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ABSTRACT

Spatial Mismatch: From the Hypothesis to the Theories

Since the 1950s, there has been a steady decentralization of entry-level jobs towards the suburbs of American cities, while racial minorities — and particularly blacks — have remained in city centres. In this context, the spatial mismatch hypothesis argues that because the residential locations of minorities are disconnected from suburban job opportunities, low-skilled minorities residing in inner cities face adverse labour market outcomes. The reason why distance to jobs may be harmful to minorities has, however, long remained unclear, while the abundant but essentially empirical literature on spatial mismatch has lead to much controversy. The present work presents the main stylised facts associated with spatial mismatch and reviews the main theoretical models that started to emerge in the late 1990s.

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1 Introduction

The research work by two sociologists, Kasarda (1985, 1988, 1989) and Wilson (1987, 1996), have highly contributed to a renewed interest in the so-called "spatial mismatch hypothesis" in the United States. Their studies have shown the existence of a black underclass in inner-city ghettos and attributed the endemic problems of that underclass to the sharp decrease in the number of entry-level jobs located in inner cities. However, the idea that a spatial mismatch between residential and work locations may be detrimental to ethnic or racial minorities was first mentioned in a seminal paper by Kain (1968). That paper argued that the spatial disconnection between inner-city ghettos (where minorities resided) and the suburbs (where low-skilled jobs had already begun to decentralize) was a major source of unemployment for blacks in US cities. For more than three decades, this assumption has inspired numerous empirical works which have tried to test the existence of a causal link between spatial mismatch and the bad labor-market outcomes of minorities. According to Kain, this causal link, known today as the "Spatial Mismatch Hypothesis" (SMH), can be summarized in the following way:

> *"Serious limitations on black residential choice, combined with the steady dispersal of jobs from central cities, are responsible for the low rates of employment and low earnings of Afro-American workers"*

This definition raises four main comments that are worth stressing here:

First, the SMH refers to two separate issues that must be clearly distinguished: (i) *the reasons why minorities reside far away from jobs* and (ii) *the mechanisms according to which distance to job opportunities may be harmful to minorities*. The standard SMH proposed by Kain and in its subsequent formulations have a clear answer to the first issue since they present job decentralization and the persisting residential location of minorities in inner-cities as the two historical causes that jointly explain why minorities live far away from job opportunities. The mechanisms, however, are not always clearly identified.

Second, the SMH is only concerned with the way *low-skilled minority workers* —and notably inner-city black residents— are affected by distant job locations. This approach seems to suggest that *because ethnic minorities are poorly qualified*, they can be adversely affected by the distant location of jobs.[1] As a matter of fact, the SMH does not focus on how *skilled* minority workers may be affected by distance to job opportunities. Nor does it pretend to say anything about the difficulties faced by *low-skill minority workers who reside in areas where entry-level jobs are supposedly numerous* (as in the suburbs of decentralized American cities).

[1] Some authors prefer the expression *spatial-skill-mismatch* to more accurately depict the spatial disconnection between the residential locations of inner-city minorities and the locations of the *low-skilled suburban jobs* they could occupy (see Ong and Blumenberg, 1998, or Immergluck, 1998).

Third, in order to dispel an unfair but frequent objection, it should be said that the SMH does not argue that distance to jobs is the *unique* cause of the difficulties faced by inner-city minorities, but only that it has an adverse and significant impact on the wages and the level of unemployment of unskilled minority workers residing in central cities. In no way does it rule out the possibility of alternative explanations (such as labor-market discrimination for instance).

Lastly, when it was first introduced, the SMH was more of an intuition than a fully-fledged theory. It is striking that the original formulation of the SMH did not explain how distance to jobs could harm minorities. In this context, given the incomplete formulation of the SMH and its lack of theoretical foundations, it is not surprising that researchers have long had an imprecise understanding of what the SMH clearly meant and implied. This probably explains part of the controversy associated with the nevertheless abundant empirical literature on spatial mismatch.[2] It is only recently that economists have started to provide theoretical explanations to the SMH and to model the underlaying mechanisms.

Therefore, the aim of the present survey is twofold:

We first want to present the main relevant stylized facts of spatial mismatch in US cities. This is often overlooked by spatial mismatch studies which usually offer an incomplete characterization of the metropolitan areas studied and take spatial mismatch for granted. Compiling some of these empirical studies and computing our own statistics, we have selected a series of relevant figures that enables us to assess the extent to which minorities can be said to be disconnected from job opportunities in US cities.[3]

We then want to present the recent theoretical contributions to the spatial mismatch literature. We will not focus on the causes of the spatial disconnection between places of residence and job locations but on the mechanisms at work that could explain the adverse labor-market outcomes of ethnic minorities in a spatial mismatch context. Our objective is to present the theoretical arguments that support the main intuitions beyond spatial mismatch.

Our work is organized as follows. In section two, we present the main stylized facts of spatial mismatch in US cities. In section three, we detail the mechanisms that may account for the unemployment and the low incomes of ethnic minorities. Section four concludes.

[2] The empirical controversy was initiated by Ellwood (1986) for whom race is much more important than job accessibility to explain the adverse labor market outcomes of minorities. According to that author, "*race, not space, remains the key explanatory variable*". Even though discussing this empirical controversy is beyond the scope of the present paper (for more details, see the comprehensive surveys by Jencks and Mayer, 1990; Holzer, 1991; Ihlandfeldt and Sjoquist, 1998), it should be said that, in the absence of a clear understanding of the SMH, many empirical studies have focused on either incorrect, partial or irrelevant specifications of the SMH (Kain, 1992, provides interesting examples).

[3] In accordance with the mainstream spatial mismatch literature, we will focus on the black minority. Other communities such as hispanic youth are also affected by spatial mismatch (Ihlanfeldt, 1993) but to a lesser extent than African-Americans.

2 Empirical facts

Over the second half of the twentieth century, dramatic changes have occurred in US Metropolitan Areas. In particular, the concentration of jobs has continuously decreased in central cities and increased in the suburbs. Over the same period, many black households have remained in central cities while whites have continuously decentralized to suburban residential areas. The combination of these two trends is said to have created a situation of spatial mismatch to the extent that African Americans are now located far away from suitable suburban job opportunities. Even though these trends are well established, the degree of spatial mismatch remains unclear, in particular because most empirical studies only focus on a specific aspect of spatial mismatch and fail to provide a full picture of the phenomenon. To assess the intensity of spatial mismatch in US cities one should ask oneself two simple questions: (*i*) *What are the jobs that have suburbanized and to what extent have they suburbanized?* (*ii*) *How central are the residential location of blacks and how far are they located from suitable job opportunities?*

In this section, we shed light on and measure the progressive emergence of spatial mismatch by compiling some key descriptive statistics. We first present a set of figures that illustrate the suburbanization of population as well as the creation and relocation of jobs in the suburbs of US cities. This trend is well documented until the late 1980s (see Stanback, 1991, Mills and Hamilton, 1994, Mills and Lubuele, 1997) and we provide statistics for the three past decades, including figures from Census 2000. We then provide another set of figures that illustrates the residential concentration of African Americans in central cities. These two persisting trends confirm the existence of a significant spatial mismatch for black workers in today's US cities.

2.1 Suburbanization and urban labor markets

One of the most striking feature of the American urban landscape has been the massive and continuous suburbanization of both people and jobs in the second half of the twentieth century. In the following subsections, we illustrate these dramatic changes with adequate figures and show how the resulting spatial organization of cities relates to the workings of urban labor markets.

2.1.1 The suburbanization of population and jobs

We first depict the huge decentralization of people that has occurred since the Second World War. Whereas on average, more than 57% of MSA residents were located in a central city in 1950, the proportion of central-city residents was 40% in 1980 (Mieszkowski and Mills, 1993). Our own calculations from the census show that suburbanization still goes on, but at a slower pace. Indeed, in the ten largest MSAs, the proportion of central city residents has declined from

48% in 1980 to 42% in 2000 (see Table 1).[4] Today, the median resident in a US metropolitan area lives farther than nine miles from the city center (Glaeser and Kahn, 2000).

Table 1: *Percentage Population in Central Cities, 1970-2000*

	1970	*1980*	*1990*	*2000*
Los Angeles - Long Beach	47	47	47	46
New York	88	86	86	87
Chicago	53	47	43	41
Boston	35	33	32	31
Philadelphia	42	37	34	31
Washington	30	24	20	17
Detroit	39	32	29	26
Houston	68	61	52	49
Atlanta	28	19	13	10
Dallas	60	52	46	42
Ten largest MSAs	53	48	45	42

(Source: calculated from census data)

Between 1950 and 1980, the changes in the distribution of central-city and suburban residents was accounted for by a decrease in the central-city population and an increase in the suburban population. Table 2 indicates the emergence of a new pattern in the 1990s: between 1970 and 1990, the average annual rate of population growth was significantly negative in the city centers of 7 out of the 10 largest MSAs. On average, the population in the central cities of theses MSAs decreased by 0.2 percent each year. This contrasts with the steady population growth in the suburban areas of all MSA's, the average growth rate being 1.5 percent each year.[5] In the 1990s, the population in central cities has been growing again in 7 out of the 10 largest MSAs and the average annual growth rate between 1990 and 2000 stands at 0.7 percent. Observe that this is much lower than the average annual growth rate of the suburban population over the same period.

[4] All the tables we have computed from Census data refer to the 10 largest MSAs, according to the 1999 NECMA number (MSA-PMSA Number for Non-New England Metro Areas).

[5] The average growth rate corresponds to the growth rate of the total population in the 10 largest MSAs.

Table 2: *Annual Rates of Population Change, 1970-2000 (%)*

	1970-1990		*1990-2000*	
	Central City	*Suburbs*	*Central City*	*Suburbs*
Los Angeles - Long Beach	1.1	1.2	0.6	0.8
New York	−0.4	0.2	0.9	0.6
Chicago	−0.8	1.1	0.6	1.4
Boston	−0.1	0.7	0.3	0.8
Philadelphia	−1.0	0.7	−0.5	0.8
Washington	−0.7	2.1	−0.0	1.9
Detroit	−1.7	0.5	−0.6	0.8
Houston	1.5	4.9	1.8	2.9
Atlanta	−1.2	3.6	0.6	3.7
Dallas	1.1	4.1	1.7	3.6
Ten largest MSAs	−0.2	1.5	0.7	1.6

(Source: calculated from census data)

Jobs have also moved to the suburbs over the second half of the twentieth century: whereas in 1950, central cities gathered nearly 70% of MSA jobs, the figure has gone down to 50% in 1980 (Mills and Lubuele, 1997). We provide figures for the changes between 1980 and 1990, showing that this trend continues. In the ten largest MSAs, the proportion of jobs located in central cities has decreased from 57% in 1980 to 51% in 1990 (see Table 3).[6] If we exclude the case of New York's city center which concentrates about 90% of the metropolitan area's jobs, the average proportion of central city jobs for the nine remaining MSAs goes down from 50% in 1980 to 44% in 1990. Today, jobs in American Cities are very decentralized. Glaeser and Kahn (2000) estimate that in 1996, on average, only 16% of jobs were located within a three mile radius from a city's geographical center.[7]

The third and fourth columns of Table 3 show that the decrease in the percentage of jobs located in central cities can be explained by a higher growth rate of jobs in the suburbs than in the central city. In the ten largest MSAs, between 1980 and 1990, the number of jobs increased on average by 3% each year in the suburbs. It only grew by 0.8% in the central cities of these selected MSAs.[8]

[6] Job figures by location are not available yet for the year 2000 (see the State of the Cities Data System, http://socds.huduser.org, for an update).

[7] Of course, all cities do not have the same degree of job suburbanization and a metropolitan area such as Los Angeles is much more decentralized than New York (see Table 3).

[8] Stanback (1991, p.26) also provides job growth figures by location for the periods 1969-1979 and 1979-1987. The interesting pattern that arises from the comparison of these two periods is that central cities in New-York and Chicago had a negative growth rate in the seventies, but a positive one in the eighties. All suburbs had a positive growth over the two periods.

Table 3: *Percentage Jobs in Central City and Average Annual Growth Rates of Jobs by Workplace*, $1980 - 1990$

	% Jobs (Central City) 1980	*% Jobs (Central City) 1990*	*Growth Rate (Central City) 1980-1990*	*Growth Rate (Suburbs) 1980-1990*
Los Angeles - Long Beach	51	51	1.9	2.1
New York	91	89	1.1	3.3
Chicago	50	44	−0.2	2.3
Boston	46	41	0.6	2.4
Philadelphia	41	35	−0.0	2.4
Washington	46	38	1.4	4.5
Detroit	38	28	−2.1	2.5
Houston	78	72	1.0	3.9
Atlanta	35	25	0.9	5.6
Dallas	69	60	1.4	5.6
Ten largest MSAs	57	51	0.8	3.0

(Source: calculated from census data)

It should also be noted that, in US cities, employment suburbanization goes along with the appearance of two major urban patterns that break up with the traditional vision of a monocentric city: the *emergence of suburban job centers* and the *development of edge cities* at the periphery of large metropolitan areas (see Garreau, 1991; Henderson and Mitra, 1996; Fujita, Thisse and Zenou, 1997; McMillen and McDonald, 1998). Suburban job centers can be defined as *suburban areas that are above a minimal number of jobs and a minimal job density*. Considering a threshold of 10,000 jobs and a density of 10 employed workers per acre, Giuliano and Small (1991) identify 29 different employment centers in the sole Los Angeles Metropolitan Area in 1981, thereby proving the polycentricity of that zone. In general, suburban centers have two major characteristics: first, their existence is usually correlated with high rents in their vicinity (White, 1999); second, even taken together, they never group more than half the jobs in the city (Anas, Arnott and Small, 1998).[9] In fact, despite the emergence of employment subcenters, employment suburbanization can be said to remain rather diffuse (Glaeser and Kahn, 2000). As for edge cities, contrary to subcenters, they can be defined as *real towns* located near transport nodes and which typically group service industries they export (see Bogart, 1998; for example, information technology traded over the internet). In his book, Garreau (1991) identifies 123 existing edge cities and 77 emerging ones for the US as a whole. The emergence of edge cities thus appears to be truly characteristic of US

[9] For instance, even though San Francisco has huge suburban centers, they only account for 47% of all the metropolitan area's jobs. In Los Angeles, a city that is very decentralized, suburban centers only group one third of jobs and the city center remains the biggest employment center of all, two times bigger than the second biggest center and nearly ten times bigger than South Coast Metro, the biggest edge city in the region (Anas, Arnott and Small, 1998).

cities and has important implications for the location of both jobs and people. In this respect, Garreau asserts that more people now live in edge cities than in traditional cities.

2.1.2 The changing distribution of industries and skills

The spatial-skill-mismatch hypothesis assumes that entry-level jobs are mainly created in the suburbs but tend to disappear from city centers whereas low-skill minorities remain located in central cities. Table 4 presents the average growth rate of jobs by place and skill between 1980 and 1990. The most striking feature is the decrease in low-skill jobs in almost all city centers of the ten largest MSAs, the average annual rate of decrease being 1.5%. On the contrary, the number of low-skill jobs grew on average in the suburbs at the low rate of 0.5%. The number of professional and services jobs grew both in the suburbs and the city centers, but at a much higher rate in the suburbs.

Table 4: *Average Annual Growth Rates of Jobs by Workplace, 1980-1990 (%)*

	Central City			*Suburbs*		
	Manual[1]	*Prof.*[2]	*Services*[3]	*Manual*[1]	*Prof.*[2]	*Services*[3]
Los Angeles - Long Beach	1.1	2.7	2.6	0.6	3.5	2.2
New York	−0.8	2.6	2.0	0.9	5.0	2.0
Chicago	−2.9	1.4	0.6	−0.1	4.0	1.5
Boston	−3.5	2.8	0.8	−1.6	4.4	1.5
Philadelphia	−3.1	1.9	0.4	−0.6	4.3	1.5
Washington	−0.9	3.0	1.7	2.7	6.1	3.5
Detroit	−4.8	−0.1	−1.7	1.0	3.9	1.3
Houston	−1.4	2.5	3.3	1.7	5.7	5.4
Atlanta	−1.5	2.9	1.2	2.4	7.5	4.9
Dallas	−0.9	3.2	2.4	2.2	7.9	6.2
Ten largest MSAs	−1.5	2.4	1.6	0.5	4.8	2.4

(Source: calculated from census data)

[1]Machine operators and other laborers

[2]Managerial, professional, technicians and related supports

[3]Protective, private household, and other Services

Table 5 presents the average annual growth rates of workers by skill and place of residence between 1980 and 1990. For professional and services workers, the pattern is the same as for professional and services jobs (see Table 4): the number of both types of workers grew in the suburbs and in the central cities but the growth rate was much higher in the suburbs. However, the trend is different for manual workers whose number decreased both in the central cities (-1.4% annually) and in the suburbs (-0.2% annually). Comparing Table 5 with Table 4, this means that the number of manual workers decreased in the suburbs between

1980 and 1990, while the number of manual jobs increased in the suburbs over the same period.

Table 5: *Average Annual Growth Rates of Workers by Place of Residence*, $1980 - 1990$ (%)

	Central City			*Suburbs*		
	Manual[1]	*Prof.*[2]	*Services*[3]	*Manual*[1]	*Prof.*[2]	*Services*[3]
Los Angeles - Long Beach	1.3	2.6	2.7	0.4	3.6	1.9
New York	−1.1	2.8	2.0	−1.6	2.9	0.6
Chicago	−2.5	2.7	0.4	−0.9	2.9	1.2
Boston	−2.7	4.7	1.1	−2.4	4.6	1.0
Philadelphia	−2.3	3.0	0.9	−1.1	4.1	1.2
Washington	−1.3	3.5	0.5	2.0	6.2	3.8
Detroit	−3.2	0.5	−0.8	−0.7	3.1	0.6
Houston	−2.2	0.6	2.6	1.9	5.7	6.1
Atlanta	−2.4	2.4	−0.7	1.8	6.5	4.8
Dallas	−0.6	3.0	2.9	1.5	6.6	5.3
Ten largest MSAs	−1.4	2.7	1.5	−0.2	4.4	2.1

(Source: calculated from census data)

[1]Machine and transportation equipment operators, material handlers and laborers.

[2]Professional specialty and technical, executive, managerial, and admnistrative.

[3]Non-household and private household services.

Table 6 presents the average annual growth rates of jobs and workers by industry in central cities and in the suburbs between 1980 and 1990. The trade, finance and services industries exhibit the same patterns as the professional and services occupations for both jobs and workers as in Table 4 and Table 5: a positive growth rate in the central cities and the suburbs, the growth rate being higher in the surburbs. The most interesting figures of Table 6 concern the manufacturing and construction industries: both the number of jobs and workers decreased in central cities and increased in the suburbs. In these industries, the number of suburban jobs grew at a higher rate than the number of suburban workers.

Table 6: *Average Annual Growth Rates of Jobs and Workers by Place and Industriesfor the ten largest MSAs*, $1980 - 1990$

	Manuf.[1]	*Trade*[2]	*Finance*[3]	*Services*[4]
Jobs (Workplace)				
Central City	-1.7	0.7	1.7	2.4
Surburbs	1.2	3.3	5.9	4.1
Workers (Place of Residence)				
Central City	-1.5	1.0	1.7	2.3
Surburbs	0.3	2.6	4.3	3.8

(Source: calculated from census data)

[1]Manufacturing and Construction

[2]Wholesale and Retail Trade

[3]Finance, Insurance and Real Estate

[4]Personal, Professional, Business and Repair Services

2.1.3 Spatial mismatch and the segmentation of urban labor markets

In this context of continuous job suburbanization, it is little surprising that American cities exhibit significant spatial differences across neighborhoods in commuting patterns. The fairly decentralized structure of cities also goes along with significant local differences in unemployment rates and earnings, which we document in the present section.

The separation of the places of work and residence The SMH stipulates that inner-city residents are physically disconnected from jobs. This disconnection may be perceived through commuting patterns. In 1995, the average commuting distance is 12 miles (13.2 miles for chain trips) and the average commuting time is 21.7 minutes (24.5 minutes for chain trips) (Giuliano, 2000). Table 7 shows the commuting flows in the largest MSAs in the US by place of origin and destination in 1990. The striking fact is that, in all MSAs, over 70% of the workers residing in central cities occupy a job in the city center. Suburbanites also tend to work predominantly in the suburbs contrary to the traditional conception of commuting in which rich suburbanites commuted to the CBD where they held jobs.

Table 7: *Flow from Place of Residence to Place of Work (% of all Trips by Place of Origin)*, 1990

Flow from...	*Central City*		*Suburb*	
to...	*Central City*	*Suburb*	*Central City*	*Suburb*
Los Angeles	95	5	16	84
New York City	85	15	19	81
Chicago	91	9	27	73
Boston	–	–	–	–
Philadelphia	81	19	12	88
Washington, DC	84	16	27	73
Detroit	78	22	17	83
Houston	93	3	41	59
Atlanta	71	29	29	71
Dallas	92	8	28	72

(Source: calculated from Rossetti and Eversole, 1993, Table 4-12)

In order to complete the analysis of Table 7, it is worth mentioning that the type of commuting and means of transportation used are strongly correlated: whereas 90% of all workers traveling daily from the suburbs use their car, only 60% of all journeys originating from central cities are by car (Mills and Hamilton, 1994). These figures emphasize the crucial importance of owning a car for those who work out of their residential neighborhood but also underline the tendency of many inner-city residents to resort to public transportation when traveling (see Glaeser, Kahn and Rappaport, 2000). These geographic contrasts support the existence of distinct local labor markets that separate inner cities from suburbs. The idea of separate local labor markets is confirmed by a few key descriptive statistics in US cities:

Central city and suburbs: the labor-market outcomes There are stark differences in local employment rates within any given metropolitan area. Strikingly, the unemployment rate is always higher in central cities than in the suburbs. Table 8 presents the city/suburbs contrasts in unemployment in the ten largest MSAs in 1990 and 2000. Intra-urban variations in the unemployment rate can be huge. In Detroit for instance, the unemployment rate for the year 2000 reaches 6.6% in the city center, which is more than two times the 2.5% unemployment rate prevailing in the suburbs.

Table 8: *Unemployment Rates, 1990-2000 (%)*

	Central City		*Suburbs*	
	1990	*2000*	*1990*	*2000*
Los Angeles-Long Beach	6.4	5.9	5.3	4.9
New York	7.2	5.7	3.2	3.0
Chicago	7.9	5.5	4.9	3.4
Boston MSA	4.9	2.7	4.6	2.1
Philadelphia	6.2	6.4	4.3	3.1
Washington	4.8	4.3	2.3	2.0
Detroit	13.9	6.1	6.6	2.5
Houston	6.5	5.0	4.3	3.2
Atlanta	6.5	4.7	4.2	2.6
Dallas	6.1	3.8	4.4	2.5
Ten largest MSAs	7.0	5.4	4.5	3.0

(Source: calculated from the Current Labor Force Survey)

Another important feature of urban labor markets in US cities is that, on average, wages are higher in city centers than in the suburbs. Indeed, in most cities, the difference in average suburban and central-city wages varies between 10% and 35% and tends to have increased between the late sixties and the late eighties (Stanback, 1991). It should be recalled, however, that these figures are only means, which calls for the following comments: first, the average wage depends on the sectoral distribution of employment in each zone and some sectors offer higher wages than other sectors. Furthermore, not all sectors pay higher wages in the city center. In the manufacturing industry for instance, it is the opposite: workers are often paid higher wages in the suburbs than in the city center. Second, the average wage that is measured also depends on the local distribution of skills, and the wage gradient of high- and low-skill jobs seem to be of opposite signs. As a matter of fact, the high-skilled jobs that pay the most are located within the CBD, whereas the low-skilled jobs the pay the most are located in the suburbs. In this respect, Ihlanfeldt (1997) reports that the hourly hiring wage in a fast food restaurant is \$4.39 in the northern suburbs of Atlanta, but only \$3.84 the city center. This means that low-skilled jobs are remunerated less in city centers (where the poor allegedly live) than in the suburbs (where residents are relatively more wealthy).

Table 9 presents the family income ratio between central cities and suburbs in 1970, 1980 and 1990 for the ten largest MSAs. All figures are below one at all dates and in all cities, indicating that families living in city centers have a lower income than families living in the suburbs.[10] In all cities, the discrepancy between central cities and suburban families has continuously widened over the 1970-1990 period.

[10]It is well known in fact that in US cities, richer families tend to locate in residential suburban areas (Brueckner, Thisse and Zenou, 1999).

Table 9: *Family Income Ratios between city center and suburbs*, $1970 - 1990$

	1970	1980	1990
Los Angeles-Long Beach	0.93	0.87	0.82
New York	0.73	0.64	0.63
Chicago	0.76	0.67	0.64
Boston	0.82	0.75	0.72
Philadelphia	0.79	0.67	0.62
Washington	0.80	0.75	0.73
Detroit	0.78	0.65	0.53
Houston	0.93	0.79	0.70
Atlanta	0.79	0.61	0.58
Dallas	0.98	0.84	0.76
Ten largest MSAs	0.82	0.72	0.69

(Source: calculated from census data)

Finally, the high unemployment and low incomes of inner city dwellers is the source of intense poverty in central cities as shown in Table 10. Moreover, the discrepancy between central cities and suburbs is rising. Whereas the average poverty rate in the ten largest MSAs has remained constant since 1970 (at 7%), it has raised in city centers from 14% in 1970 to 20% in 1990. Most MSAs reproduce this average trend even though the poverty rate difference between suburbs and central cities may vary.

Table 10: *Poverty Rates by Place of Residence, 1970-1990*

	Central City			*Suburbs*		
	1970	*1980*	*1990*	*1970*	*1980*	*1990*
Los Angeles-Long Beach	13	16	18	9	11	12
New York	15	20	19	6	7	6
Chicago	14	19	20	4	4	4
Boston	12	15	15	6	6	5
Philadelphia	15	21	21	6	6	5
Washington	14	16	14	6	6	5
Detroit	14	20	30	5	5	6
Houston	14	13	21	11	7	9
Atlanta	20	28	27	10	9	8
Dallas	12	13	17	10	7	8
Ten largest MSAs	14	18	20	7	7	7

(Source: calculated from census data)

To sum up, the main features of urban labor markets in US cities suggest that low-skilled central-city residents face lower local wages, higher local unem-

ployment rate and have a higher exposure to poverty than those residing in the suburbs.

2.2 Blacks have not followed the suburbanization of employment

In the previous subsection, we have provided simple figures that illustrate the suburbanization of jobs, and notably in the services sector (see Table 6). The commuting flows suggest that central-city workers are disconnected from suburban jobs (see Table 8). As far as low-skilled jobs are concerned, they are usually better paid in the suburbs. All these features are compatible with the SMH which stipulates that inner-city low-skilled minorities have few contacts with better-paid suburban job opportunities.

We will now focus on the second aspect of spatial mismatch in US cities: the spatial gap between the residential location of minorities and their job opportunities. In the context of decentralized American cities, this broadly amounts to showing that blacks are under-represented in the residential suburbs (Kasarda, 1988 and 1989). We will then present some key figures that illustrate the adverse labor-market outcomes of inner-city blacks.

2.2.1 The over-representation of blacks in central cities

A basic pattern in American metropolitan areas is that, contrary to whites, blacks have not massively suburbanized. Whereas in 1950, 56% of whites were located in central cities, they have massively shifted to suburban residential areas where they represented 66% of the population in 1990 (Mills and Hamilton, 1994). Table 11 compares the recent changes in the centralization of blacks and whites in the ten largest MSAs between 1980 and 2000. It is striking that the proportion of central dwellers among both blacks and whites decreases constantly over past two decades, which reflects the continuing suburbanization. However, the percentage of central city dwellers among blacks always remains more than two times that of whites. In 2000, 64% of blacks live in a central city in comparison with 28% of whites.

Table 11: *Percentage of Population living in Central City by Race* (%), $1980 - 2000$

	Blacks			*Whites*		
	1980	*1990*	*2000*	*1980*	*1990*	*2000*
Los Angeles-Long Beach	61	58	56	45	45	46
New York	94	94	93	79	78	77
Chicago	88	81	73	31	27	25
Boston	84	79	74	30	27	24
Philadelphia	77	73	68	27	23	18
Washington	53	40	29	14	12	12
Detroit	89	86	80	17	11	8
Houston	87	77	69	50	38	34
Atlanta	53	35	22	8	6	5
Dallas	84	75	63	43	36	28
Ten largest MSAs	79	72	64	37	32	28

(Source: calculated from census data)

Table 12 presents the racial composition of the ten largest MSAs between 1980 and 2000 by location. It is striking that even though the proportion of blacks has constantly increased in the suburbs, blacks have remained underrepresented in peripheral areas. In 2000, they account for only 11% of the suburban population, but for 27% of central city residents. The second observation is that, on average, the concentration of black residents increased between 1980 and 1990 and has remained nearly constant since then. It should be noted that the proportion of black residents varies across cities. In Detroit for instance, a highly segregated metropolitan area, 70% of inner-city residents are blacks, whereas blacks only account for 6% of the suburban population.

Table 12: *Percentage of Blacks by Location, 1980-2000*

	Central City			*Suburbs*		
	1980	*1990*	*2000*	*1980*	*1990*	*2000*
Los Angeles-Long Beach	16	13	11	9	8	8
New York	24	26	24	10	11	12
Chicago	37	36	33	5	6	8
Boston	9	10	11	1	1	2
Philadelphia	38	40	43	7	8	9
Washington	56	51	44	16	19	22
Detroit	56	66	70	3	4	6
Houston	27	27	24	6	9	10
Atlanta	66	67	61	14	19	25
Dallas	25	25	23	5	7	9
Ten largest MSAs	24	28	27	7	9	11

(Source: calculated from census data)

The intensity of segregation in American cities can be measured by the dissimilarity index, also known as the Duncan and Duncan index (1955).[11] According to Cutler, Glaeser and Vidgor (1999), the average black/white dissimilarity index in American cities increased between 1940 and 1970, rising from 72% to 79%, but decreased afterwards, reaching 66% in 1990. This trend is confirmed by other studies which nevertheless present somewhat higher segregation indices (see Farley, 1984; Frey and Farley, 1996; Farley et al., 1993).[12] Table 13 presents dissimilarity index at the Census Tract level for the ten largest MSAs in 1990 and 2000, showing that residential segregation kept decreasing over the last decade even though it remained high.

[11] By definition, the dissimilarity index is equal to $\frac{1}{2} i \sum \left| \frac{Blacks_i}{Blacks} - \frac{Non-blacks_i}{Non-blacks} \right|$.

This index gives the percentage of blacks (or similarly of non-blacks) that should be relocated in order to obtain a homogenous distribution of population in the city. A dissimilarity index of less than 30% is considered to be low. Between 30% and 60%, it is medium. Over 60%, it is considered to be high (Cutler, Glaeser and Vidgor, 1999). This index is sensitive to the size of districts (areas i in the formula).

[12] One explanation of the decrease in segregation could be linked to the increase in black suburban population, in particular, after the seventies.

Table 13: *Dissimilarity Indexes at the Census Tract Level*, $1990 - 2000$ (%)

	1990	*2000*
Los Angeles	64	57
New-York	69	67
Chicago	84	78
Boston	68	63
Philadelphia	75	69
Washington	64	60
Detroit	64	60
Houston	62	57
Atlanta	67	62
Dallas	59	54

(Source: Glaeser and Vidgor, 2001)

2.2.2 Commuting specificities

Blacks and whites not only differ by their residential location in MSAs, but also by their commuting patterns. First, it is well known that urban blacks have a bad access to automobiles. Whereas 8.7% of white households do not have a car in 1990, this percentage reaches 30.4% for black households (McGuckin, 2000). The distance traveled and the means of transportation used by black and white commuters differ significantly as shown by Table 14 for the year 1995. Whereas 2% of white workers' commutes are by public transit (by bus or by rail), this percentage stands at 12% for black workers. Similarly, black workers resort more to car pooling (20% of their trips) than white workers (14% of their trips) who massively use their private vehicle to commute. It is also striking that whatever the transportation mode considered, the average distance traveled by whites is higher than that of blacks. Excluding the category "other transportation modes", one can calculate that the average commute of a white workers is 11.8 miles, but only 10.5 miles for a black worker. Note that this does not necessarily mean that blacks reside closer to job opportunities than whites: indeed, black workers may experience difficulties finding or accepting distant jobs, resulting in shorter commuting distances than whites.

Morevover, although travel distances favor blacks over whites, the average travel time to work is higher for blacks than for whites. In 1990, the average time to work for blacks was 24 minutes, but only 20 minutes for whites (Source: 1990 PUMS B data, Krovi et Barnes, 2000). It is thus not clear whether blacks bear higher commuting costs than whites or not.

Table 14: *Mode Choice and Average Distance for Travel to Work by Race*, 1995

	Private Vehicle	*Car Pooling*	*Transit (bus)*	*Transit (rail)*	*Walk*	*Other*
Mode Choice (% of Trips)						
Black	62	20	8	4	3	3
White	79	14	1	1	2	3
Average Distance (in miles)						
Black	10.6	10.9	10.0	14.1	1.2	–
White	11.8	13.2	12.1	17.3	0.7	–

(Source: extracted from 1995 NPTS, McGuckin, 2000, Table 4-8 and Table 4-15)

2.2.3 Blacks have poor access to job opportunities

Commuting flows (see Table 7) suggest that African Americans living in central cities could not benefit from job offers located in the suburbs. This intuition is confirmed by Table 15 (extracted from Stoll, Holzer and Ihlanfeldt, 1999) built from which presents the distribution of recently filled jobs and people for a pooled sample of MSAs (Atlanta, Boston, Detroit, Los Angeles). Whereas blacks are over-represented in central cities, recently filled jobs are mainly located in the suburbs. This pattern is even more striking for the less-educated and the jobs they may occupy. While 76.3% of black high school dropouts live in central cities, the suburbs group 79.6% of recently filled low-skill jobs. In contrast, the proportion of white high school dropouts residing in the suburbs is nearly equal to that of the recently-filled low-skill jobs located there.

Table 15: *Distribution of Recently Filled Jobs and People : Pooled Sample of MSAs*

	Central city	*Suburbs*
All Jobs	25.2	74.8
*Low-skill Jobs**	20.4	79.6
Whites	13.1	86.9
Blacks	65.3	34.8
White H.S. dropouts	22.2	77.9
Black H.S. dropouts	76.3	23.6

(Source: Stoll, Holzer and Ihlanfeldt, 1999)

*No H.S. diploma, no experience or training, no reading, writing, math

2.2.4 Unemployment, low income, and poverty

We have seen that the unemployment rate is always higher in central cities than in the suburbs (see Table 8). This is true for the urban population as a whole,

but also for each racial group as can be seen from Table 16 which represents the unemployment rates of whites and blacks in the twenty-five largest cities in 1997. The figures show the sharp contrast that opposes white and black workers, and the distressed situation of central cities. Indeed, the unemployment rate of central-city blacks reaches 12.5%, which is 5 points above the unemployment rate of suburban blacks and more than three times the unemployment rate of suburban whites.

Table 16: *Unemployment in the Twenty-five Largest Cities (%)*

	Central City	*Suburbs*
Whites	$5,5$	$3,7$
Blacks	$12,5$	$7,6$
*Total Population**	$7,3$	$4,0$

(Source: Brueckner and Zenou, 2003) *Including Hispanic origin

There also exist stark disparities concerning the distribution of income in American cities. In 1990, the average income of a central-city black is close to \$8,700, which is almost half the average income of a central-city white. In the suburbs, disparities are also very large although relatively narrower than in central cities. Indeed, in 1990, suburban blacks have an average per-capita income of \$11,000, which is one third lower than that of suburban whites but 25% higher than that of central-city blacks (Mills and Lubuele, 1997).

In this context, it is not surprising that poverty incidence differs greatly across places and racial groups. The main pattern is that the poverty rate is always higher in central cities than in the suburbs and is usually three or four times higher for blacks than for whites. Indeed, in central-cities, poverty is sometimes endemic: in 1996, whereas only 30% of the US urban population reside in a central city, central cities group more than half the poor families (U.S. Bureau of the Census, 1997) and 72% of the inner-city poor are ethnic minorities (US. Department of Housing and Urban Development, 1999). In 1990, 31.1% of blacks living in central cities are poor whereas the poverty rate of central-city whites only stands at 12% (Mills and Lubuele, 1997).[13]

2.2.5 The residential inertia of blacks in poor areas

The poverty of blacks in American cities goes along with a strong residential inertia in poor areas. This is captured over the 1979-1984 period by Bogart (1998) who provides estimates of the average transition probabilities between neighborhoods with different economic profiles for poor families with children (see Table 17 below). Each cell gives the probability for a poor family living in a certain type of neighborhood the current year to be located in another type of neighborhood the next year. It appears that a black household with children

[13] In the suburbs, poverty rates are lower for both whites and blacks, but, as in central cities, blacks are also more affected by poverty than whites: only 6.6% of suburban whites but 19.5% of suburban blacks are poor (Mills and Lubuele, 1997).

living in a low-income neighborhood only has a 9% chance to be living in a better neighborhood the following year, whereas for whites, this probability reaches 20%. Moreover, a black household living in a middle-income neighborhood has a higher probability to be located in a poor neighborhood the following year than a white household in a similar area.

Table 17: *Transition Matrix for Poor Families with children, 1979-1984 (en %)*

	Tract Type Next Year			
Tract Type in Current Year	*Low Income*	*Middle Income*	*High Income*	*Non Metropolitan*
White Household				
Low Income	73	20	0	7
Middle Income	3	87	9	1
High Income	0	14	78	8
Non Metropolitan	0	1	1	98
Black Household				
Low Income	91	8	1	0
Middle Income	8	88	3	1
High Income	5	23	72	0
Non Metropolitan	3	1	0	96

(Source: Bogart, 1998, p.298)

Thus, blacks living in poor areas are less mobile than whites residing in poor areas. This suggests that, for some reason, it is more difficult for blacks than for whites to escape inner-city residences. In this perspective, a recent study has shown that blacks have a lower probability than whites to move from central city to suburbs, but a higher probability to move from suburbs to central city, even after controlling for socioeconomic characteristics (South and Crowder, 1997).

To sum up, the main trends that can be observed in US cities are as follows:

(i) There are higher job growth rates in the suburbs than in central cities where the number of jobs can also decline. This is the case in the most prevalent sectors in the economy. In particular, the number of low-skilled jobs has grown rapidly in the suburbs and possibly declined in central cities. Low-skill jobs are also better remunerated in the suburbs.

(ii) At the same time, it is noticeable that blacks, and particularly those living in poor areas, have a lower residential mobility than whites. They remain located mainly in central cities whereas it is well known that middle- and upper-class whites have moved to the suburbs.

(iii) Inner cities are more affected by unemployment and poverty than the suburbs, and minorities are always more affected than whites.

It must be said that these features remain trends and that American cities present a wide range of configurations, in particular with respect to the degree of job suburbanization (see Glaeser and Kahn, 2000). On average, the figures nevertheless confirm the existence of a spatial mismatch between the residential

locations of blacks and those of suitable job opportunities. In the next section, we will try to understand what economic mechanisms may cause spatial mismatch and how the spatial organization of US cities may contribute to the local unemployment and poverty of racial minorities.

3 Theories

We now turn to the theoretical explanations that underpin the spatial mismatch hypothesis: how can the disconnection between the locations of jobs and the places of residence explain the poor labor-market outcomes of minorities?[14] The objective is not to explain why minorities reside far away from jobs but how distance to job opportunities can affect them.[15] In view of the empirical spatial mismatch literature, we can think of (at least) seven different underlying mechanisms that explain how distance to job opportunities could be harmful:

(i) *The efficiency of job search may decrease with distance to jobs.* For example, workers may obtain less information about distant job opportunities or firms may resort to local recruiting methods (such as ads in local newspapers or wanted signs, see Turner, 1997) that exclude distant workers.

(ii) *Incentives may be too low for workers residing far away from jobs to search intensively.* For instance, when housing prices are very low at a distance from jobs, unemployed workers may feel less pressure to find a job in order to pay their rent. Another example is as follows. If search costs are much higher for distant workers, then they may be discouraged and search less intensively.

(iii) *Workers may refuse jobs that involve too long commutes* because commuting to that job would be too costly in view of the proposed wage. They may prefer to search for job opportunities at the vicinity of their neighborhood. As a result, workers may restrict their spatial search horizon.

(iv) *An inadequate transportation mode* (public transit in some US cities) can exacerbate both search and commuting costs, amplifying (i), (ii) and (iii).

(v) *Employers may discriminate against residentially segregated workers* because of the stigma or prejudice associated with their residential location

[14] Most of these theories use an urban land-use approach. See Brueckner (1987), Fujita (1989) and Fujita and Thisse (2002) for overviews on urban economics.

[15] The reasons why minorities, and especially African Americans, reside at a distance job locations in MSAs are diverse. The traditional spatial mismatch literature stresses the role of housing market discrimination that maintains minorities in distressed inner cities (Yinger, 1986, 1996, Squires, 1996) while entry-level jobs have decentralized to the suburbs. There are of course alternative explanations that involve other housing market distortions such as zoning regulations (Duranton, 1997) or the location of housing projects (Kain, 1992). On the contrary, other explanations that do not involve restrictions on the location choices of minorities may also play a role such as racial differences in the preferences for public goods (Anas, Arnott and Small, 1998), the preference for the racial composition of the neighborhood (Ihlanfeldt and Scafidi, 2002), or even the flight of jobs from minority neighborhoods.

(*redlining*). In particular, employers may consider that, on average, inner city residents are less productive or more likely to be criminal (*statistical discrimination*).

(*vi*) *Employers may refuse to hire or pay lower wages to distant workers because commuting long distances makes them less productive* (they are more tired or more likely to be absent).

(*vii*) *Employers may think that their white local customers are unwilling to have contacts with minority workers*, and thus discriminate against minority workers (*customer discrimination*).

It should be noted that these arguments are not based on ethnicity at the exception of (*vii*) and possibly (*v*). However, in American cities, minorities are disconnected from job opportunities and should thus be sensitive to such economic mechanisms involving distance to jobs. Also observe that explanations $(ii) - (iii)$ adopt the point of view of the minority workers whereas explanations $(v) - (vii)$ adopt the perspective of firms. (i) adopts the perspective of both firms and workers. To the best of our knowledge, all these points have been theoretically addressed at the exception of (iv) and (vii).[16] It should be said that a single model sometimes incorporates several of these points (even though it is not always explicitly stated by the authors)[17] and that some mechanisms are embodied in models that do not adopt a standard spatial mismatch perspective. All of them, however, shed light on the spatial mismatch hypothesis and we will now present them.

3.1 Information is too scarce (i)

The first mechanism revolves around the decrease in information on job opportunities with distance. It implies that a worker that resides far away from job opportunities has less information about a job than an individual that resides closer. Indeed, several empirical studies suggest that physical distance to jobs reduces available information on the existence and characteristics of job vacancies (see Ihlanfeldt and Sjoquist, 1990, Ihlanfeldt, 1997). Davies and Huff (1972) also show that individuals looking for a job can only search efficiently in a restricted perimeter centered around their residence, even though there are only low quality and low salary jobs in the area. Consequently, being distant to jobs may lead to a high unemployment rate and low incomes, in conformity with the spatial mismatch hypothesis. Several studies characterize the effects of distance on employment accessibility: Rogers (1997) and Immergluk (1998) estimate that the workers who reside close to jobs remain unemployed for a shorter period of

[16] These mechanisms are nevertheless empirically documented. For (iv), see Table 16 in the present paper and also Raphael (1998), Raphael and Stoll (2000), Glaeser, Kahn and Rappaport (2000). For (vii), see Holzer and Ihlanfeldt (1998).

[17] See in particular Arnott (1998) and Anas (2003). Observe also these two models address the issue of local wages but do not yield predictions concerning unemployment.

time. Similarly, Ihlanfeldt and Sjoquist (1990) show that proximity to jobs is an important factor in the employment probability of the young.

In US cities, black workers are mainly located in central cities far away from jobs which growth is much higher in the suburbs (see Tables 3 and 11 in the previous section). Thus, their high unemployment rate (see Table 16) could partly be explained by the poor information they get on suburban job opportunities. This mechanism has not been modeled in the racial perspective of American cities but Wasmer and Zenou (2002) incorporate it in a search-matching model which formalizes the link between distance to jobs and unemployment.

We now present this model in which the city is monocentric. It is a spatial extension of the standard search-matching model (Mortensen and Pissarides, 1999, Pissarides, 2000). The authors consider a linear city in which individuals endogenously sort themselves at a greater or shorter distance from a unique employment center, that corresponds to a suburban employment center if one has in mind the configuration of a US city.[18] The main idea defended here is that search efficiency is deteriorated with the distance between a searcher's residence and the prospected center of employment. Formally, the efficiency of job search s_i for a unemployed worker i residing at a distance x from the suburban employment center is given by:

$$s_i(x) = s_0 - ax \tag{1}$$

where s_0 and a are positive parameters, a being a measure of the deterioration in job search efficiency associated with a marginal increase in the distance to the suburban employment center.

At the aggregate level, the number of matches between the two sides of the market (workers and firms) is determined by the following matching function:

$$m(\overline{s}u, v)$$

where $\overline{s}$ is the average search efficiency of unemployed workers (given their locations), u the unemployment level, and v the number of vacancies. The matching function $m(.)$ is assumed to be increasing in both its arguments, concave and homogeneous of degree 1 (or equivalently has constant return to scale). It depends on search frictions (through u and v) and *the average information workers have about job opportunities* (through $\overline{s}$). In this context, for a worker i with efficiency s_i, the job acquisition rate at a distance x from the employment center is:

$$p(x) \equiv \frac{m(\overline{s}u, v)}{u} \frac{s_i}{\overline{s}} = m(1, \lambda) s_i(x)$$

[18] In view of job decentralization in American cities, the assumption of a monocentric city may seem restrictive to study spatial mismatch. In fact, it is not very restrictive since the main focus of the model is only to shed light on the effects associated with distance to jobs. If need be, one could always imagine without much loss of generality that the employment center represents suburban job opportunities. In this context, the workers that are distant from the (suburban) employment center do reside in the historic city center —the other end of the line—, as in a standard American city.

where $\lambda \equiv v/\overline{s}u$ is the labor-market tightness.

In this model, individuals change their residential location whenever they experience a change in their employment status, so that occupied and unemployed workers reside in distinct portions of the city. The model's contribution lies with the existence of several forces that attract unemployed and occupied workers with different intensities. The first one is the fact that the employed workers travel to the job center more frequently than the unemployed workers (formally, it is assumed that the transportation cost per unit of distance of employed workers t_e is higher than that of unemployed workers t_u) so that residing closer to the job center becomes relatively more attractive for employed workers than for unemployed workers. On the contrary, there exists an attraction force towards the job center that only concerns unemployed workers: the increase in their job-search efficiency associated with proximity to jobs. The confrontation of these two opposite forces leads to two possible urban configuration in equilibrium. A first equilibrium, the "Integrated City Equilibrium", has unemployed workers residing close to the employment center whereas employed workers reside further away. In a second equilibrium, the "Spatial Mismatch Equilibrium", it is the opposite: employed workers reside close to the employment center whereas unemployed workers reside at a distance from job opportunities.

Which equilibrium prevails depends on a trade-off between the difference in commuting costs per unit of distance between employed and unemployed workers $t_e - t_u$, and the expected return of being more efficient in search when unemployed workers reside marginally closer to the employment center $m(1, \lambda)a(I_e - I_u)$ with I_e and I_u the respective intertemporal utilities of the employed and the unemployed. The Integrated City Equilibrium occurs when the difference in commuting costs is lower than the expected return of getting closer. In that case, the unemployed bid away the employed far from the suburban employment center (close to the historic center). On the contrary, the Spatial Mismatch Equilibrium prevails when the expected return is higher than the difference in commuting costs. Employed workers are willing to pay higher land rents than unemployed workers to live closer to the suburban employment center and bid away unemployed workers at a distance from jobs (close to the historic center). In this spatial mismatch configuration, unemployed workers have few chances to find a job.

The authors show that the overall unemployment rate is higher and the search efficiency is lower when unemployed workers reside at a distance from jobs than in the other equilibrium in which they reside close to jobs. The most striking result of this model is as follows: even though the unemployment rate is higher in the Spatial Mismatch Equilibrium, the employed workers incur lower commuting costs than in the Integrated City Equilibrium. This means that the ranking of the two equilibria in terms of welfare is ambiguous. Consequently, an important result of the model is that distance to jobs implies more unemployment but not necessary less welfare.

3.2 Incentives to search for a job are too low (ii)

Another mechanism that can explain spatial-mismatch patterns relies on the incentives to search for a job. We illustrate this point with two different models that can explain variations in search intensities: one involving the housing market and another one relying on search costs.

3.2.1 Search intensity and the housing market

A worker residing far away from an employment center makes a trade-off between the short term costs of searching (for instance, because of frequent search trips and more interviews) and the long term benefits associated with a higher probability of being employed and thus of having potentially higher income. Smith and Zenou (2002) model such a mechanism using a search-matching model with housing. They use an urban framework similar to that of Wasmer and Zenou (2002) except that the search intensity and the consumption of land are now endogenous. The intensity of the search process s ($s_0 < s < 1$) is interpreted as the frequency of search trips to the employment center, so that it directly influences the unemployed's per-unit cost of transportation.[19] In this context, an unemployed worker residing at a distance x from the employment center chooses its optimal search intensity $s(x)$ so as to satisfy the following first-order condition:

$$-\frac{\partial U_u(s,x)}{\partial s} = r\, p(\overline{s})\ [I_e - I_u\,(s,x)]$$

where $U_u(s,x)$ is the instantaneous utility of the unemployed, $p(\overline{s})$ is the job acquisition rate as a function of the mean search intensity $\overline{s}$, r is the discount rate, I_e and $I_u\,(s,x)$ are the respective intertemporal utilities of the employed and the unemployed.

The left-hand side of this equation is the *short-run utility loss* consecutive to a marginal increase in search intensity, which implies higher transportation costs (more frequent trips) and a lower housing consumption (because of a lower net disposable income, housing being a normal good). The right-hand side is the *long-run utility gain* from future employment since searching more intensively increases the chances to obtain a job and the life-time surplus of being employed $I_e - I_u$. The fundamental aspect of this model is that the optimal search intensity depends on the distance from the employment center: locations near the employment center are costly in the short run (both in terms of high rents and low housing consumption), but allow higher search intensities which in turn increase the long-run prospects of reemployment. Conversely, locations far away from the employment center are more desirable in the short run (low land rents and high housing consumption) but allow only infrequent trips to the employment center and hence reduce the long-run prospects of reemployment.

[19] The per-unit transportation cost of unemployed workers is sc whereas it is c for employed workers.

Under some assumptions, the authors show that, in equilibrium, the employed (who bear a higher commuting cost per unit of distance than the unemployed) reside closer to the employment center and outbid the unemployed to further locations. For the unemployed, search intensity is a decreasing function of their distance to the employment center. The unemployed workers located far away from the employment center compensate for losses in long-run job prospects by short-run gains in net income, so that all unemployed workers obtain the same intertemporal utility I_u.

This model suggests that spatial mismatch could be the result of an optimizing behavior on the part of labor-market participants. This is because, in the model, the unemployed optimally *choose* low amounts of search and low prospects of employment. In US cities, this would imply that inner-city blacks could choose to remain in the inner-city and only sporadically search for a job.

3.2.2 Job-search costs are too high

When search costs are high, workers may be deterred from searching far away from their residential location. In the American context, this could be very detrimental to inner-city minorities that live far away from suburban job centers. In a search-matching framework, Ortega (2000) proposes a two-area model of migration that revolve around a similar mechanism. Even though the model is not spatial-mismatch oriented, we believe it can have interesting implications for the present survey.

Ortega (2000) focuses on the migration of job seekers between two geographic zones (and that we will interpret within our urban framework as the center and the suburbs of a single metropolitan area). Each one of the two zones has a local labor market and are structurally asymmetric since each market has a specific job destruction rate which we will consider higher in the central-city than in the suburbs.[20] The main assumption in this model concerns the search costs that differ whether the research is undertaken "at home" or in the other local labor market. These costs account for traveling costs associated with job search in different areas of the city. These search costs are assumed to be zero in the home area and strictly positive in the host area. According to this simplifying assumption, central-city residents (respectively suburban residents) have higher search costs to search in the suburbs (respectively in the city center) than to search in the city center (respectively in the suburbs). To this extent, search costs increase with distance in the model. The efficiency of job search is endogenously determined in each zone and depends on the local labor-market tightness, i.e. on the local ratio of job vacancies to the number of job seekers in the same zone. In this context, individuals choose where to search for a job by trading off the efficiency and the cost of job search. For central-city residents, when the probability of finding a job is higher in the suburbs than in the central city, individuals must choose between the benefit of a more efficient job search in the suburbs but at a higher cost since they reside far away from the

[20] Some jobs are destroyed at each moment in time, but the destruction rate is higher in one area than in the other.

suburban job center. Under certain conditions, when these costs are too high, city-center residents have no incentive to search for a job in the suburbs, and the unemployment rate in the city-center is higher than in the suburbs. Another interesting result of the model is that the suburban wages bargained by the central-city residents are lower than those bargained by suburban residents for suburban jobs. This asymmetry results from the high search cost which lowers the bargaining power of individuals at a distance from their place of residence.

3.3 Commuting costs are too high (*iii*)

Commuting costs can deter unemployed workers from searching in distant locations or accepting suburban jobs (since the potential wages net of commuting costs would be too low). In US cities, these mechanisms could significantly contribute to the unemployment of inner-city minorities. Indeed, some authors have tried to test the effect of transport costs in the acceptance (or refusal) of jobs. In this respect, Zax and Kain (1996) analyze the impact of a firm's relocation from Detroit's central city to a white suburb on workers' mobility and employment. They show that as white employees are confronted with longer commutes, they move to get closer to the firm's new location. On the contrary, few black employees change their place of residence (maybe because they are discriminated against on the housing market in the white suburb). The resulting increase in black workers' commutes induces many of them to quit their jobs. This study thus tends to validate the spatial mismatch hypothesis by suggesting that blacks residing in city centers have difficulties following job decentralization because of high transportation costs and low residential mobility. Fernandez (1994) stresses similar results by studying the relocation of a food-processing firm from the center of Milwaukee to one of its suburbs.

There exist two distinct theoretical models that incorporate commuting costs in a spatial mismatch perspective. Since the two frameworks are very different even though the mechanisms involved are similar, we will present them successively.

3.3.1 Entry costs of firms, commuting costs and spatial mismatch

Coulson, Laing and Wang (2001) explain the existence of spatial mismatch in American cities in an urban model of job search. The authors consider two asymmetric zones (a central city or CBD and a suburb or SBD) which form two separate local labor markets. Whereas workers are assigned to a place of residence (for some in the central city, for others in the suburbs), firms endogenously decide whether to locate in the central city or in the suburbs, the suburbs being more attractive in terms of entry costs. Workers can hold a job in any one of the two zones but incur higher transport costs if they work out of their zone of residence. In each zone, workers are heterogenous with respect to their utility or their capacity to commute out of their zone of residence. This assumption can account for the heterogeneity of locations in each zone. In this context, different individuals anticipate different commuting costs and thus different net

wages for potential job offers. The firms' differing entry costs, the heterogeneity of workers in terms of transportation costs, and the frictions in the job-matching process suffice to generate a spatial-mismatch situation. The authors show that there exists an equilibrium in which the SBD residents work in their zone of residence (which is more attractive to firms) whereas some residents of the CBD commute daily to the SBD (reverse commuting). In this equilibrium, the number of job vacancies in the CBD is lower than in the SBD, in particular because the entry-cost differential favors job creation in the SBD. Moreover, in the SBD, the unemployment rate is lower and the gross wage is higher than in the CBD. Even though the CBD residents who bear low commuting costs find SBD jobs attractive, those with high commuting costs prefer to search in the CBD even if the unemployment rate is higher there. It should finally be noted that this model simultaneously accounts for the two major consequences of spatial mismatch: the low income and the high unemployment rate of city-center residents. However, it does not propose an analysis along the racial line as assumed by the traditional spatial mismatch literature. This is done by Brueckner and Zenou (2003) which we will now present.

3.3.2 Ethnic minorities, commuting costs, and spatial mismatch

The first attempt to model spatial mismatch in a standard urban economics framework was initially proposed by Brueckner and Martin (1997).[21] In accordance with the traditional spatial mismatch hypothesis, the objective was to study the combined effects of job decentralization and housing market discrimination on the wages of minorities. The originality consisted in considering a local labor market at each end of a linear city (a central-city employment center and a suburban employment center). In this framework, the authors presented a comparison "before" and "after" the introduction of spatial mismatch in the model, that is "with" and "without" housing market discrimination assigning blacks to central-city locations. However, this formalization did not model the effects of spatial mismatch on unemployment rates. Brueckner and Zenou (2003) propose an extension which bridges this gap.

The authors consider a closed linear city with absentee landlords with an employment center at each end of the segment: the Central Business District (CBD) and the Suburban Business District (SBD). There are two continua of individuals, blacks and whites, who are uniformly distributed in the city and go to work in one center or the other. Each individual chooses the location of her job by comparing the wages offered in each center net of commuting costs. The authors assume housing market discrimination so that blacks are not authorized to live in the suburbs (close to the SBD). In this context, black workers are skewed towards the CBD and blacks' residences are thus remote from the SBD. For a black worker, working in the SBD involves high commuting costs which may deter many of them from accepting SBD jobs. As a result, the black CBD labor pool is large relative to the black SBD pool, and the competition among

[21] See also Martin (1997).

blacks for central jobs is thus fiercer. In a simple version of this model, the wages of both whites and blacks are set at an exogenous level. In an extension, the wages of blacks are endogenously determined to deter shirking (efficiency wages). In such an efficiency-wage setting, as we are in a context of asymmetric labor pools with a fixed labor demand at each place, it is easy to see that the unemployment rate of blacks is higher and their wage lower in the CBD than in the SBD. This is because, unemployment acts as a worker discipline device which enables employers to pay low wages when unemployment is high (see Shapiro and Stiglitz, 1984).

We now present the model in more detail. The authors assume that the continua of black and white workers have respective masses of N and K. Each black worker consumes an exogenous quantity of land $\theta < 1$ lower than that of a white worker which is normalized to 1 (this is justified since black workers will be poorer than whites in equilibrium). In terms of urban economics modeling, this means that white workers have flatter bid-rent than blacks in absolute terms: both groups want to get closer to jobs to reduce their commuting costs but whites are not willing to pay as much as blacks to get marginally closer to an employment center because they consume more. Given this, the authors consider two possible equilibria depending on whether blacks are obliged to reside close to the CBD (*housing discrimination*) or not.

In the first equilibrium, i.e. without discrimination (the unrestricted equilibrium), blacks outbid whites to reside near jobs and split equally between the two employment centers, while whites reside in the middle of the city. In the second equilibrium, i.e. with housing market discrimination (the spatial-mismatch equilibrium), blacks are not authorized to live in the suburbs, i.e. in the interval $[\theta N, x_f]$ where whites live, $x_f = K + \theta N$ being the city edge. Even though all blacks reside close to the CBD, those who reside in $[0, \widetilde{x}]$ commute to the CBD, whereas those who reside in $[\widetilde{x}, \theta N]$ commute to the SBD, $\widetilde{x}$ being endogenously determined in the model.[22] Observe that housing discrimination implies that whites face no competition for suburban land whereas blacks must still outbid whites for land in the central part of the city. This results in a dramatic bid-rent discontinuity at $x = \theta N$, with black SBD workers offering much more for land at the edge of the white area than the white residents themselves.

The authors solve the labor market equilibrium starting with the case of exogenous wages. They assume that black workers are paid at the minimum wage w_m and that whites are better paid (for example, because they are more skilled). To simplify the analysis, they assume that CBD workers, when unemployed, do not search for SBD jobs and vice versa, which means that we can treat CBD and SBD labor markets as separate. Workers live infinitely and smooth their income over time as they cycle in and out of unemployment because they do not relocate when their employment status changes. As a result, the average or permanent incomes of black CBD workers and black SBD workers are given by:

$$y_{BC} = (1 - u_{BC})w_m$$

[22] $\widetilde{x}$ corresponds to the distance from the CBD at which a black CBD commuter has the same utility as a black SBD commuter.

$$y_{BS} = (1 - u_{BS})w_m$$

where u_{BC} and u_{BS} respectively denote the "unemployment rate" of black CBD workers and black SBD workers.[23] Since employment at each center must equal labor demand $\overline{L}$ (which is the same in both centers and given by $F'(\overline{L}) = w_m$), we have

$$(1 - u_{BC})N_{BC} = \overline{L}$$

$$(1 - u_{BS})N_{BS} = \overline{L}$$

where $N_{BC} = \widetilde{x}/\theta$ is the number of black CBD workers (i.e. the CBD black labor pool size) and $N_{BS} = N - \widetilde{x}/\theta$ is the number of black SBD workers (i.e. the SBD black labor pool size).

The authors show that black CBD workers are more numerous and experience a higher unemployment rate than black SBD workers:

$$u_{BC} > u_{BS} \text{ and } N_{BC} > N_{BS}$$

The intuition is straightforward. Because blacks are forced to live in the central part of the city, those who work and search at the SBD support longer commutes. However, due to competition in the land market, rents do not completely compensate their higher commuting costs. Since, in equilibrium, all black workers must have the same utility level, it must be that black SBD workers experience a lower unemployment rate and thus a higher expected income than black CBD workers. To sum up, *housing discrimination skews the distribution of blacks towards the city center, thus increasing the demand for central jobs and decreasing the demand for suburban jobs.* Since the number of jobs is fixed, this obviously leads to a higher unemployment in the CBD than in the SBD.

Another interesting and intuitive result arises from the comparison between the unrestricted and the spatial mismatch equilibria since the authors are able to show that the common black unemployment rate $\widehat{u}_B$ at the two centers in the unrestricted equilibrium lies between the CBD and SBD unemployment rates in the restricted equilibrium:

$$u_{BC} > \widehat{u}_B > u_{BS}$$

The authors then turn to the efficiency-wage case in which the wages of blacks are set by employers to prevent shirking. The wages of black CBD and black SBD workers are given by:

$$\begin{aligned} w_{BC} &= e + \frac{e}{c}\frac{\delta}{u_{BC}} \\ w_{BS} &= e + \frac{e}{c}\frac{\delta}{u_{BS}} \end{aligned}$$

[23] u_{BC} and u_{BS} can also be viewed as the fraction of time a black CBD worker and a black SBD worker experience unemployment over their lifetime.

where e is the effort level provided by the worker, c is the monitoring (control) technology and δ is the exogenous destruction rate. The key aspect of this wage setting is that unemployment acts as a worker discipline device, so that the higher the unemployment, the lower the efficiency wage. In this context, the authors show that, when there is housing discrimination against blacks, we still have that black CBD workers are more numerous and experience a higher unemployment rate than black SBD workers. It can now be shown that black CBD workers have lower wages than black SBD workers: $w_{BC} < w_{BS}$.

The intuitions concerning the differences in unemployment rates and labor pool sizes between the CBD and the SBD are exactly the same as in the minimum wage case. For the difference in wages, the argument is simply that, in an efficiency-wage setting, higher unemployment rates are associated with lower wages.

As before, the authors are able to show that the common black unemployment rate at the two centers in the unrestricted equilibrium lies between the CBD and SBD unemployment rates in the restricted equilibrium. The same property holds for wages.

3.4 Residential neighborhood is too repulsive (v)

There is a widespread practice of discrimination which is harmful to spatially concentrated population groups. It consists in discriminating against all individuals originating from a stigmatized neighborhood, just as if all of them were identical and shared repulsive characteristics. This practice, called *redlining* (just as if the discriminated neighborhood had been circled by a red line) can encompass both prejudices against social or racial groups, or *statistical discrimination*.[24] It is thought to be common not only on the housing market (see Yinger, 1986, 1996, Tootel, 1996) but also on the labor market. As far as the labor market in US cities is concerned, suburban employers may discriminate against inner-city residents, for instance because they view them as less productive on average or more likely to be criminal.

Zenou and Boccard (2000) model redlining without justifying its existence however. While racial discrimination is against black workers, spatial discrimination (or redlining) is against residents living in the specific areas of the city (for example inner cities).

We briefly present the main lines of that model in which redlining is introduced. The authors consider a linear city in which all jobs are grouped in a single employment center. There are two continua of black and white workers that can be employed or unemployed. Both groups commute to the employment center, endogenously decide where to locate in the city and the quantity of land they want to consume (which is a normal good). The two groups differ since blacks bear a higher commuting cost per unit of distance than whites and are discriminated against by employers so that it is more difficult for them to get a

[24] Statistical discrimination consists in attributing to a single individual the real or presupposed average characteristics of a group to which he belongs (see Phelps, 1972, Aigner and Cain, 1977).

job. Irrespective of their residential location, blacks are thus more unemployed than whites. Two different urban equilibria can occur depending on a trade-off between transportation costs and land consumption: when the transport cost of blacks is high enough, they bid away all whites from central locations so that the central city gathers all unemployed and employed blacks (equilibrium 1). When the transport cost of blacks is sufficiently low, then all black and white unemployed workers locate in the central city whereas all black and white employed workers locate in the suburbs where they can consume more land since they are richer (equilibrium 2). In other words, when the relative access cost for black workers to employment centers is sufficiently large, a city is segregated by race. When the relative access cost is sufficiently small, a city is segregated by employment status.

In this framework, the authors introduce redlining which they model as an additional labor-market discrimination on all central city residents. In the first equilibrium, blacks are discriminated against both racially and spatially (redlining) and thus their unemployment rate is very high. In the second equilibrium, redlining increases the unemployment rate of both blacks and whites since the central city gathers all unemployed workers. In conclusion, an interesting feature of that model is that it shows how redlining can differently affect minorities depending on the city structure and on whom resides out of the red line.

However, the model does not completely fit with a spatial mismatch perspective to the extent that unemployed blacks always reside close to jobs and that redlining always concerns workers who reside closer to jobs.

3.5 Productivity is too low (vi)

Distance to jobs may deteriorate productivity because workers who have longer commuting trips are more tired and are thus less able to provide high levels of effort than those who reside closer to jobs. This implies that commuting costs do not only include money and time costs, but also the negative effects of longer commutes such as non-work-related fatigue. 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 live next door can go back home and relax whereas the others, who live further away, cannot rest at home, which certainly affects their productivity. As a consequence, firms may decide of a geographical boundary beyond which they will not recruit workers.

This idea has been modeled by Zenou (2002) in the context of a monocentric city. Each worker supplies one unit of labor and chooses her effort level e: she can shirk and exert zero effort ($e = 0$) and thus not contribute to production; or alternatively, she can provide a full effort. The effort then depends on the distance x to the employment center and is equal to $e(x) > 0$, for all x comprised between 0 (the employment center) and x_f (the city edge). By exerting a full effort, the worker contributes to $e(x)$ units of production. To capture the fact that the greater the distance to work, the lower the effort level, the author

assumes that $e'(x) < 0$.

It is assumed that the unemployed travel less often to the CBD but keep doing so in order to search for a job: the unemployed incur a fixed transportation cost t_u per unit of distance, whereas the employed bear a unit commuting cost t_e, with $t_e < t_u$. The author further assumes that $t_e + e'(x_b) > t_u$ with x_b being the border between the employed and the unemployed. This guarantees that employed workers always outbid unemployed workers to reside close to the employment center. Indeed, the marginal transportation and effort cost of employed workers is higher than that of unemployed workers so that they would loose more from residing marginally further away from the employment center.

The author then determines the labor-market equilibrium. It is assumed that all employed workers are paid the same wage and have the possibility to shirk. However, firms cannot perfectly monitor them, so that there exists a positive probability θ of being detected shirking. If a worker is caught shirking, she is automatically fired (see Shapiro and Stiglitz, 1984). The originality of the model is that the incentives to shirk decrease with distance x to the employment center.[25] Thus, the sufficient condition to prevent shirking must ensure that the worker residing in $x = 0$ is indifferent between shirking and not shirking. In this context, the efficiency wage set to deter the shirking of all employed workers between $x = 0$ and $x = x_b$, amounts to:

$$w = b + e(x_b) + \frac{e_0}{\theta}\left(\frac{\delta\, N}{N - M\, x_b} + r\right) + (t_e - t_u)\ \ x_b$$

with N the number of workers, M the number of firms, r the discount rate and δ the job destruction rate.

The author shows that the efficiency wage is an increasing function of x_b which means that the more numerous the employed workers (or equivalently the lower the unemployment rate), the higher the common wage. Furthermore, as employed workers differ in their locations and thus in their productivities, the per-worker profit decreases with distance to jobs. Firms anticipate that remote workers provide lower effort levels and recruit workers as far as x_b^* the location where the per-worker profit is zero. This setting is relevant for the analysis of spatial mismatch since workers that are distant from jobs (as inner-city minorities in US cities) are excluded from working.

4 Conclusion

The spatial mismatch hypothesis originally formulated by Kain (1968), supports the view that because black workers reside in segregated zones that are distant and poorly connected to major centers of growth, they are confronted to barriers

[25] This is straightforward since land rents compensate for both commuting costs and effort levels. Then shirkers (who do not provide an effort) have a higher utility when they reside closer to the employment center than further away from it (since their effort is higher in the employment center). Note however, that in equilibrium, there are no shirkers so that all workers have the same equilibrium utility.

in the finding and keeping well-paid jobs. The objective of our work was to confront the principal stylized facts of US cities and the most recent theoretical contributions to the spatial-mismatch related literature, as it had not been done before.

We have first presented figures that fairly support the existence of spatial mismatch in American cities. Then, we have given various theoretical explanations extracted from the literature that explain why residing at a distance from jobs can be so harmful for ethnic minorities. The various mechanisms involve both central-city workers and suburban firms.

Indeed, workers who reside far away from job opportunities may experience poor efficiency and high costs in the job-search process. They may also have little incentives to search for a job, for instance because they feel little pressure to find a job since they do not have to pay high house prices. Finally, they may be confronted to high commuting costs and inadequate transportation modes (public transit in some US cities) that may deter them from accepting distant job offers.

Concerning suburban firms, their local recruiting methods and their redlining behavior can exacerbate spatial mismatch. They may also be reluctant to hire long-distance commuters because of the negative effect of commuting on productivity. Finally, they may discriminate against ghetto residents to satisfy the prejudices of their local customers.

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