7}$$

is a group-specific index of aggregate information about economic opportunities. As usual (Pissarides, 2000), $M(.)$ is assumed to be increasing in both its arguments, concave and to exhibit constant returns to scale.

As a result, the rate at which the vacancies of firms of type $i = B, W$ are filled is given by:

$$\frac{M(\overline{\theta}_i U_i, Z_i)}{Z_i} = M\left(\frac{1}{\Omega_i}, 1\right) \equiv q(\Omega_i)$$

where $\Omega_i = Z_i / (\overline{\theta}_i U_i)$ is a measure of labour market i's tightness, in units of information intensity or search efficiency. Similarly, the group-specific job-arrival rate for workers of type $ik = W, BC, BS$ is given by:

$$\theta_{ik} \frac{M(\overline{\theta}_i U_i, Z_i)}{\overline{\theta}_i U_i} = \theta_{ik} M(1, \Omega_i) \equiv \theta_{ik} \Omega_i q(\Omega_i).$$

For workers of type $ik = W, BS, BC$, finding a job results from the interplay of two factors: the rate at which they gather information (which is group-specific and given by θ_{ik}) and the search externalities (which are race-specific and captured by Ω_i). Even though, as we will see below, θ_{ik} is not chosen optimally and is group and not individual-specific, it can be interpreted as the search effort or the search efficiency in gathering information. Thus, for a given labour-market tightness Ω_i, the higher θ_{ik}, the better information about jobs and the shorter the time spent unemployed for individuals of the group ik.

By using the standard properties of the matching function, it is easy to see that:

$$\frac{\partial q(\Omega_i)}{\partial \Omega_i} < 0 \text{ and } \frac{\partial [\Omega_i q(\Omega_i)]}{\partial \Omega_i} > 0$$

since a tighter labour market (i.e. more vacancies) increases the job-arrival rate of workers but decreases the rate at which vacancies are filled. Those properties account for the search externalities common to all matching models (Pissarides, 2000).

[5] As we will see, the endogenous distribution of firms will be skewed towards the employment of white workers.

In contrast to the standard job-matching model where space is absent (Mortensen and Pissarides, 1999; Pissarides, 2000), θ_{ik} *establishes a link between labour and land markets* since it is a function of workers' location and thus of city-structure.[6] Let us be more explicit about θ_{ik}. It is equal to:[7]

$$\theta_{ik} = \mu + \lambda s_{ik} - \beta \overline{x}_{ik} \qquad ik = W, BS, BC \tag{8}$$

where $\mu > 0$ is the common information about jobs available to anyone (independently of race or space), s_{ik} denotes the (endogenous) local social network of a worker of type ik, and $\overline{x}_{ik}$ is the (endogenous) average distance to the employment centre for workers of type ik. λ and β are positive parameters that measure the respective impacts of social networks and distance to jobs on θ_{ik}.

As stated above, θ_{ik} is the rate at which workers gather information about jobs. Formula (8) assumes that, besides the common knowledge factor, there are two ways of learning about jobs: either employed workers hear about a job and transmit this information to all their residential unemployed neighbours, or the unemployed directly read about job opportunities in the newspapers published in their area of residence.

Let us now present in details the two channels through which information about jobs can be gathered. *The first channel operates via social networks which are built upon local connections.* The local connections that individuals from a given group ik can use to find a job are measured by s_{ik}, which we assume to be a positive function of that group's employment rate $1 - u_{ik}$. In other words, when the unemployment rate is high among a particular group, individuals of that group have few connections that can refer them to jobs and their social network is poor (Calvó-Armengol, 2004; Calvó-Armengol and Jackson, 2004; Calvó-Armengol and Zenou, 2005; Montgomery, 1991; Mortensen and Vishwanath, 1994; Topa, 2001).[8]

As far as whites are concerned, individuals only use (local) connections with other whites so that their social network is simply defined by:

$$s_W = 1 - u_W. \tag{9}$$

For blacks, since we have two groups ($k = C$ or $k = S$), there are two cases depending on their respective residential location in the city. If blacks from group k reside far away from whites, then they only benefit from their own connections to jobs, which implies that:

$$s_{Bk} = 1 - u_{Bk}. \tag{10}$$

If, to the contrary, blacks from group k reside in the same neighbourhood as whites (or, more accurately in our model, in an adjacent neighbourhood) then they benefit from

[6] Wasmer and Zenou (2002, 2006), both with and without relocation costs, also have a model that links job search to space. This is done through search intensity, which is negatively related to distance to jobs. The present model has the same flavour since location plays an important role in determining θ_{ik}. As we will see below, an extra link between search and space is provided by social networks.

[7] Here also the assumption that each community lives in a racially homogenous neighbourhood is important to derive θ_{ik}.

[8] Resorting to word of mouth and newspaper advertisements are two major job-search methods used by unemployed workers (Holzer, 1987, 1988; Wahba and Zenou, 2005). Word of mouth, in particular, seems to be of crucial importance: almost 70% of the jobs obtained by white workers and almost 60% of those obtained by black workers are found by checking with relatives or friends or through direct application without referral (Holzer, 1987).

their own connections to jobs and also from part of the social network of whites (because of the local interactions between the two neighbouring groups). Observe that, even if black and white labour markets are segmented, employed whites can still transmit information about job opportunities to unemployed blacks since, being employed, they have access to a wider range of information than the unemployed. Thus, the social network of blacks from group *ik* depends on their own employment rate but also on that of their white neighbours, so that we have:

$$s_{Bk} = \alpha(1 - u_W) + (1 - \alpha)(1 - u_{Bk}) \tag{11}$$

with $0 < \alpha < 1$. This local externality causes the employment rate in the black neighbourhood to be positively affected by the employment rate in the adjacent white area.

The second way workers can learn about jobs involves local formal sources of information. What we have in mind here is the amount of information conveyed by advertisements in local newspapers. Obviously, this type of information is available to all workers residing in the same neighbourhood since they can all buy the same local newspaper. Since employers tend to post more advertisements in newspapers that cover areas adjacent to their firms, we assume that the quantity of information available in each district decreases with the district's distance to the BD. This is why, in (8), we have considered that the job acquisition rate of type i workers negatively depends on $\bar{x}_{ik}$, the workers' average distance to the BD – which should be considered as a measure of the district's distance to firms. As a matter of fact, several empirical studies on job search confirm that distance to jobs deteriorates the information one has on job opportunities and that job accessibility is crucial to get a job (Rogers, 1997; Ihlanfeldt, 1997; Turner, 1997; Stoll, 1999).[9] In our model, as far as firms are concerned, they only use local recruitment methods (such as local newspapers or relying on word-of-mouth communication), which further emphasises the adverse effect of physical distance to jobs.

1.3. *Unemployment and Labour Discrimination*

Workers As stated above, changes in the employment status of a worker of type $ik = W, BS, BC$ are governed by a Poisson process in which $\theta_{ik}\Omega_i q(\Omega_i)$ is the (group-specific) job acquisition rate and δ is the exogenous job separation rate. At the steady state, flows into and out of unemployment must be equal. Therefore, for whites, we have:

$$u_W = \frac{\delta}{\theta_W \Omega_W q(\Omega_W) + \delta} \tag{12}$$

whereas for status-seeker and conformist blacks, we respectively obtain:

$$u_{BS} = \frac{\delta}{\theta_{BS} \Omega_B q(\Omega_B) + \delta} \tag{13}$$

[9] Ihlanfeldt (1997) showed that Atlanta's inner-city residents are less able to identify the location of suburban employment centres than suburbanites and thus, have less information on those jobs. Turner (1997) showed that, in Detroit's suburbs, firms which resort to local recruitment methods have very few inner-city black applicants.

$$u_{BC} = \frac{\delta}{\theta_{BC}\Omega_B q(\Omega_B) + \delta} \tag{14}$$

where u_{ik} denotes the unemployment rate of workers of type $ik = W, BS, BC$. Observe from (12), (13) and (14), that the steady-state unemployment and employment rates correspond to the respective fractions of time a worker remains unemployed and employed over his infinite lifetime. We are now able to calculate the expected utilities of each group. To do that, we assume perfect capital markets with a zero interest rate.[10] With perfect capital markets, workers are able to smooth their disposable income over time so that at any moment in time, the disposable income of a type ik worker is equal to his average income over the job cycle. Therefore, the expected utility of a worker of type $ik = W, BS, BC$ residing in x is given by:

$$\mathrm{E}V_{ik} = (1 - u_{ik})V_{iE}(x) + u_i V_{iU}(x)$$

where V_{iE} and V_{iU} are given by (1), (2) or (3), and u_{ik} is determined by (12), (13) or (14).

Observe that in order to write this expected utility, we have implicitly assumed that, because workers are able to smooth their income over time, *a worker's residential location remains fixed as he enters and leaves unemployment*. This is indeed more realistic than assuming that changes in employment status involve changes in residential location.

Firms As in Becker (1957), firms have a taste for discrimination. In our framework, firms specialise in one of the two jobs available in the economy and, by doing so, decide to hire either black or white workers. Without loss of generality, we assume that each firm can hire only one worker. There is a continuum of employers (or firms) whose mass is normalised to $\overline{d} > 0$ and whose taste for discrimination d is uniformly distributed on $[0, \overline{d}]$ (i.e. there is one firm at each point in the interval $[0, \overline{d}]$). When working in a firm, each worker, black or white, has the same productivity $p > 0$ and receives the same wage y_E.[11] Employers are more or less prejudiced against blacks (depending on the value of their taste for discrimination d). In our framework, the parameter d corresponds to the psychological cost of hiring and working with a black person, and will enter in the profit function as a cost associated with the hiring of a black worker. It measures the intensity of the employer's racial preferences. In this context, the subjective cost of hiring a black worker takes into account both wage and psychological costs and is given by $y_E + d$.

In this context, the instantaneous profit function for a firm of type d hiring a black worker is given by:

$$\Pi_B(d) = p - y_E - d$$

whereas for a firm hiring a white worker, it is equal to:

$$\Pi_W = p - y_E$$

where $p > y_E$ is workers' productivity.

[10] When there is a zero interest rate, workers have no intrinsic preference for the present so that they only care about the fraction of time they spend employed and unemployed. Therefore, the expected utilities are not state dependent.

[11] There is a legislation that prevents employers from discriminating between blacks and whites in terms of wages. Because we focus on low-skill workers, y_E can be interpreted as a minimum wage.

Since blacks and whites are totally identical and are paid the same wage, one may wonder why some firms with prejudices would ever hire a black worker. Of course, if our model were static and there were no turnover, then a black worker would never be hired. As we will see below, some firms will hire black workers because their vacancy duration is shorter and thus the expected profit is higher than for whites. Let us explain this trade off in detail.

For that, we need to determine the expected profit for discriminating and non-discriminating firms. There is also a Poisson process on the firm's side in which $q(\Omega_i)$ is the (group-specific) job-contact rate and δ is the exogenous job-separation rate. At the steady state, flows into and out of vacancies are equal. Therefore, the vacancy rate for discriminating firms is equal to:[12]

$$z_W = \frac{\delta}{q(\Omega_W) + \delta} \tag{15}$$

whereas for non-discriminating firms, we have:

$$z_B = \frac{\delta}{q(\Omega_B) + \delta}. \tag{16}$$

With zero interest rate and assuming that the cost of holding a vacant job is γ, we have:

$$\begin{aligned} \mathrm{E}\Pi_W &= (1 - z_W)(p - y_E) - z_W\gamma \\ \mathrm{E}\Pi_B(d) &= (1 - z_B)(p - y_E - d) - z_B\gamma \end{aligned}$$

where $\mathrm{E}\Pi_W$ and $\mathrm{E}\Pi_B$ respectively stand for the steady-state expected profit of a discriminating firm (which hires only white workers) and the expected profit of a non-discriminating firm (which hires only black workers).

Since $\mathrm{E}\Pi_W$ is constant with d and $\mathrm{E}\Pi_B(d)$ is decreasing with d, then there may be a threshold value $\widetilde{d}$ such that all firms with prejudice $d \in [0, \widetilde{d}]$ only hire black workers, whereas all firms with prejudice $d \in \left]\widetilde{d}, \overline{d}\right]$ only hire white workers. This threshold $\widetilde{d}$ is such that

$$\mathrm{E}\Pi_W = \mathrm{E}\Pi_B(\widetilde{d})$$

which, using the equations above, yields:

$$\widetilde{d} = \left(\frac{z_W - z_B}{1 - z_B}\right)(p - y_E + \gamma). \tag{17}$$

It can easily be seen from (17) that $\widetilde{d} > 0$ whenever $z_W > z_B$, which is equivalent to $\Omega_W > \Omega_B$, i.e. when the labour market of whites is tighter than that of blacks.

Now, it is quite clear why some firms will hire black workers. Indeed, since all workers obtain the same wage, in order for any prejudiced firm to be willing to hire a black worker, it has to be that the expected duration of a vacancy is shorter for blacks than for whites, i.e. that $q(\Omega_W) < q(\Omega_B)$. Here, firms specialise to one of the two jobs by calculating their expected profit. If their $d \leq \widetilde{d}$, then they will specialise in jobs available to black workers while if $d > \widetilde{d}$, they will only hire white workers. Specialisation is here

[12] In our formulation, there is no free entry and the total number of firms/jobs is fixed and equal to $\overline{d}$.

irreversible so that no whites will apply to a 'black' firm. For example, if blacks work as plumbers and whites as electricians, then a white electrician will never apply for a job as a plumber. Therefore, when deciding which job to specialise in, firms trade off their prejudice cost d with the cost of a vacancy, given that a vacant job for a black worker lasts on average less than for a white worker. Of course, only firms with sufficiently low d will hire black workers.

To summarise, firms with low-prejudice costs specialise in jobs hiring mostly blacks (as the recent evidence described at the beginning of Section 1 suggests, such jobs are more likely to be business services, or jobs where customers are mostly blacks etc.) because there are 'plenty' of available black workers, which reduces search frictions on the firm's side. On the contrary, high-prejudice cost firms specialise in jobs only available to white workers.

2. The Different Equilibria

In equilibrium, all workers of the same type reach the same utility level: v_W, v_{BS} and v_{BC} for whites, status-seeker blacks, and conformist blacks respectively. Therefore, the bid rent of a white worker residing at a distance x from the BD is equal to:[13]

$$\Psi_W(x, v_W) = \frac{\theta_W \Omega_W q(\Omega_W)}{\theta_W \Omega_W q(\Omega_W) + \delta}(y_E - y_U) + y_U - tx + e_W|x - b_B(x)| - v_W \tag{18}$$

whereas those of status-seeker and conformist blacks are respectively given by:

$$\Psi_{BS}(x, v_{BS}) = \frac{\theta_{BS} \Omega_B q(\Omega_B)}{\theta_{BS} \Omega_B q(\Omega_B) + \delta}(y_E - y_U) + y_U - tx + e_{BS}|x - b_W(x)| - v_{BS} \tag{19}$$

and

$$\Psi_{BC}(x, v_{BC}) = \frac{\theta_{BC} \Omega_B q(\Omega_B)}{\theta_{BC} \Omega_B q(\Omega_B) + \delta}(y_E - y_U) + y_U - tx + e_{BC}|x - b_W(x)| - v_{BC}. \tag{20}$$

In equilibrium, absentee landlords allocate land to the highest bids. Since we assume that groups always form spatially homogenous communities and since bid rents are all linear in x (recall that generically $b'_B(x) = 0$ and $b'_W(x) = 0$), it is then easy to verify that six different equilibrium land-use configurations can arise depending on the relative ranking of whites (W), status-seeker blacks (BS) and conformist blacks (BC) in the city. However, we show that under a reasonable assumption, only two equilibria can be sustained: Equilibrium 1, in which, moving outward from the BD, we have the location of the following groups: W, BS, BC (see Figure 1a) and Equilibrium 2, in which, starting from the BD, we have: BC, BS, W (see Figure 2). We will refer to Equilibrium 1 as the *Spatial-Mismatch Equilibrium* since, in that equilibrium, blacks reside far away from jobs.[14] To the

[13] The bid rent is a standard concept in urban economics (Fujita, 1989). It indicates the maximum land rent that a worker located at a distance x from the BD is ready to pay in order to achieve utility level v.

[14] The spatial mismatch hypothesis, first formulated by Kain (1968), states that, residing in urban segregated areas distant from and poorly connected to major centres of employment growth, black workers face strong geographic barriers to finding and keeping well-paid jobs. See the surveys by Holzer (1991), Kain (1992), Ihlanfeldt and Sjoquist (1998) and Gobillon *et al.* (2005).

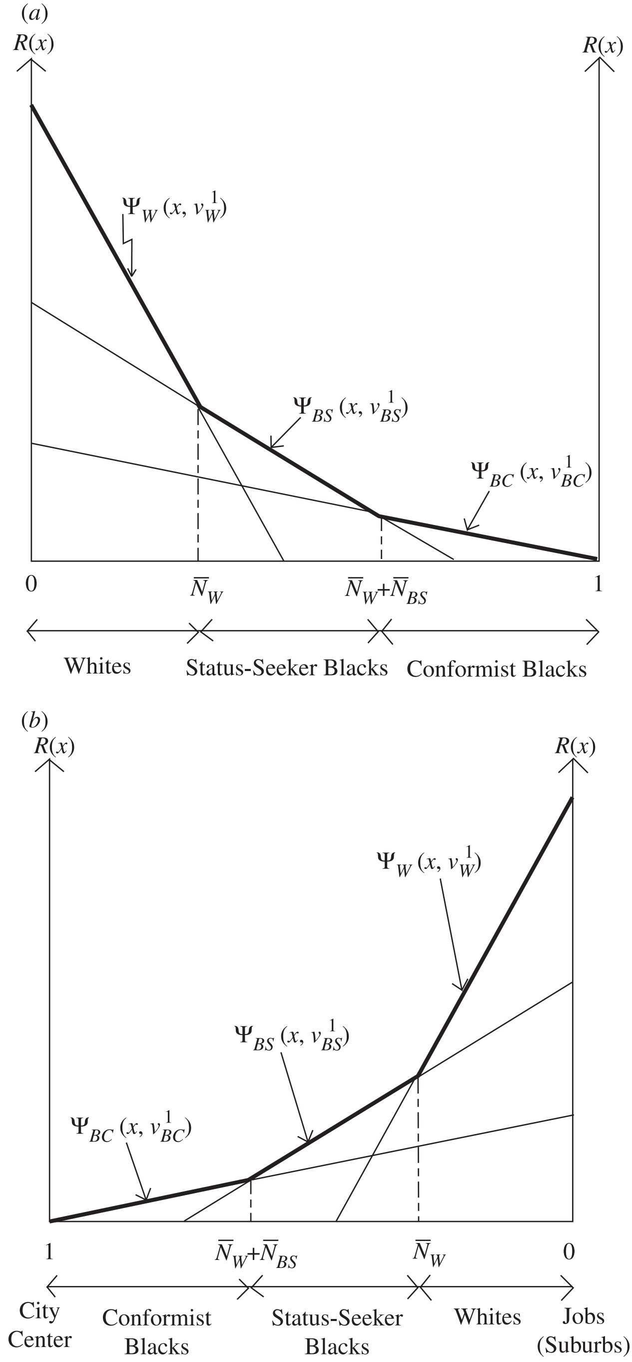

Fig. 1. *The Spatial-Mismatch Equilibrium*

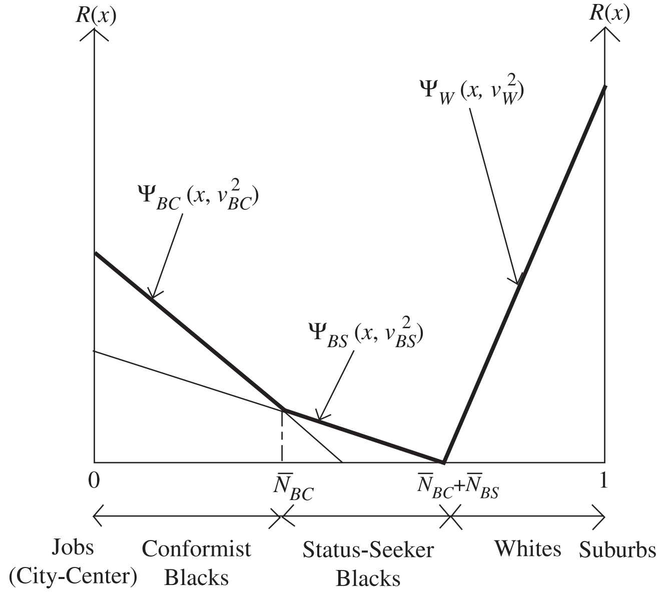

Fig. 2. *The Spatial-Match Equilibrium*

contrary, Equilibrium 2 corresponds to a situation in which blacks reside close to jobs and that we will call the *Spatial-Match Equilibrium.*

PROPOSITION 1. *Assume that*[15]

$$e_{BC} < |e_{BS}| < e_W. \tag{21}$$

Then, we have multiple equilibria in which either the Spatial-Mismatch Equilibrium (Equilibrium 1*) or the Spatial-Match Equilibrium* (*Equilibrium* 2) *occur.*

Proof. Selod and Zenou (2005).

Assuming $e_{BC} < |e_{BS}| < e_W$ means that whites are more eager to isolate themselves from blacks than status-seeker blacks to have contacts with whites ($e_W > |e_{BS}|$), while status-seeker blacks are more eager to have contacts with whites than conformist blacks to isolate themselves from whites ($|e_{BS}| > e_{BC}$). This is in accordance with the findings of Cutler *et al.* (1999) who find that whites are more likely to oppose living in a majority-black neighbourhood than blacks in either a majority-black or white neighbourhood. The reasons why only Equilibrium 1 and Equilibrium 2 can be sustained under assumption (21) are quite easy to understand. The assumption that $e_{BC} < |e_{BS}|$ is used to rule out the two urban configurations in which whites locate in between status-seeker blacks and conformist blacks, so that status-seeker blacks and conformist blacks

[15] We also assume that $|e_{BS}| < t < e_W$. These are just technical conditions that are not necessary to obtain the results of Proposition 2. The first condition ($t < e_W$) ensures that the bid rent of whites is increasing in Equilibrium 2 and the second condition ($|e_{BS}| < t$) guarantees that the bid rents of all blacks are decreasing in both equilibria, as observed in most US cities.

must locate on the same side of whites. Moreover, the two other urban configurations in which conformist blacks locate in between whites and status-seeker blacks can never be sustained since the two black groups would always prefer to switch locations (since $e_{BC} > 0$ and $e_{BS} < 0$). It follows, using $e_W > |e_{BS}|$, that status-seeker blacks must always locate in between whites and conformist blacks, so that only Equilibrium 1 and Equilibrium 2 can exist.

The reason we have multiple equilibria is because *the driving force behind the location of communities is racial preferences* since commuting costs do not discriminate between blacks and whites (the commuting cost per unit of distance is the same for both races). Therefore, multiple equilibria emerge since what matters is only the desire of workers to live or not to live with other individuals of their communities. In this context, which equilibrium will prevail only depends on the coordination of workers.

From now on, we impose the following condition to guarantee that the θ_i^ms are always positive:

$$\mu \geq \beta. \tag{22}$$

2.1. *The Spatial-Mismatch Equilibrium*

This urban equilibrium is represented by Figure 1*a*. In this urban configuration, whites live close to the BD whereas status-seeker blacks and conformist blacks live further away.

We are now able to give a formal definition of the market equilibrium (i.e. an equilibrium in both land and labour markets).

Definition 1. *A Spatial-Mismatch Equilibrium is a nontuple* (v_W^{1*}, v_{BS}^{1*}, v_{BC}^{1*}, u_W^{1*}, u_{BS}^{1*}, u_{BC}^{1*}, z_W^{1*}, z_B^{1*}, $\widetilde{d}^{1*}$) *such that:*

$$\Psi_W(\overline{N}_W, v_W^{1*}) = \Psi_{BS}(\overline{N}_W, v_{BS}^{1*}) \tag{23}$$

$$\Psi_{BS}(\overline{N}_W + \overline{N}_{BS}, v_{BS}^{1*}) = \Psi_{BC}(\overline{N}_W + \overline{N}_{BS}, v_{BC}^{1*}) \tag{24}$$

$$\Psi_{BC}(1, v_{BC}^{1*}) = 0 \tag{25}$$

and u_W^{1*}, u_{BS}^{1*}, u_{BC}^{1*}, z_W^{1*}, z_B^{1*}, $\widetilde{d}^{1*}$ *are respectively defined by* (12), (13), (14), (15), (16), (17).

Equations (23)–(25) reflect the equilibrium conditions in the land market (see Figure 1*a*). Observe that the Spatial-Mismatch Equilibrium is typical of many decentralised US cities where most jobs are created in the suburbs and where blacks reside close to the city centre. Figure 1*b* illustrates this case by flipping the city so that our BD corresponds to a suburban business district that concentrates all jobs.

Solving (23)–(25) yields the following equilibrium utilities:

$$v_W^{1*} = (1 - u_W^{1*})(y_E - y_U) + y_U - t + e_{BS}\overline{N}_{BS} + e_{BC}\overline{N}_{BC} \tag{26}$$

$$v_{BS}^{1*} = (1 - u_{BS}^{1*})(y_E - y_U) + y_U - t + e_{BS}\overline{N}_{BS} + e_{BC}\overline{N}_{BC} \tag{27}$$

$$v_{BC}^{1*} = (1 - u_{BC}^{1*})(y_E - y_U) + y_U - t + e_{BC}(1 - \overline{N}_W). \quad (28)$$

It is now interesting to compare the different unemployment rates and utility levels. We have:

PROPOSITION 2. *In the Spatial-Mismatch Equilibrium (Figure 1a) with discrimination, i.e. when* $0 < \widetilde{d}^{1*}/\overline{d} < N_B$,

(*i*) *Communities that live closer to jobs have lower unemployment rates:*

$$u_W^{1*} < u_{BS}^{1*} < u_{BC}^{1*}.$$

In particular, whites live close to jobs, have the lowest unemployment rate and experience the shortest unemployment spells.

(*ii*) *Blacks who value most interacting with other blacks (conformist blacks) live further away from jobs, have a higher unemployment rate, experience longer unemployment spells than status-seeker blacks.*

Proof. Selod and Zenou (2005).

Observe that we define a discriminating equilibrium whenever $\widetilde{d}^*/\overline{d} < N_B$, that is when the fraction of jobs available to black workers is lower that the fraction of black individuals in the economy. Of course, $\widetilde{d}^*/\overline{d} < N_B$ is equivalent to $\left(\overline{d} - \widetilde{d}^*\right)/\overline{d} > N_W$. In this equilibrium, it is clear that whites and conformist blacks are respectively the most and the less favoured group. Indeed, whites have a very good access to jobs (because they are closest to jobs), are not discriminated against, and benefit from a good social network. On the contrary, conformist blacks have very bad access to jobs, have a poor social network (in particular because they reside far away from whites) and are discriminated against. Therefore, in this equilibrium, the place where conformist blacks live can be viewed as a ghetto: unemployment is rampant and peer pressure (to conform to the ghetto's norm and accept adverse racial preferences) has negative effects on those who are sensitive to it. These results are partly based on the fact that information about jobs can only be acquired locally, either through social networks (employed friends), or via formal sources of information (local newspapers). In this respect, conformist blacks are totally isolated from jobs, both physically and through their local contacts, and have very little information on job opportunities in the BD. The situation is different for status-seeker blacks who do not live in the ghetto but seek contacts with whites. They are less isolated from jobs, both physically and because they have contacts with whites.

2.2. *The Spatial-Match Equilibrium*

The urban equilibrium is described by Figure 2. Conformist blacks live close to the BD, whereas status-seeker blacks and whites live further away.

We have:

Definition 2. *A Spatial-Match Equilibrium is a nontuple* $(v_{BC}^{2*}, v_{BS}^{2*}, v_W^{2*}, u_{BC}^{2*}, u_{BS}^{2*}, u_W^{2*}, z_W^{2*}, z_B^{2*}, \widetilde{d}^{2*})$ *such that:*

$$\Psi_{BC}(\overline{N}_{BC}, v_{BC}^{2*}) = \Psi_{BS}(\overline{N}_{BC}, v_{BS}^{2*}) \tag{29}$$

$$\Psi_{BS}(\overline{N}_{BC} + \overline{N}_{BS}, v_{BS}^{2*}) = 0 \tag{30}$$

$$\Psi_W(\overline{N}_{BC} + \overline{N}_{BS}, v_W^{2*}) = 0 \tag{31}$$

and u_W^{2*}, u_{BS}^{2*}, u_{BC}^{2*}, z_W^{2*}, z_B^{2*}, $\widetilde{d}^{2*}$ *are respectively defined by* (12), (13), (14), (15), (16), (17).

By solving the land market conditions (29)–(31), we come up with the following equilibrium utilities:

$$v_{BC}^{2*} = (1 - u_{BC}^{2*})(y_E - y_U) + y_U - t\overline{N}_B + (e_{BC} - e_{BS})\overline{N}_{BS} \tag{32}$$

$$v_{BS}^{2*} = v_{BS}^{2*} = (1 - u_{BS}^{2*})(y_E - y_U) + y_U - t\overline{N}_B \tag{33}$$

$$v_W^{2*} = (1 - u_W^{2*})(y_E - y_U) + y_U - t\overline{N}_B \tag{34}$$

We then obtain the following result:

Proposition 3. *In the Spatial-Match Equilibrium (Figure 2) with discrimination, i.e.* $0 < \widetilde{d}^{2*}/\overline{d} < N_B$, *unemployment rates cannot be ranked. However,*

(*i*) *If* $e_W\overline{N}_W - e_{BS}\overline{N}_{BS} - e_{BC}\overline{N}_{BC} > t(1 + \overline{N}_{BS})$, *then whites living far away from jobs pay on average higher land rents than blacks residing at the vicinity of the BD.*
(*ii*) *Even though status-seeker blacks are further away from jobs than conformist blacks, they can have a lower unemployment rate than conformist blacks because they reside close to whites and therefore benefit from their social network.*
(*iii*) *Even though whites are the furthest away from jobs, they can experience the lowest unemployment rate when they are sufficiently favoured by employers (because of racial discrimination against blacks).*

Proof. Selod and Zenou (2005).

First, condition (*i*) guarantees that the average land rent paid by whites is strictly greater than the land rent paid by blacks close to the BD. This condition is obviously satisfied whenever there is a sufficiently large number of whites, which is the case of most US cities. It is easy to see that, in this equilibrium, whites are ready to pay a very high land rent in order to separate themselves from blacks. This may be one of the explanations of high land prices in American residential suburbs. Second, one of the main results in this Proposition is to show that access to jobs is more crucial to blacks than to whites (which is in accordance with the spatial-mismatch literature). Indeed, an equilibrium in which whites are the furthest away from jobs can still entail that whites have the lowest unemployment rate in the city (if discrimination is sufficiently high). Because of their advantage in terms of labour-market discrimination, whites can easily find a job even if they reside far away from jobs. In other words, for *high levels of labour discrimination, whites may benefit from a much better social network than blacks, even if they are physically isolated from jobs.* On the contrary *the social networks of blacks are strongly connected to their physical distance to jobs.* However, if there are strong social network spillovers across adjacent neighbourhoods, then, *for status-seeker blacks, proximity to the white community may be even more crucial than proximity to jobs.*

3. City Structure and Labour-market Outcomes

3.1. *Comparison Between the Two Equilibria*

Since our model leads to multiple equilibria (Proposition 1), it is quite natural to compare the utilities of agents between the different urban configurations. This involves comparing gains and losses associated with variations in permanent income, transportation costs, and land consumption. Even though analytical comparisons do not enable us to rank these two equilibria systematically, it is quite easy to show that, under a plausible condition on parameters, all workers are better off in Equilibrium 2 than in Equilibrium 1. We have indeed:

PROPOSITION 4. *If*

$$t\overline{N}_W - e_{BC}\overline{N}_{BC} - e_{BS}\overline{N}_{BS} > y_E - y_U \tag{35}$$

then all workers are better off in the Spatial-Match Equilibrium than in the Spatial-Mismatch Equilibrium.

Proof. Selod and Zenou (2005).

Proposition 4 states that if blacks are sufficiently keen on interacting with whites, i.e. if status-seekers are very eager to have contacts with whites (e_{BS} sufficiently negative) and conformists are not too conformist (e_{BC} small enough), then workers are better off in the Spatial-Match Equilibrium (Equilibrium 2) than in the Spatial-Mismatch Equilibrium (Equilibrium 1).

The intuition runs as follows. In our model, racial preferences (as well as transport costs) are completely capitalised in land rents. Comparing the two equilibria, condition (35) guarantees that reductions in land rents more than compensate possible losses in permanent income or that increases in land rents do not completely offset possible gains in permanent income. Conformist blacks are better off in the Spatial-Match Equilibrium (Equilibrium 2) because they are much less unemployed than in the Spatial-Mismatch Equilibrium (Equilibrium 1) and because, even if they reside closer to jobs, the increase in land rent is quite limited. Whites are better off even though their unemployment rate is higher because, residing far away from jobs, they now face lower land rents. The same intuition applies to status-seeker blacks.

Observe that in Proposition 4, we only compare the utilities of workers. If one compares the total surplus which includes the utility of absentee landlords and the profit of firms, then one cannot rank the two equilibria analytically. However, in the numerical simulations proposed below (and in many others that we do not display), the total surplus is greater in the *Spatial-Match Equilibrium* than in the *Spatial-Mismatch Equilibrium*.

3.2. *How Realistic Are These Urban Equilibria?*

Let us now describe in more detail our two equilibria and show that they exhibit some common features with US cities. The first equilibrium, *the Spatial-Mismatch Equilibrium* corresponds to a situation in which blacks reside far away from jobs and whites close to jobs whereas in the second equilibrium, *the Spatial-Match Equilibrium*, we have the reverse pattern.

Raphael and Stoll (2002, Table 1) have categorised all Metropolitan Statistical Areas (MSAs) in the US according to the severity of their spatial mismatch. The authors measure the spatial imbalance between jobs and residential locations using an index of dissimilarity. The Duncan and Duncan dissimilarity index is generally used to measure the extent of housing segregation between members of different racial and ethnic groups within a given metropolitan area (Glaeser and Vigdor, 2001). Raphael and Stoll adapt this measure in order describe the imbalance between the residential locations of population groups and the general employment distribution. In the present context, the dissimilarity index thus ranges from 0 to 100, with higher values indicating a greater geographic mismatch between populations and jobs within a given metropolitan area. For instance, a dissimilarity index of 50 for blacks means that 50% of all blacks residing in the metropolitan area would have had to relocate to different neighbourhoods within the metropolitan area in order to be spatially distributed in perfect proportion to jobs.

Tables 1*a,b* illustrates our two equilibria using the spatial-mismatch indices calculated by Raphael and Stoll. It is interesting to see that the two types of cities – with spatial-mismatch and spatial-match features – do coexist in the US, even though the size of the population is larger for the first type of cities. In particular, there are many MSAs with more than 100,000 inhabitants in which whites reside further away from jobs than blacks.

3.3. *Numerical Simulations*

We will now proceed to some basic simulations that illustrate the workings of the model. The surplus in Equilibrium $m = 1, 2$ is defined as:

$$S^{m*} = \overline{N}_W v_W^{m*} + \overline{N}_{BS} v_{BS}^{m*} + \overline{N}_{BC} v_{BC}^{m*} + TLR^{m*} + TP^{m*} \tag{36}$$

where $TLR^{m*} \equiv \int_0^1 R^k(x)\mathrm{d}x$ is the total land rent in Equilibrium m (i.e. the sum of all land rents paid to absentee landlords) and TP^{m^*} denotes the aggregate profit of all firms. It is easy to see that both wages and land rents are pure transfers that cancel out

Table 1

Illustrations of the Spatial-Mismatch Equilibrium. American MSAs with the Worse Spatial Mismatch in 2000

	Blacks			Whites			
	% Pop	SM	% Un	% Pop	SM	% Un	Population
(*a*) for Blacks							
Atlanta, GA MSA	29	54	8.98	63	40	3.09	4,112,198
Baltimore, MD, PMSA	27	52	11.69	67	37	3.05	2,552,994
Chicago, IL PMSA	19	69	17.27	66	34	4.18	8,272,768
Cleveland-Lorain-Elyria, OH, PMSA	19	62	14.09	77	31	4.17	2,250,871
Detroit, MI, PMSA	23	71	14.89	71	36	4.27	4,441,551
Houston, TX, PMSA	17	57	10.85	61	40	4.46	4,117,646
Los Angeles-Long Beach, CA, PMSA	10	62	15.57	49	37	6.64	9,519,338
Miami, FL, PMSA	20	65	13.44	70	36	6.23	2,253,362
New York, NY, PMSA	25	70	14.63	49	44	5.61	9,314,235
Newark, NJ, PMSA	22	65	13.90	66	34	3.96	2,032,989
Oakland, CA, PMSA	13	55	12.08	55	37	3.95	2,392,557
Philadelphia, PA-NJ, PMSA	20	64	13.93	72	34	4.47	5,100,931
Saint Louis, MO-IL, MSA	18	63	14.21	78	38	4.11	2,603,607
Washington, DC-MD-VA-WV, PMSA	26	56	8.64	60	42	2.63	4,923,153
(*b*) for Whites							
Anniston, AL, MSA	18	17	13.74	79	37	4.85	112,249
Athens, GA, MSA	20.5	16	13.74	73.2	38	5.95	153,444
Billings, MT, MSA	1	9	4.17	93	24	4.63	129,352
Decatur, AL, MSA	12	18	9.33	83	40	6.22	145,867
Dothan, AL, MSA	23	19	13.46	73	32	3.10	137,916
Eugene-Springfield, OR, MSA	1	20	12.90	91	35	6.51	322,959
Florence, AL, MSA	12	21	12.22	86	44	4.17	142,950
Hattiesburg, MS, MSA	26	18	14.54	72	30	3.58	111,674
Rocky Mount, NC, MSA	43	23	12.82	53	34	2.22	143,026
Salt Lake City-Ogden, UT, MSA	1	26	10.03	88	36	4.18	1,333,914
Savannah, GA, MSA	35	23	10.23	61	42	3.32	293,000
Sherman-Denison, TX, MSA	6	11	8.23	87	39	4.13	110,595

Source: Raphael and Stoll (2002) and Census (2000), calculations from the authors.
% Pop: Percentage of (black or white) individuals in the population in the MSA or PMSA.
SM: Measure of the Spatial Mismatch (for black or white) between people and jobs using the Raphael's and Stoll's dissimilarity index.
% Un: Percentage of (black or white) male unemployed in the MSA or PMSA.

in the surplus calculation. We use a Cobb-Douglas form for the matching function, as commonly used in most empirical analyses and numerical simulation; see Petrongolo and Pissarides (2001). We have:

$$M_i^m = \kappa\left(\overline{\theta}_i^{*m} U_i^{*m}\right)^{\eta}\left(Z_i^{*m}\right)^{1-\eta} \quad i = B, W, m = 1, 2$$

where $\kappa > 0$ is a scale or an efficiency parameter. Using this specific matching function implies that the vacancy-filling rates (on the white and the black labour-markets respectively) and the job-acquisition rates (of whites, conformist blacks, and status-seeker blacks respectively) are given by:

$$\kappa(\Omega_i^{m*})^{-\eta} \text{ and } \kappa\theta_{ik}(\Omega_i^{m*})^{1-\eta}.$$

Let us consider a city (Base Case) that consists of 80% whites, 10% status-seeker blacks, and 10% conformist blacks. In this economy, the exogenous job destruction rate stands at 0.07. If we interpret a time period of unit length to be one year, this means that 7% of all jobs are destroyed every year or, equivalently, that the average employment spell is approximately 14 years. As for the job acquisition rate, the unemployment spell of individuals located in a neighbourhood at an average distance equal to 1 from the job centre, would be of $7\frac{3}{4}$ months. In other words, for individuals of this socially well-endowed group – which exhibits a low unemployment rate – spatial frictions double the unemployment spell.

Table 2 presents our results. We calibrate our simulations to obtain unemployment rates that are consistent with Tables 1*a* and 1*b*. The unemployment rate of whites varies little across equilibria and is always the lowest of all groups, even when they live the furthest away from jobs. In Equilibrium 1, as expected, conformist blacks are more unemployed than status-seeker blacks (18.1% versus 13.2%). In Equilibrium 2, status-seeker blacks live further away from jobs than conformist blacks but experience only a slightly higher unemployment rate (8.8% versus 8.2%). This is because in this equilibrium status-seeker blacks strongly benefit from the social network spillover of whites, which in Equilibrium 2 nearly compensates for their comparatively more distant location from jobs.

Comparing the two equilibria, it can be seen that in both cases, we have $\widetilde{d}^k/\overline{d} < (\overline{N}_{BC} + \overline{N}_{BS})/\overline{N} = 20\%$, which means that, in both equilibria, the equilibrium proportion of occupied and vacant jobs offered to blacks is lower than the proportion of blacks in the city. As we have seen, this indicates *de facto discrimination*. Also, in the welfare calculation, we can isolate the total cost of discrimination for firms hiring black workers. Since $\overline{d} = 0.96$, the total cost of discrimination is $\widetilde{d}^1 = 17.7\overline{d} = 17$ in Equilibrium 1 and $\widetilde{d}^2 = 19.2\overline{d} = 18.43$ in Equilibrium 2. Thus, discrimination costs are not surprisingly lower in the Spatial-Match Equilibrium than in the Spatial-Mismatch Equilibrium. Observe finally that, for blacks, Equilibrium 2 is preferable to Equilibrium 1 to the extent that they are both closer to jobs and less discriminated against. In other words, *proximity to jobs is crucial for minorities to the extent that it ameliorates their frequency of contacts with jobs and is also likely to decrease the intensity of racial discrimination in the city.*

As we have seen, a closer look at the labour market shows that, in both equilibria, labour-market tightness is higher for whites than for blacks. For instance in Equilibrium 1, labour-market tightness is approximately five times greater for whites than for blacks. This explains that the different groups experience very different unemployment spells: in Equilibrium 1, it takes on average less than 6 months for an unemployed white worker to find a job, 26 months for a status seeker black, and 37 months for a conformist black. Conversely, 'black' firms have an advantage over 'white' firms in their search for a worker: a vacancy is filled on the white labour market on average only after 6 weeks whereas it takes $3\frac{3}{4}$ months to fill a vacancy on the white labour market. As discussed before, this explains why some firms may be willing to hire black workers in spite of their strictly positive taste for racial discrimination.

Finally, observe that all workers are better off, that the aggregate profit of firms is higher, and that the total surplus (taking into account the surplus of absentee land-

Table 2

	Base Case	1 − 2	Variations from Base Case		
			$\beta = 0$	$\lambda = 0$	$\alpha = 0$
Equilibrium 1 (2)					
u_W^m	3.3 (4.7)	+	3.2 (3.2)	2.9 (6.1)	3.3 (4.7)
u_{BS}^m	13.2 (8.8)	−	13.2 (13.2)	14.6 (6.1)	13.8 (8.9)
u_{BC}^m	18.1 (8.2)	−	13.5 (13.5)	33.9 (5.5)	17.8 (8.2)
$\widetilde{d}^m/\overline{d}$ (%)	17.7 (19.2)	+	18.1 (18.1)	16.2 (19.9)	17.7 (19.2)
z_W^m	2.0 (1.8)	−	1.5 (1.5)	3.5 (2.4)	2.0 (1.8)
z_B^m	0.9 (0.6)	−	0.3 (0.3)	2.5 (1.2)	0.9 (0.6)
Ω_W^m	0.022 (0.017)	−	0.011 (0.011)	0.067 (0.032)	0.022 (0.017)
Ω_B^m	0.004 (0.002)	+	0.001 (0.001)	0.033 (0.007)	0.004 (0.002)
U.D. W	0.487 (0.711)	+	0.470 (0.470)	0.430 (0.938)	0.484 (0.711)
U.D. BS	2.168 (1.381)	−	2.176 (2.176)	2.446 (.927)	2.285 (1.392)
U.D. BC	3.147(1.282)	−	2.229 (2.229)	7.338 (0.830)	3.083 (1.279)
V.D. W	0.297 (0.261)	−	0.215 (0.215)	0.517 (0.355)	0.299 (0.261)
V.D. B	0.131 (0.083)	−	0.046 (0.046)	0.363 (0.169)	0.133 (0.083)
v_W^m	9.226 (9.521)	+	9.235 (9.645)	9.256 (9.407)	9.228 (9.521)
v_{BS}^m	8.436 (9.195)	+	8.432 (8.842)	8.320 (9.412)	8.387 (9.190)
v_{BC}^m	8.076 (9.271)	+	8.440 (8.850)	6.805 (9.491)	8.100 (9.273)
P_W^m	3.707 (3.671)	−	3.756 (3.756)	3.602 (3.567)	3.707 (3.671)
P_B^m	0.814 (0.887)	+	0.846 (0.846)	0.707 (0.902)	0.812 (0.887)
TP^m	4.521 (4.558)	+	4.602 (4.602)	4.309 (4.469)	4.519 (4.558)
LR_W^m	0.888 (0.480)	−	0.888 (0.480)	0.888 (0.480)	0.888 (0.480)
LR_{BS}^m	0.007 (0.001)	−	0.007 (0.001)	0.007 (0.001)	0.007 (0.001)
LR_{BC}^m	0.002 (0.006)	+	0.002 (0.006)	0.002 (0.006)	0.002 (0.006)
TLR^m	0.897 (0.487)	−	0.897 (0.487)	0.897 (0.487)	0.897 (0.487)
S^m	14.451 (14.508)	+	14.575 (14.575)	14.124 (14.372)	14.448 (14.508)

In Base Case $\overline{d} =$ $\alpha = 0.9$, $\mu = 30$, $\delta = 0.07$, $\kappa = 0.5$, $\eta = 0.5$, $t = 0.5$, $p = 15$, $\gamma = 10$, $y_E = 10$, $y_U = 2$, $N_{BC} = 10\%$, $N_{BS} = 10\%$, $N_W = 80\%$, $e_{BS} = -0.2$, $e_W = 2$.
The first number in each column is for Equilibrium 1, the second number, in parenthesis, is for Equilibrium 2 U.D.: Unemployment Duration $= 1/\kappa\theta_{ik}^m\,(\Omega_{ik}^m)^{1-\eta}$, $ik = W,BC,BS$, $m = 1,2$.
V.D.: Vacancy Duration $= 1/\kappa(\Omega_i^m)^{-\eta}$, $i = W,B$, $m = 1,2$.

lords) is higher in the Spatial-Match Equilibrium than in the Spatial-Mismatch Equilibrium.

Let us now simulate a few variations from the Base Case, which will give us a better intuition of how the model behaves (see Table 2 where the first figures in each column refer to Equilibrium 1, and figures in parenthesis refer to Equilibrium 2). Comparing the case $\beta = 0$ (where we neutralise the 'distance to jobs' effect) with the Base Case, it can be seen that in Equilibrium 1, the unemployment rate of each group is lower when $\beta = 0$ than in the Base Case. This is because discrimination is less intense and because all workers are now 'freed' from the harmful effect of space on job-search efficiency. The changes in Equilibrium 2 tell a different story. Indeed, in Equilibrium 2, discrimination is *more intense* when $\beta = 0$ than in the Base Case ($\widetilde{d}^2/\overline{d}$ decreases from 19.2% in the Base Case to 18.1% when $\beta = 0$).

In the third column, we neutralise the beneficial effect of social networks. Setting $\lambda = 0$ increases discrimination in the Spatial-Mismatch Equilibrium and decreases discrimination in the Spatial-Match Equilibrium. This suggests that social networks are crucial in the Spatial-Mismatch Equilibrium not only because they may attenuate the harmful effect of distance to jobs (which is the main device through which blacks may gather information about job opportunities) but also because social networks seem to be associated with a lower endogenous intensity of discrimination against blacks when the latter reside far away from jobs. The fourth column presents our simulation with $\alpha = 0$, i.e. when there are *no* inter-group social-network externalities. In this case, it can be seen that the unemployment rate of status-seeker blacks significantly increases in Equilibrium 1 (from 13.2% to 13.8%) but rises only slightly in Equilibrium 2 (from 8.8% to 8.9%), which suggests that *social networks are once again crucial to blacks when they reside far away from jobs.*

4. Policy Implications

We would now like to consider two different policies that can improve the situation of blacks as well as increase social welfare (as defined by (36)) in the economy. We thus add one more stage in the timing of the model. In stage 0, the government announces its policy (Affirmative Action or employment subsidy) and then we solve the three next stages as before.

4.1. *Affirmative Action*

Let us start by considering an affirmative-action policy that consists in giving a preferential treatment to minority groups, for example by imposing minimum hiring quotas to firms. In particular, we would like to assess the efficiency of such a policy and determine whether different quotas should be imposed depending on the structure of the city.

In the present model, an affirmative-action policy consists in imposing a quota $0 < \phi < 1$ to all firms that do not choose to hire blacks voluntarily, i.e. the discriminating firms. Since each firm only employs one worker at a time, imposing a quota means that a discriminating firm has to fill a vacancy with a black worker ϕ% of the time and with a white worker $(1 - \phi)$% of the time. In brief, a 'white firm' must turn into a 'black firm' ϕ% of the time. In the context of our model, this means that when a firm chooses to specialise in 'white' jobs (say jobs that involve customers that are mostly whites or manufacturing jobs), it anticipates that ϕ% of its time it has to hire a black worker (who may be unpopular with white consumers or specialised in service jobs).

As a result, a non-discriminating firm has an expected profit of $\mathrm{E}\Pi_B^A(d) = \mathrm{E}\Pi_B(d)$ while a discriminating firm now has an expected profit of $\mathrm{E}\Pi_W^A(d) = \phi\mathrm{E}\ \Pi_B(d) + (1 - \phi)\mathrm{E}\Pi_W$ (with $d \in [\widetilde{d}^A, \overline{d}]$).[16] In fact, it is easy to see that there exists a unique threshold $\widetilde{d}^A$ such that:

$$\mathrm{E}\Pi_B^A(\widetilde{d}^A) = \mathrm{E}\Pi_W^A(\widetilde{d}^A).$$

Solving this equation leads to:

$$\widetilde{d}^A = \left(\frac{z_W^A - z_B^A}{1 - z_B^A}\right)(p - y_E + \gamma). \tag{37}$$

[16] In the rest of the article, the superscript A stands for affirmative action. When there is no ambiguity, we omit the superscript $m = 1, 2$ that defines each equilibrium. We continue to call 'white firms' firms whose d is above $\widetilde{d}^A$ even though they now operate on both white and black labour markets.

The expression of $\widetilde{d}^A$ is thus the same as without any policy. In fact, the main change that an affirmative-action policy introduces is that the total number of vacancies on the labour market of blacks is now given by:

$$Z_B^A = \widetilde{d}^A z_B^A + \phi\left(\overline{d} - \widetilde{d}^A\right) z_B^A \tag{38}$$

while the total number of vacancies on the 'white' labour market is:

$$Z_W^A = (1-\phi)\left(\overline{d} - \widetilde{d}^A\right) z_W^A. \tag{39}$$

Observe that z_B^A is now the vacancy rate of all firms employing blacks, i.e. of 'black firms' strictly speaking as well as of 'white firms' when they hire a black worker. Inspection of (38) and (39) reveals that, all things else being equal (i.e. if $\widetilde{d}^A$, z_B^A and z_W^A were constant), an affirmative-action policy should increase the labour-market tightness of blacks but decrease that of whites.[17] It should thus also increase the vacancy duration of firms which hire blacks and decrease that of firms which hire whites.

Another important change in the model is that our measure of *effective discrimination* (the proportion of occupied jobs or vacancies on the 'black' labour market) is now given by:

$$\frac{\widehat{d}^A}{\overline{d}} = \frac{\widetilde{d}^A + \phi\left(\overline{d} - \widetilde{d}^A\right)}{\overline{d}}. \tag{40}$$

In this context, our prediction, is that an affirmative action policy should reduce effective labour-market discrimination by increasing the value of $\widehat{d}^A/\overline{d}$.

To check these different intuitions, we now run some numerical simulations using the same parameter values as in the previous Section. Table 3 presents the effects of an affirmative-action policy for different values of ϕ on labour-market outcomes in the two urban configurations. The first column recapitulates the Base Case, which can be obtained under a particular affirmative-action policy with $\phi = 0$. The second and third columns presents our results for a quota of 5% and one of 15%. In both city-structures, it is clear that quotas significantly reduce the unemployment rates of blacks, while only raising slightly that of whites. Consequently, the equilibrium utility of whites decreases while those of blacks increase. As predicted, an affirmative-action policy also reduces (increases) the labour-market tightness, the vacancy rate, and the vacancy duration on the white labour market (on the black labour market).

Table 3 also enables us to check that while $\widetilde{d}^A/\overline{d}$ the proportion of strictly speaking black firms decreases, $\widehat{d}^A/\overline{d}$ the effective proportion of black jobs and black vacancies always increases. For instance, in the Base Case, in Equilibrium 1, the proportion of black jobs and black vacancies only amounts to 17.7%. Under an affirmative-action policy with $\phi = 15\%$, the same figure rises to 18.8%. Finally, and not surprisingly, the total cost of discrimination sharply decreases when ϕ increases. Indeed, in the base case

[17] The tightness of the labour market $i = B, W$ under an affirmative-action policy is $\Omega_i^A = Z_i^A/(\overline{\theta}_i^A N_i u_i^A)$, where Z_i^A are now defined by (38) and (39) and $\overline{\theta}_i^A$ and u_i^A are still given by (7) and (12)–(14) respectively, with the new value of labour-market tightness.

Table 3

Affirmative Action

	Base Case: $\phi = 0\%$	$\phi = 5\%$	$\phi = 15\%$	Constraining	No discrimination	Optimal
Equilibrium 1 (2)				$\overline{\phi}^1 = 19.1\%$ $\underline{\phi}^2 = 20.4\%$	$\widehat{\phi}^1 = 20.0\%$ $\widehat{\phi}^2 = 12.7\%$	$\phi^{o1} = 9.9\%$ $\phi^{o2} = 1.3\%$
u_W^m (%)	3.3 (4.7)	3.6 (5.1)	4.2 (5.6)	4.4 (5.9)	5.2 (5.5)	3.8 (4.8)
u_{BS}^m (%)	13.2 (8.8)	12.0 (7.2)	9.4 (4.7)	8.3 (3.7)	5.5 (5.2)	10.7 (8.4)
u_{BC}^m (%)	18.1 (8.2)	16.2 (6.7)	12.4 (4.3)	10.9 (3.4)	7.0 (4.8)	14.3 (7.8)
$\widetilde{d}^m/\overline{d}$ (%)	17.7 (19.2)	13.8 (15.3)	4.5 (6.0)	0(0)	0 (8.4)	9.5 (18.2)
$\widehat{d}^m/\overline{d}$ (%)	17.7 (19.2)	18.1 (19.5)	18.8 (20.1)	19.1 (20.4)	20 (20)	18.4 (19.3)
z_W^m (%)	2.0 (1.8)	1.9 (1.7)	1.6 (1.5)	1.5 (1.4)	1.3 (1.5)	1.7 (1.8)
z_B^m (%)	0.9 (0.6)	1.0 (0.7)	1.3 (1.1)	1.5 (1.4)	2.4 (1.0)	1.1 (0.6)
Ω_W^m	0.022 (0.017)	0.019 (0.015)	0.014 (0.012)	0.012 (0.011)	0.009 (0.013)	0.016 (0.016)
Ω_B^m	0.004 (0.002)	0.005 (0.003)	0.009 (0.007)	0.012 (0.011)	0.030 (0.005)	0.007 (0.002)
U.D. *W*	0.487 (0.711)	0.526 (0.760)	0.619 (0.849)	0.660 (0.889)	0.788 (0.829)	0.570 (0.724)
U.D. *BS*	2.168 (1.381)	1.942 (1.113)	1.479 (0.699)	1.297 (0.545)	0.832 (0.780)	1.713 (1.307)
U.D. *BC*	3.147 (1.282)	2.763 (1.029)	2.023 (0.641)	1.747 (0.499)	1.077 (0.717)	2.391 (1.213)
V.D. *W*	0.297 (0.261)	0.275 (0.245)	0.234 (0.220)	0.220 (0.210)	0.185 (0.225)	0.254 (0.257)
V.D. *B*	0.131 (0.083)	0.147 (0.103)	0.193 (0.164)	0.220 (0.210)	0.344 (0.147)	0.166 (0.087)
v_W^m	9.226 (9.521)	9.206 (9.496)	9.158 (9.451)	9.137 (9.431)	9.072 (9.461)	9.183 (9.514)
v_{BS}^m	8.436 (9.195)	8.533 (9.322)	8.739 (9.527)	8.824 (9.606)	9.050 (9.486)	8.633 (9.229)
v_{BC}^m	8.076 (9.271)	8.223 (9.392)	8.528 (9.587)	8.648 (9.660)	8.959 (9.548)	8.373 (9.304)
P_W^m	3.707 (3.671)	3.888 (3.844)	4.300 (4.245)	4.495 (4.499)	4.495 (4.144)	4.081 (3.715)
P_B^m	0.814 (0.887)	0.632 (0.707)	0.206 (0.278)	0 (0)	0 (0.388)	0.434 (0.842)
TP^m	4.521 (4.558)	4.520 (4.552)	4.506 (4.523)	4.495 (4.499)	4.495 (4.532)	4.515 (4.557)
LR_W^m	0.888 (0.480)	0.888 (0.480)	0.888 (0.480)	0.888 (0.480)	0.888 (0.480)	0.888 (0.480)
LR_{BS}^m	0.007 (0.001)	0.007 (0.001)	0.007 (0.001)	0.007 (0.001)	0.007 (0.001)	0.007 (0.001)
LR_{BC}^m	0.002 (0.006)	0.002 (0.006)	0.002 (0.006)	0.002 (0.006)	0.002 (0.006)	0.002 (0.006)
TLR^m	0.897 (0.487)	0.897 (0.487)	0.897 (0.487)	0.897 (0.487)	0.897 (0.487)	0.897 (0.487)
S^m	14.451 (14.508)	14.458 (14.507)	14.457 (14.483)	14.449 (14.458)	14.451 (14.491)	14.460 (14.509)

The first number in each column is for Equilibrium 1, the second number, in parenthesis, is for Equilibrium 2
U.D.: Unemployment Duration $= 1/\kappa\theta_{ik}^m\ (\Omega_{ik}^m)^{1-\eta}$, $ik = W,BC,BS$, $m = 1,2$.
V.D.: Vacancy Duration $= 1/\kappa(\Omega_i^m)^{-\eta}$, $i = W,B$, $m = 1,2$.

$(\phi = 0)$, it was equal to $\widetilde{d}^1 = 17.0$ and $\widetilde{d}^2 = 18.4$ while, for example, when $\phi = 15\%$, it is equal to 4.32 and 5.76 respectively. As for the total surplus, for both equilibria, it turns out to be increasing for low values of ϕ and decreasing for higher values. This indicates that the welfare effects of such policies is not monotonic.

We would now like to deepen our analysis by answering the three following questions for each city $m = 1, 2$:

(*i*) Since $\widetilde{d}^A$ decreases with ϕ, what is the value of ϕ (denoted by $\overline{\phi}$) that would make $\widetilde{d}^A = 0$, i.e. the value that would make all firms perceive the quota as an active constraint?[18]

(*ii*) Since $\widehat{d}^A$ increases with ϕ, what is the value of ϕ (denoted by $\widehat{\phi}$) that would ensure that $\widehat{d}^A/\overline{d} = \overline{N}_B/\overline{N} = 20\%$, i.e. the value that would suppress discrimination by equating the proportion of firms effectively employing blacks or searching for a black worker and the proportion of blacks in the city?[19]

(*iii*) What is the optimal ϕ (denoted by ϕ^o) that maximises the total surplus (36) in the city?

The last three columns of Table 3 present our results in the two urban configurations when ϕ takes the three values just defined above (i.e. $\overline{\phi}$, $\widehat{\phi}$ and ϕ^o). There are obviously stark differences between the different city-structures. Indeed, the optimal quota ϕ^o is quite high (nearly 10%) in the urban configuration in which blacks are far away from jobs and quite low (just above 1%) in the urban configuration in which they are close to jobs. This difference is also reflected in the value of $\widehat{\phi}$ since one has to impose a 20% black quota in order to suppress discrimination in the first equilibrium, but only a 12.7% quota in the second equilibrium. Indeed, we have seen in the previous Section that blacks are more discriminated against when they live far away from jobs. Therefore, when an affirmative-action policy is implemented in order to eliminate discrimination or to maximise the total welfare, it is thus natural that the quota has to be higher in the Spatial-Mismatch Equilibrium so as to compensate for this discrepancy between the two equilibria. This suggests that *affirmative-action policies have different impacts depending on city-structure and are more justified in cities where blacks reside far away from jobs.*

4.2. *Employment Subsidies*

We now consider another policy in which the (local) government gives a subsidy σ to all firms that agree to hire a black worker. This policy is financed with a lump-sum tax T on all profits. This implies that firms' profits can now be written as follows:[20]

[18] Observe that, by definition, we then have $\overline{\phi}^m = \widehat{d}^A/\overline{d}$. This is because whenever $\phi \geq \overline{\phi}^m$ (and in the present case $\phi = \phi^m$) there are no 'black firms' so that the proportion of black jobs and black vacancies is exactly determined by the quota imposed onto 'white firms'. Also observe that when $\phi = \widehat{\phi}$, we must have $z_W^{m,A} = z_B^{m,A}$, which is equivalent to $\Omega_W^{m,A} = \Omega_B^{m,A}$.

[19] Removing discrimination means that the demand side of the labour-market will not treat blacks and whites differently. It does not mean that blacks and whites will have the same unemployment rates (since they occupy different locations in the city).

[20] The superscript S stands for employment subsidy. When there is no ambiguity, we omit the superscript $m = 1, 2$ that defines each equilibrium.

$$\mathrm{E}\Pi_W^S = \left(1 - z_W^S\right)(p - y_E) - z_W^S\gamma - T$$
$$\mathrm{E}\Pi_B^S(d) = \left(1 - z_B^S\right)(p - y_E - d + \sigma) - z_B^S\gamma - T$$

and the government's budget constraint is given by:

$$\overline{d}T = \widetilde{d}^S\sigma \Leftrightarrow T = \frac{\widetilde{d}^S}{\overline{d}}\sigma.$$

Equating $\mathrm{E}\Pi_W^S$ and $\mathrm{E}\Pi_B^S(d)$ gives the value of $\widetilde{d}$ under an employment-subsidy policy. We now have:

$$\widetilde{d}^S = \left(\frac{z_W^S - z_B^S}{1 - z_B^S}\right)(p - y_E + \gamma) + \sigma.$$

Comparing with (17), it can be easily seen that an employment subsidy increases the proportion of firms employing blacks. However, contrary to the previous policy, observe that $\widetilde{d}^S$ always increases with σ. Also observe that this policy implies a redistribution from firms which employ whites towards firms which employ blacks.

The first three columns of Table 4 present the effect of employment subsidies for two different values of σ. Clearly, as with the previous policy, the unemployment rates of blacks decrease with σ while the unemployment rate of whites increases. Also, even if the total cost of discrimination $\widetilde{d}^m$ monotonically increases with σ, the total welfare first increases and then decreases with σ. The mechanism at stake is however quite different from the previous policy since firms that are subsidised now *freely chose* whether it is more profitable for them to hire a black worker or not.

In comparison with the Base Case, observe that in both equilibria, black workers are less discriminated against when black employment is subsidised and that is why the total cost of discrimination for firms hiring blacks increases. However, because the location of each group differs across equilibria, the impact of σ on both welfare and unemployment is also quite distinct in each city.

Let us further investigate this issue by calculating the subsidy $\widehat{\sigma}$ which neutralises discrimination and the subsidy σ^o which maximises the total surplus, subject to the (local) government budget constraint. Table 4 presents our results. As σ increases, it is easy to see that Ω_W^m always decreases while Ω_B^m always increases.[21] Indeed, since the number of firms which hire black workers increases, the number of firms which hire white workers decreases, and thus it becomes easier for blacks and more difficult for whites to find a job. The second interesting result is that the optimal subsidy (and thus the taxation) is higher (three times higher in our simulations) in a city where blacks are far away from jobs than in a city where blacks are closer to jobs. Indeed, as stated above, the main problem for isolated blacks in Equilibrium 1 is that their job-acquisition rate is indeed *very low*. So even when there are many unemployed black workers as in Equilibrium 1 (which should imply that the vacancy-filling rate of black firms should be quite high), firms are in fact *seldom contacted by black workers* (which

[21] These effects are large. For example, in Equilibrium 1, when σ increases from 0 to 0.357, Ω_W^1 is more than halved (from 0.022 to 0.009) while Ω_B^1 is multiplied by 7 (from 0.004 to 0.030). In Equilibrium 2, we observe similar effects but of a slightly smaller amplitude.

Table 4
Employment Subsidies

	Base Case: $\sigma = 0$	$\sigma = 0.05$	$\sigma = 0.2$	No discrimination	Optimal	AAequivalent
Equilibrium 1 (2)				$\widehat{\sigma}^1 = 0.357$ $\widehat{\sigma}^2 = 0.111$	$\sigma^{o1} = 0.166$ $\sigma^{o2} = 0.062$	$\widetilde{\sigma}^1 = 0.023$ $\widetilde{\sigma}^2 = 0.001$
u_W^m (%)	3.3 (4.7)	3.6 (5.1)	4.5 (5.9)	5.2 (5.5)	4.3 (5.2)	3.4 (4.8)
u_{BS}^m (%)	13.2 (8.8)	11.7 (6.9)	8.0 (3.6)	5.5 (5.2)	8.7 (6.5)	12.5 (8.8)
u_{BC}^m (%)	18.1 (8.2)	15.8 (6.4)	10.4 (3.3)	7.0 (4.8)	11.4 (6.0)	17.0 (8.2)
$\widetilde{d}^m/\overline{d}$ (%)	17.7 (19.2)	18.2 (19.6)	19.2 (20.4)	20 (20)	19.0 (19.7)	17.9 (19.2)
z_W^m (%)	2.0 (1.8)	1.9 (1.7)	1.5 (1.4)	1.3 (1.6)	1.6 (1.6)	2.0 (1.8)
z_B^m (%)	0.9 (0.6)	1.0 (0.7)	1.6 (1.5)	2.4 (1.0)	1.4 (0.8)	1.0 (0.6)
Ω_W^m	0.022 (0.017)	0.018 (0.015)	0.012 (0.011)	0.009 (0.013)	0.013 (0.014)	0.020 (0.017)
Ω_B^m	0.004 (0.002)	0.006 (0.003)	0.013 (0.011)	0.030 (0.005)	0.011 (0.003)	0.005 (0.002)
U.D. W	0.487 (0.711)	0.535 (0.770)	0.674 (0.891)	0.788 (0.829)	0.645 (0.783)	0.509 (0.713)
U.D. BS	2.168 (1.381)	1.896 (1.060)	1.239 (0.536)	0.832 (0.780)	1.362 (0.995)	2.041 (1.374)
U.D. BC	3.147 (1.282)	2.688 (0.979)	1.660 (0.491)	1.077 (0.717)	1.845 (0.918)	2.929 (1.276)
V.D. W	0.297 (0.261)	0.271 (0.242)	0.215 (0.210)	0.185 (0.225)	0.225 (0.238)	0.284 (0.261)
V.D. B	0.131 (0.083)	0.150 (0.108)	0.230 (0.213)	0.344 (0.147)	0.209 (0.115)	0.139 (0.083)
v_W^m	9.226 (9.521)	9.201 (9.491)	9.129 (9.430)	9.072 (9.461)	9.144 (9.484)	9.215 (9.520)
v_{BS}^m	8.436 (9.195)	8.553 (9.347)	8.851 (9.611)	9.050 (9.486)	8.794 (9.379)	8.490 (9.198)
v_{BC}^m	8.076 (9.271)	8.253 (9.417)	8.687 (9.664)	8.959 (9.548)	8.605 (9.447)	8.159 (9.274)
P_W^m	3.707 (3.671)	3.702 (3.659)	3.675 (3.623)	3.638 (3.644)	3.682 (3.656)	3.705 (3.671)
P_B^m	0.814 (0.887)	0.828 (0.900)	0.855 (0.910)	0.861 (0.908)	0.851 (0.902)	0.820 (0.888)
TP^m	4.521 (4.558)	4.530 (4.559)	4.530 (4.533)	4.499 (4.553)	4.533 (4.559)	4.525 (4.558)
LR_W^m	0.888 (0.480)	0.888 (0.480)	0.888 (0.480)	0.888 (0.480)	0.888 (0.480)	0.888 (0.480)
LR_{BS}^m	0.007 (0.001)	0.007 (0.001)	0.007 (0.001)	0.007 (0.001)	0.007 (0.001)	0.007 (0.001)
LR_{BC}^m	0.002 (0.006)	0.002 (0.006)	0.002 (0.006)	0.002 (0.006)	0.002 (0.006)	0.002 (0.006)
TLR^m	0.897 (0.487)	0.897 (0.487)	0.897 (0.487)	0.897 (0.487)	0.897 (0.487)	0.897 (0.487)
S^m	14.451 (14.508)	14.469 (14.516)	14.485 (14.492)	14.455 (15.512)	14.486 (14.516)	14.460 (14.509)
T^m/TP^m (%)	0 (0)	0.2 (0.2)	0.8 (0.9)	1.6 (0.5)	0.7 (0.3)	0.09 (0.004)

The first number in each column is for Equilibrium 1, the second number, in parenthesis, is for Equilibrium 2.
U.D.: Unemployment Duration $= 1/\kappa\theta_{ik}^m\,(\Omega_{ik}^m)^{1-\eta}$, $ik = W,BC,BS$, $m = 1,2$.
V.D.: Vacancy Duration $= 1/\kappa(\Omega_i^m)^{-\eta}$, $i = W,B$, $m = 1,2$.

explains why the duration of a black vacancy is higher in the Spatial-Mismatch Equilibrium than in the Spatial-Match Equilibrium). For this reason, we have $\widetilde{d}^1/\overline{d} < \widetilde{d}^2/\overline{d}$. As a result, in order to reduce discrimination or in order to maximise total welfare, *a more intense employment-subsidy policy is required in the city where blacks are further away from jobs.*

4.3. *Affirmative Action Versus Employment Subsidies*

We have seen that both policies imply that they should be more intense in cities in which the spatial mismatch (i.e. the distance between black workers and jobs) is more severe.[22]

If we go back to Table 1 which characterises different MSAs according to the severity of the spatial mismatch for both blacks and whites, we see that the Equilibrium-1 type of cities (Spatial-Mismatch Equilibrium) corresponds to big MSAs such as New York, Los Angeles or Chicago whereas the Equilibrium-2 type of cities (Spatial-Match Equilibrium) consists of MSAs of a smaller population size such as Salt-Lake City or Eugene-Springfield. Our policy results from the previous Sections suggest that it would be preferable to implement an affirmative-action policy or an employment-subsidy policy in the MSAs listed in Table 1*a* rather than in those listed in Table 1*b*. Even if we did not show it explicitly, our results also suggest that between the MSAs of Table 1*b*, it would preferable to implement the two above-mentioned policies in Detroit or New York rather than in Baltimore or Atlanta because the mismatch between blacks and jobs is higher in the former cities than in the latter. This is quite interesting because the debate on affirmative action has been carried out at the state level in the U S but not at the MSA level. This is at odds with our analysis, which, for example, would recommend implementing an affirmative action policy in Houston but not in Sherman-Denison, even though both MSAs are located in Texas.

Another important issue that we would like to address is which policy should be preferred. There are two aspects that need to be considered. First, it appears in our simulations that, for both equilibria, the optimal employment-subsidy policy leads to a higher surplus than the optimal affirmative-action policy. This is because the mechanisms are quite different. An affirmative-action policy imposes a *hiring constraint* on the firms which employ whites whereas employment subsidies let firms *freely choose* whom they want to hire. In other words, with affirmative action, a policy maker forces firms which are not willing to hire black workers to hire them, even if these firms would be better off hiring white workers. With an employment-subsidy policy, some firms that were not willing to hire blacks do hire them now because it becomes profitable to do so. Accordingly, the first policy reduces $\widetilde{d}^m/\overline{d}$ but increases $\widehat{d}^m/\overline{d}$ whereas the second policy directly increases $\widetilde{d}^m/\overline{d}$.

[22] As we have seen from Table 2, when space does not matter (i.e. when $\beta = 0$), the labour-market outcomes are identical in the two equilibria. This means that each policy (affirmative action, or employment subsidies) would have the same impact in both equilibria. Whenever space matters (i.e. whenever $\beta > 0$), there is a discrepancy between the two equilibria since black workers have more difficulties in obtaining information about jobs in Equilibrium 1. In this case, both policies should be more intense in the city in which blacks are far away from jobs than in the city in which blacks are close to jobs.

This leads to our second aspect, which is more political. In choosing between the two policies, one has to trade off a policy that has a *purely psychological cost* and which is in general not popular among white firms and white workers (affirmative action) with a policy that has a *monetary cost* (employment subsidies). Also, the structure of the city does play an important role when comparing these two policies. If one implements an optimal policy which maximises the total welfare (Table 3 and 4), then, in Equilibrium 1, the trade off is between the psychological cost of imposing a quota of nearly 10% black workers in each 'white' firm, or a taxation corresponding to 0.7% of the aggregate profit. In Equilibrium 2, the optimal taxation is still relatively high (0.3%) whereas the optimal quota is much lower (1.3%). As a result, it may be that a policy maker may prefer an employment-subsidy policy in Equilibrium 1 and an affirmative-action policy in Equilibrium 2. One may argue however that this comparison is not completely correct since the two optimal policies lead to different surpluses. This is why in the last column of Table 4 (AA equivalent), we present, for both equilibria, the impact of an employment subsidy that would lead to the same aggregate surplus that can be obtained with the optimal quota. In this case, Table 4 indicates that the trade off is now between setting a quota of 9.9% in Equilibrium 1 (1.3% in Equilibrium 2) and taxing 0.09% of the aggregate profit (0.004% in Equilibrium 2). These figures imply that, in a utilitarian context, *an employment-subsidy policy could be preferred in both equilibria*. Observe however that when the two policies are such that they yield the same welfare, employment subsidies slightly favour firms and white workers at the expense of black workers. It is easy to understand why since employment subsidies can be viewed as a redistribution towards freely operating firms whereas quotas are perceived as a constraint that hinders firms.

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