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# THE ROLE OF RESIDENTIAL LOCATION AND HOUSING TENURE ON UNEMPLOYMENT: THE CASE OF LYON

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***Abstract:***
Several empirical and theoretical findings suggest that labor-market outcomes of individuals depend not only on their personal and household characteristics but also on their residential location within the city as well as on their housing tenure. The aim of this paper is to test these theories in the case of Lyon's agglomeration (France), by using data from the 1999 Population Census. More specifically, we try to test whether, in Lyon, being located in a deprived area and housed in the public renting sector influence the probability of being unemployed. We deal with the endogeneity of these two residential variables by resorting to a simultaneous probit model.

***Keywords:*** unemployment, public housing, deprived neighborhoods, multivariate probit

***Classification:*** E1, E3

# THE ROLE OF RESIDENTIAL LOCATION AND HOUSING TENURE ON UNEMPLOYMENT: THE CASE OF LYON

## INTRODUCTION

The explanation of labor-market outcomes usually revolves around well-known determinants, such as the educational level or professional experience. Recent theories suggest however that, in urban areas, labor-market outcomes may also be influenced by residential location. For example, the spatial mismatch hypothesis suggests that physical disconnection between jobs and residential locations can be a source of unemployment among disadvantaged communities (Ihlanfeldt and Sjoquist, 1998). Other studies highlight the negative impacts of residential segregation, and more generally the quality of the social environment, on socioeconomic outcomes (Ellen and Turner, 1997).

The central point of this strand of literature is that labor-market outcomes of individuals depend not only on their personal and household characteristics but also on their residential location within the city. However, linking individual outcomes to their residential location raises the important issue of location choices endogeneity (Osterman, 1991; Plotnick and Hoffman, 1996; Dietz, 2002). Indeed, individuals having similar socioeconomic characteristics, notably similar labor-market outcomes, tend to sort themselves in certain areas of the urban space. There is thus a two-way causality: on the one hand, residential location influences labor-market outcomes, and on the other hand, labor-market outcomes influence the choice of a residential location. Consequently, results of studies based on standard methods that do not control for this simultaneity will probably be biased. The inadequate correction for this bias has been put forward by several authors to explain the great divergence of results obtained by many empirical studies (O'Regan and Quigley, 1998; Dietz, 2002).

The objective of this paper is to test these theories in the case of Lyon's agglomeration (France) by using an appropriate methodology that controls for the endogeneity of location choices. Moreover, in France, the standard hypotheses need to be adapted to take into account the existence of a large public housing sector mainly located in deprived areas. We argue that residing in public housing may affect labor-market opportunities of individuals by constraining their location choices and residential mobility. To our knowledge, the influence of housing tenure on the relationship between residential location and labor-market opportunities has not been tested. Some authors (such as Oreopoulos, 2003) use information on housing tenure to achieve exogeneity of residential location. Indeed, they focus on residents of public housing units (for which residential choices are limited and thus less endogenous) and analyse the effect of the quality of their neighborhood of residence on socioeconomic outcomes. However they do not examine the proper impact of residing in public housing on labor-market outcomes. Flatau *et al* (2003) test the role of housing tenure on unemployment but do not examine it in conjunction with the effect of neighborhood quality. In this context, the objective of the present paper will be to examine how individual labor-market outcomes are influenced by the interaction between public housing and neighborhood quality.

To this end, we estimate a model of unemployment probability that takes into account the effect of residential location through two different aspects: the type of neighborhood in which the individual resides and the fact that s/he lives or not in a public housing unit. The neighborhood type is defined through a data analysis step, that allows us to classify neighborhoods according to their social composition. The endogeneity of the two residential variables is treated through the simultaneous estimation of the probit equation for unemployment with two other probits dealing with the neighborhood type and housing tenure choice. The paper is structured as follows. Section 1 explains the main reasons why residential location and public housing might influence labor-market outcomes in the French case. Section 2 presents the empirical model and the econometric method used for estimation. Section 3 describes the database and the typology of Lyon's neighborhoods. Section 4 presents the main results and section 5 concludes.

## I. HOW DO THE RESIDENTIAL SITUATION AND LABOR-MARKET OUTCOMES INTERACT IN THE FRENCH CASE ?

A relatively recent strand of literature suggests that residential location may influence labor-market outcomes of individuals. Several reasons have been put forward to explain such an influence (see Gobillon and Selod, 2002 for a comprehensive survey). Firstly, the spatial mismatch hypothesis (Kain, 1968) focuses on the role of physical disconnection between jobs and residential location on labor-market outcomes. Indeed, this disconnection can be a source of long and expensive commuting costs, which may increase individual reservation wages and deter workers from accepting distant jobs (Brueckner and Zenou, 2003). Moreover, distance to job opportunities may also deteriorate the intensity and efficiency of job search, particularly because information available on job openings decreases with distance to jobs (Ihlanfeldt, 1997). Secondly, residential segregation of low-skilled and low-income workers in deprived neighborhoods may influence labor-market outcomes through peer effects. For example, Benabou (1993) and Arnott and Rowse (1987) show that the concentration of less-able learners in school exerts negative externalities on the learning process, which can further deteriorate the later employability of workers. Thirdly, residential segregation by income can deteriorate social networks, which may be important in order to find a job, especially for low-skilled workers who often resort to informal search modes such as personal contacts (Mortensen and Vishwanath, 1994; Holzer, 1987). Finally, the stigmatization of these neighborhoods may lead employers to discriminate workers on the basis of their address (a practice which is often called *redlining*; see Zenou and Boccard, 2000).

Such general mechanisms may be at play in France but are likely to express themselves in a specific manner. French cities are of more moderate size than US ones and physical disconnection between jobs and residence might be an issue only in the biggest cities. Moreover, almost half of rented housing in France are public sector housing, while such housing represents only a much smaller part of the American housing stock (in 2002, 57% of the French housing stock was owner-occupied, 20% privately rented, 17% rented by the public sector and 6% in other tenure). More than a third of this public housing stock was built between 1962 and 1974 under the form of large projects located in urban outskirts, that have after years become deprived neighborhoods. Today, this part of the public housing sector is occupied by the less well-off part of public housing renters (Driant and Rieg, 2004).

Besides the fact that these neighborhoods offer a poor social environment and are far from employment opportunities, the way by which people obtain a public housing unit may

increase the issue of unemployment in these neighborhoods. Actually, in order to be eligible for public housing, people must have an income below a certain threshold (varying with the household composition and region). Because demand largely exceeds offer, applications are ranked on a waiting list, subject to criteria that may vary locally. Households facing big financial difficulties, or with a disabled person, or single-parent families are considered as having priority. Available housing units are proposed to households following their order on the waiting list. They may then accept or refuse the proposal, and in the latter case may receive other proposals later. This process constrains the location choice of public renters[1]. Moreover, as they incur the risk of not obtaining other public housing if they move, people are less inclined to move home if they are already in a public housing unit[2]. This increase in the mobility costs of public renters may raise their reservation wage, thus increasing their unemployment probability. As a consequence, one may ask whether in French cities the mobility constraints of public sector renters could reinforce their disadvantage in terms of locational characteristics and explain part of the high unemployment rate in areas where public housing is concentrated. In other words, do the influences on labor-market outcomes of being in a deprived area and in public housing reinforce each other? In order to test these relations, we will estimate an empirical model on a large dataset concerning Lyon's agglomeration (France). This model focuses on the simultaneous influence of location and public housing on the probability of being unemployed.

## II. EMPIRICAL MODEL AND ECONOMETRIC METHOD

We aim at showing whether, in Lyon, residing in a deprived area and being housed in the public housing sector influence the probability of being unemployed. Obviously, both characteristics are endogenous for two reasons. First, being unemployed increases directly the probability of obtaining a public housing unit as well as the probability of being located in a deprived neighborhood, where housing prices are lower. Second, we are allowed to think that unobserved individual characteristics influencing the labor-market participation may also influence the residential choice: people less inclined to search for a job are likely to sort into deprived neighborhoods (Smith and Zenou, 2004).

Various strategies have been developed in order to deal with the endogeneity of neighborhood choices. Following Cutler and Glaeser (1997), some recent papers rely on inter-city variations for identification (Weinberg, 2000; Martin, 2004). US subsidized housing programs such as the Gautreaux Program and the Moving To Opportunity Program offer quasi-experimental datasets that have been extensively studied (see Oreopoulos, 2003 for a review). Following a similar approach, Oreopoulos (2003) uses administrative assignment process of households to public housing projects in Toronto in order to be able to consider neighborhood choice as exogenous. The French public housing application process is somewhat different in that households are allowed to express neighborhood preferences and to reject offered housing units while staying on the waiting list[3].

In this paper, we argue that it is possible to identify the effect of residential location on labor-market outcomes by using an appropriate econometric method and adequate exclusion

[1] Although not sufficiently as to consider this location as independent from employment status.
[2] Mobility rates of public renters are at 9.9% against 15.9% in the private sector (Debrand and Taffin, 2004).
[3] In 2002, one quarter of households housed in the public housing sector had rejected at least one offer before to accept one; half of these refusals were justified by the fact that “the housing unit was in a neighborhood that did not fit households’ preferences” (INSEE, 2002).

restrictions, that permit to rule out observed and unobserved sorting effects. We estimate a simultaneous model of three probit equations relating to (*i*) accommodation in a public housing unit, (*ii*) location in a deprived area, and (*iii*) unemployment probability, allowing for correlations between the residual terms of the three equations. The first equation (2.1) represents how various social and demographic household characteristics influence the propensity of being housed in the public housing sector. The second equation (2.2) aims at explaining neighborhood choice, which will be assumed to be determined both by household characteristics and the fact of being housed in the public housing sector. The third equation (2.3) estimates, besides individual and household characteristics, the influence of neighborhood type and accommodation in the public housing sector on unemployment probability, while accounting for endogeneity of the two variables. This system can be expressed as follows:

$$\hat{y}_1 = \alpha_1 X_1 + u_1 \quad (2.1)$$

$$\hat{y}_2 = \beta_2 y_1 + \alpha_2 X_2 + u_2 \quad (2.2)$$

$$\hat{y}_3 = \gamma_3 y_2 + \beta_3 y_1 + \alpha_3 X_3 + u_3 \quad (2.3)$$

where $\hat{y}_1$ is the latent variable influencing the probability of being housed in the public housing sector (its observed counterpart variable being $y_1$ taking the value 1 if the individual is housed in the public sector, 0 otherwise), $\hat{y}_2$ is the propensity to live in a deprived area (corresponding to an observed variable $y_2$ taking the value 1 if the individual resides in a deprived neighborhood, 0 otherwise), $\hat{y}_3$ is the propensity to be unemployed (corresponding to $y_3$, with value 1 if the individual is unemployed, 0 if he is employed). $X_1$, $X_2$ and $X_3$ are vectors of exogenous individual and household characteristics affecting the three choices.

Note that it is the observed variables ($y_1$ and $y_2$) that are included on the right-hand side of the equations, and not the corresponding latent variables. This is justified because it is the fact that people live really in a public housing and a deprived neighborhood, that influence unemployment propensity, rather than the underlying latent variables. The same holds for the neighborhood equation. Further, one can wonder why the public housing and neighborhood equations do not include the two other observed "endogenous" variables on the right-hand side. This is because including observed discrete variables on the right-hand side of the equations amounts to a mixed model and compels us to write a recursive system. Otherwise, the system would not be coherent (Maddala, 1983). Therefore, in the second equation, employment status is not included *per se* but taken into account by the introduction of exogenous variables that determine the probability of unemployment and may therefore influence the location choice due to financial resources. Similarly, in the first equation, the propensity to be housed in the public sector is explained by such employment-status variables as well as demographic variables that public housing offices take into account in the assignment process.

When it comes to exogenous explanatory variables, unemployment is explained, in a classical manner, by individual characteristics relating to education, experience (proxied by age), profession and social category of previous job, nationality and some characteristics of the spouse. Location in a deprived area is explained by demographic characteristics of household, housing size that pushes households towards low-price neighborhoods, as well as social category and education that will be proxies for permanent income. Being housed in the public housing sector is explained by the same sort of variables (the complete list of variables and their descriptive statistics are given in appendix).

As we assume that unobserved characteristics may simultaneously affect unemployment and residential choices (such as the sorting in deprived neighborhoods of people with a low intensity of job search), the correlation terms between the residuals of the three probit equations ($u_1$, $u_2$ and $u_3$) are all supposed to be non zero. Therefore, we cannot impose any identification assumption on the variance matrix of residuals and identification of the parameters of the three equations relies only on exclusion restrictions, which amounts to find variables that influence residential choices, while not being correlated with employment status. More specifically, the neighborhood equation (2.2) does not contain the age variable, that appears on the contrary in the public housing equation (2.1). Furthermore, the unemployment propensity (equation 2.3) is supposed not to be influenced by the housing floor space and the number of children in the household. The former exclusion is rather evident, while the latter is justified by the fact that in this paper, we only deal with household heads of couples, who in our sample are only males. We may reasonably think that labor-market participation of males is not influenced by their number of children.

This choice in terms of sample was made because the model differs greatly depending on whether the household contains a couple or not, as labor-market participation is influenced by the situation of the spouse. Moreover, the case of single adults suffers from a selection bias, because young adults are less likely to form a separate household if they are unemployed.

The estimation of the system given by our three equations is complicated because it involves the calculation of a triple integral in the likelihood function. Simulated maximum likelihood methods have been developed to circumvent this problem. In particular, it is possible to use the Geweke-Hajivassiliou-Keane simulator to evaluate the tri-dimensional normal integrals involved in the likelihood function. We used the MVPROBIT procedure of STATA, that was developed by Cappellari and Jenkins (2003) and implements this simulator. Results are presented in section IV.

## III. DATA AND A BRIEF DESCRIPTION OF LYON

### 3.1. Data and study area

The empirical analyses conducted in this paper are based on two datasets based on the 1999 Population Census. The first one is at the aggregate level and includes various indicators of the socioeconomic composition and average housing characteristics of each neighborhood. Neighborhoods are either municipalities, or subdivisions of municipalities if the latter have more than 10.000 inhabitants. This database will be used to describe the spatial structure of Lyon and define a typology of neighborhoods. The second database corresponds to a sample of individuals (1/20th of total population), for whom main personal and household characteristics are provided (age, gender, level of education, employment status, household type, household size, housing tenure,...) as well as the personal characteristics of the other members of his/her household. This database also contains information on the neighborhood of residence which allows to link each individual to the type of neighborhood in which s/he lives in. This database will be used to estimate our econometric model.

This paper focuses on Lyon, the third largest city in France. Its urban agglomeration (defined here by its urban unit[4]) extends over a 958 km² area and hosts around 1.3 inhabitants. The agglomeration of Lyon presents a well-marked spatial structure, with some parts of the city characterized by a concentration of disadvantaged communities. Figure 1 maps the percentage of unemployed workers among labor-force participants. The highest unemployment rates are found in the close periphery of Lyon's municipality, on the north-east side. This pattern is very typical of French cities and is closely related to the location of public housing, built for their most part between 1962 and 1974. The unemployment spatial structure is also quite related to the distribution of educational levels and professional status, as well as to the distribution of ethnic minorities.

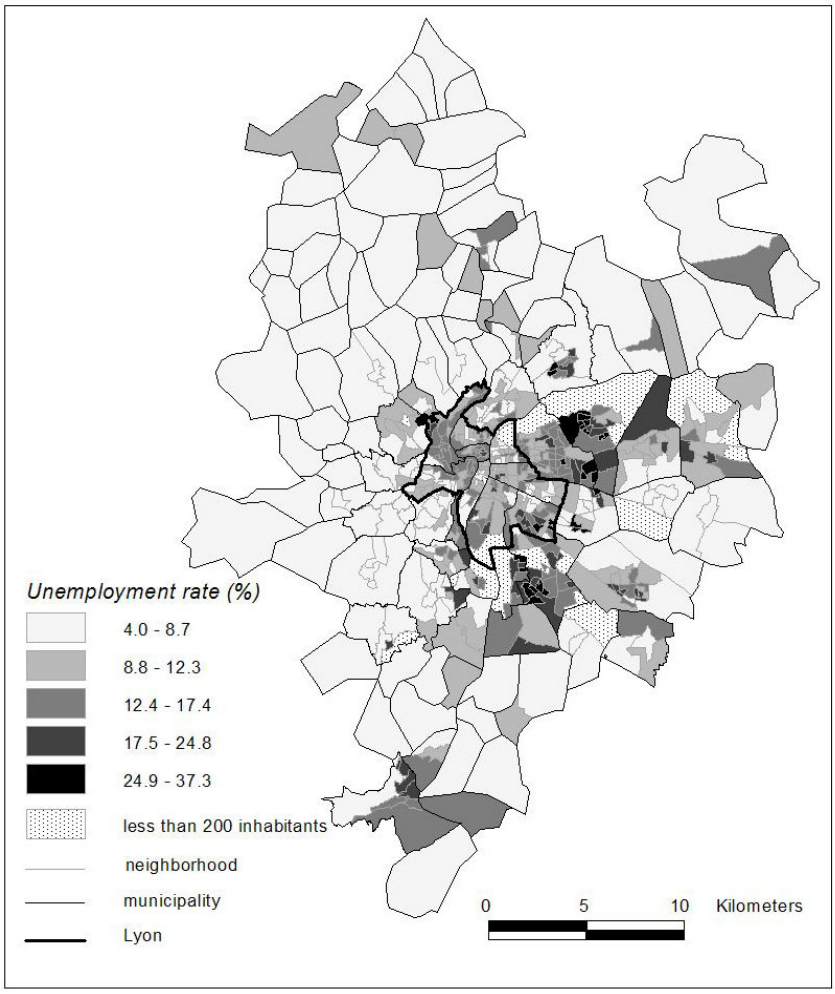


*Figure 1: Percentage of unemployed workers within labor-force participants*

### 3.2. A typology of neighborhoods

In order to measure the effect of neighborhood quality on individual unemployment probability, we first built a typology of neighborhoods on the basis of their socioeconomic

[4] The urban unit, in French *unité urbaine*, is a set of municipalities, the territory of which is covered by a built-up area of more than 2 000 inhabitants and in which buildings are separated by no more than 200 meters. The urban unit of Lyon consists of 102 municipalities corresponding to its city-center and its periphery (Le Jeannic and Vidalenc, 1997). For practical purposes, we added the municipality of Poleymieux-au-Mont-D'Or and the urban unit of Quincieux, which were enclosed within the urban unit of Lyon.

composition. To this end, we run a Principal Component Analysis followed by a hierarchical ascending classification method. Variables used for the Principal Component Analysis comprise indicators of the socioeconomic composition of neighborhoods (unemployment rates, percentage of foreigners, monoparental households, levels of education and professional status), as well as some characteristics of the housing stock (percentage of public housing units and number of rooms per inhabitants) used as indicators of low-income households concentration. We obtained five clusters of neighborhoods (very well-off, well-off, mixed, deprived and very deprived areas), that are presented on figure 2 below[5]. In order to estimate a system of binary probits, we grouped the two least favored neighborhood types (deprived and very deprived areas) and opposed these to the rest of the agglomeration, thus defining the endogenous variable $y_2$. These neighborhoods are labeled "deprived" in the rest of the paper. Their average characteristics are given in table 1. The "deprived" neighborhoods are characterized by high unemployment rates (twice the average unemployment rate of the rest of the agglomeration), high percentages of foreigners, high rates of public housing renters (almost half of the housing stock) and low educational level and professional status.

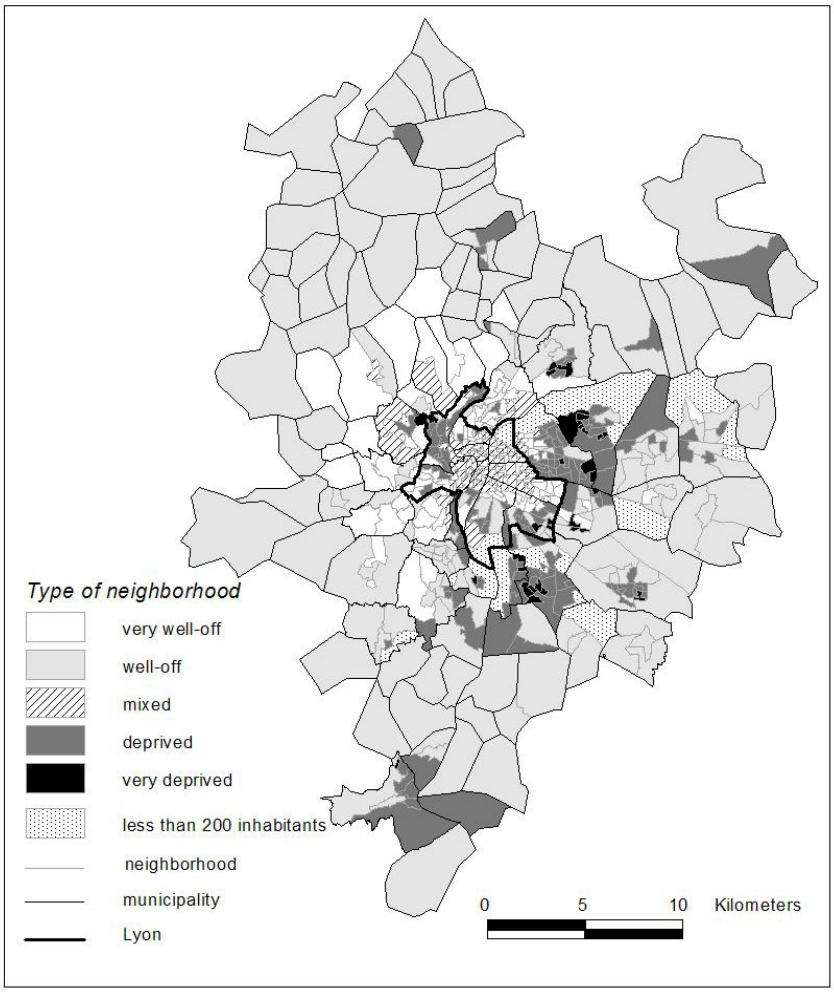


*Figure 2 : Typology of neighborhoods*

[5] Results of the Principal Component Analysis and the neighborhood classification are available upon request.

| | ***Deprived neighborhoods*** | ***Rest of the agglomeration*** | ***Total*** |
|---|---|---|---|
| *% unemployed workers* | 18.7 | 9.3 | 12.3 |
| *% foreign household heads* | 20.7 | 6.5 | 10.9 |
| *% monoparental families* | 18.2 | 11.5 | 13.6 |
| *% public housing units* | 47.2 | 9.6 | 21.3 |
| *% at most a college degree* | 52.5 | 34.4 | 40.1 |
| *% university diplomas* | 12.5 | 30.1 | 24.6 |
| *% blue-collars* | 34.9 | 15.7 | 21.7 |
| *% executives* | 6.9 | 21.7 | 17.1 |

*Table 1: Average characteristics of the types of neighborhoods*

## IV. RESULTS

We turn now to the simultaneous estimation of our three probit equations model. Table 2 presents the parameters of the three equations as well as their standard errors for the estimation of the model by simulated maximum likelihood with 300 random draws[6]. The correlation coefficient between the error terms of the neighborhood and the unemployment equations ($\rho_{23}$) is significantly different from zero at a 1% level. This shows that unobserved variables influencing unemployment are negatively correlated with unobserved characteristics affecting neighborhood choices. The other two correlation coefficients are not significant.

The first column gives the determinants of public housing renting. It shows as expected that younger households with at least two children are more likely to live in a public housing unit and that being foreign (and to a lesser extend French born of foreign parents) increases the propensity of being housed in the public sector. As far as proxy variables for income are concerned, workers with no diploma and with lower professional status (office workers and blue-collars) are more likely to live in a public housing than technicians, supervisors, executives or independent workers. The characteristics of the spouse are also important: the propensity of being housed in the public sector is greater if the spouse has a low educational level or is not participating to the labor force.

The second column gives the determinants of neighborhood choices. The household head and spouse's characteristics influencing neighborhood choices are quite similar to the ones influencing public housing renting and we will not comment them in detail. As far as household characteristics are concerned, having at least three children increases the propensity to live in a deprived neighborhood, confirming the hypothesis made earlier that floor space needs push households towards low-price neighborhoods. Once this household size effect has been taken into account, it is observed that households with a housing size between 40 and 70 m² are also more likely to live in these neighborhoods. The endogenous variable $y_1$ (being housed in the public sector) also increases significantly the propensity to live in a deprived neighborhood. This is quite natural as the majority of public housing units are located in such neighborhoods (63% of the public housing units in our sample) thus constraining the residential choices of public housing renters.

[6] The use of the GHK simulator makes the results dependent of the number of random draws used to compute the simulated likelihood function. Cappellari and Jenkins (2003) recommend to choose a number of random draws at least equal to the square root of sample size. As a consequence, the choice of 300 random draws enables us to be quite confident in our parameters estimates.

The determinants of unemployment propensity are presented in the third column of table 2. As far as personal characteristics are concerned, the age, nationality and professional status influence the propensity of being unemployed. The probability of being unemployed decreases with age until 44 years, and increases again after. Individuals of foreign nationality or born of foreign parents are also more likely to be unemployed. For educational levels, fewer variables than might be expected are of significant influence. This is maybe because the highest diploma obtained is a poor indicator of the qualification level and the professional experience gained from previous jobs. But it can also results from correlations between professional status and diploma. For professional status, independent workers and executives are less likely to be unemployed than technicians, supervisors, office workers and blue-collars. Our results also show that the characteristics of the spouse slightly influence household head's unemployment probability, suggesting than social networks at the household level may be important to find a job. Of the two residential variables, only the deprived-neighborhood variable exerts a positive effect on unemployment probabilities. That is, being accommodated in a public housing does not influence access to job *per se*. The positive correlation between public housing and unemployment that is observed in aggregate statistics is explained by the fact that low-income households are more likely to live in a public housing, and not the reverse causality. However, public housing accommodation indirectly increases unemployment propensity, as it has a positive effect on living in a deprived quarter, which itself raises unemployment.

## CONCLUSION

The explanation of labor-market outcomes usually revolves around well-known determinants, such as the educational level or professional experience. Recent theories suggest however that, in urban areas, labor-market outcomes may also be influenced by residential location. Indeed, residential segregation, and more generally the quality of the social environment may exerts negative impacts on socioeconomic outcomes through peer effects, poor social networks or stigmatization of deprived areas. Moreover, in French cities, being housed in the public sector may also affect labor-market opportunities by constraining location choices and residential mobility, thus reinforcing the effect of residential segregation. The objective of the present paper is to test these theories in the case of Lyon's agglomeration (France) by using data from the 1999 Population Census. More specifically, we estimate a model of unemployment probability that takes into account personal and household characteristics of individuals as well as their residential situation. The model estimated in this paper takes residential situation into account through two different aspects: the type of neighborhood in which the individual resides (deprived or not) and the fact that s/he lives or not in a public housing unit.

However, linking individual outcomes to their residential location raises the important issue of location choices endogeneity. Indeed, being unemployed increases the probability of residing in a deprived neighborhood as well as the probability of obtaining a public housing unit. Consequently, results of studies based on standard methods that do not control for this simultaneity bias are probably biased. In this paper, we deal with the endogeneity of the two residential variables through the simultaneous estimation of the probit equation for unemployment with two other probits dealing with the neighborhood type and housing tenure choices. Estimation by simulated maximum likelihood allows us to solve endogeneity issues, as well as to take possible correlations between the error terms of the three equations into account.

Results mainly show that all other things being equal, residing in a deprived neighborhood exacerbates unemployment probability. This is consistent with theories on social networks or peer effects mentioned in section 1. However, being accommodated in a public housing does not directly influences unemployment propensity, but only indirectly through the concentration of public housing renters in deprived neighborhoods. This last effect could not have been identified without the simultaneous estimation of our three equations. Indeed, in previous works, we estimated the unemployment equation solely, in a univariate probit model. Both the deprived-neighborhood and public housing variables were significant at a 1% level. This previous result was misleading as it did not allowed us to distinguish between direct and indirect effects of public housing. Besides the empirical results, our paper thus highlight the importance of properly correcting the statistical bias resulting from the endogeneity of residential location.

| | ***Public housing*** | ***Deprived neighborhood*** | ***Employment status*** |
|---|---|---|---|
| *Intercept* | -0.057$^{NS}$ (0.318) | -1.009*** (0.062) | -0.329$^{NS}$ (0.355) |
| ***Residential characteristics*** | | | |
| *Public housing* | - | 0.794*** (0.185) | -0.387$^{NS}$ (0.309) |
| *Deprived neighborhood* | - | - | 0.722*** (0.200) |
| ***Personal characteristics*** | | | |
| *Age* | - | - | -0.069*** (0.017) |
| *Squared-age* | - | - | 0.001*** (0.0002) |
| *Nationality* | | | |
| *French born of French parents* | Ref. | Ref. | Ref. |
| *French born of foreign parents* | 0.334*** (0.050) | 0.196*** (0.065) | 0.188*** (0.070) |
| *Foreign nationality* | 0.412*** (0.062) | 0.241*** (0.048) | 0.372*** (0.084) |
| *Level of education* | | | |
| *No diploma* | 0.142** (0.063) | 0.113* (0.059) | 0.130$^{NS}$ (0.081) |
| *CEP or brevet diploma* | 0.099$^{NS}$ (0.064) | 0.092$^{NS}$ (0.057) | 0.137* (0.079) |
| *CAP or BEP diploma* | 0.045$^{NS}$ (0.055) | 0.013$^{NS}$ (0.049) | 0.017$^{NS}$ (0.070) |
| *Baccalaureate / A-level* | Ref. | Ref. | Ref. |
| *University diploma* | -0.097$^{NS}$ (0.062) | -0.091* (0.053) | -0.004$^{NS}$ (0.074) |
| *Professional/social status* | | | |
| *Farmer or independent worker* | -0.556*** (0.072) | -0.068$^{NS}$ (0.058) | -0.315*** (0.092) |
| *Executive* | -0.452*** (0.061) | -0.200*** (0.050) | -0.161*** (0.070) |
| *Technician or supervisor* | Ref. | Ref. | Ref. |
| *Office worker* | 0.323*** (0.055) | 0.087$^{NS}$ (0.056) | -0.062$^{NS}$ (0.084) |
| *Blue-collar* | 0.453*** (0.044) | 0.193*** (0.052) | 0.087$^{NS}$ (0.080) |
| ***Characteristics of the spouse*** | | | |
| *Foreign nationality* | 0.163** (0.064) | 0.0139** (0.064) | 0.095$^{NS}$ (0.078) |
| *Level of education* | | | |
| *No diploma* | 0.541*** (0.059) | 0.235*** (0.062) | 0.162* (0.096) |
| *CEP or brevet diploma* | 0.353*** (0.058) | 0.117** (0.052) | 0.132* (0.079) |
| *CAP or BEP diploma* | 0.264*** (0.052) | 0.191*** (0.048) | 0.043$^{NS}$ (0.096) |
| *Baccalaureate / A-level* | Ref. | Ref. | Ref. |
| *University diploma* | -0.221*** (0.055) | 0.016$^{NS}$ (0.047) | 0.080$^{NS}$ (0.080) |
| *Not labor-market participant* | 0.101** (0.041) | 0.071* (0.036) | -0.006$^{NS}$ (0.050) |
| ***Household characteristics*** | | | |
| *Mean age of household head and his spouse* | -0.041** (0.017) | - | - |
| *Squared-mean age* | 0.0002$^{NS}$ (0.0002) | - | - |
| *Number of children* | | | |
| *None* | Ref. | Ref. | - |
| *One* | 0.045$^{NS}$ (0.046) | 0.064$^{NS}$ (0.039) | - |
| *Two* | 0.082* (0.049) | 0.044$^{NS}$ (0.040) | - |
| *Three or more* | 0.267*** (0.056) | 0.187*** (0.051) | - |
| *Housing size* | | | |
| *< 40 m²* | - | 0.115$^{NS}$ (0.108) | - |
| *40-70 m²* | - | 0.123*** (0.036) | - |
| *70-100 m²* | - | Ref. | - |
| *100-150 m²* | - | -0.305*** (0.039) | - |
| *> 150 m²* | - | -0.577*** (0.080) | - |

***significant at a 1% level; **significant at a 5% level ; * significant at a 10% level ; $^{NS}$ not significant at a 10% level. Figures in brackets give standard errors.

Correlation coefficients: $\rho_{12}$=0.033$^{NS}$ (0.106) ; $\rho_{23}$=-0.333*** (0.109) ; $\rho_{13}$=0.258$^{NS}$ (0.180)

*Table 2: Model estimates*

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## APPENDIX : VARIABLES USED AND DESCRIPTIVE STATISTICS

| | ***Full sample*** | ***Unemployed persons*** | ***Unemployment rate*** |
|---|---|---|---|
| *Number of observations* | 10 473 | 673 | - |
| *Unemployed* | 673 (6.43) | - | - |
| | | | |
| ***Residential characteristics*** | | | |
| *Public housing* | 2 007 (19.16) | 256 (38.04) | 12.76 |
| *Deprived neighborhood* | 2 889 (27.59) | 302 (44.87) | 10.45 |
| | | | |
| ***Personal characteristics*** | | | |
| *Age* | 41.8 | 41.6 | - |
| *Nationality* | | | |
| *French born of French parents* | 8 426 (80.45) | 423 (62.85) | 5.02 |
| *French born of foreign parents* | 1 052 (10.04) | 86 (12.78) | 8.17 |
| *Foreign nationality* | 995 (9.50) | 164 (24.37) | 16.48 |
| *Level of education* | | | |
| *No diploma* | 1 423 (13.59) | 167 (24.81) | 11.74 |
| *CEP or brevet diploma* | 1 335 (12.75) | 112 (16.64) | 8.39 |
| *CAP or BEP diploma* | 2 979 (28.44) | 183 (27.19) | 6.14 |
| *Baccalaureate / A-level* | 1 332 (12.72) | 71 (10.55) | 5.33 |
| *University diploma* | 3 404 (32.50) | 140 (20.80) | 4.11 |
| *Professional/social status* | | | |
| *Farmer or independent worker* | 1 078 (10.29) | 37 (5.50) | 3.43 |
| *Executive* | 2 557 (24.42) | 89 (13.22) | 3.48 |
| *Technician or supervisor* | 2 685 (25.64) | 154 (22.88) | 5.74 |
| *Office worker* | 1 021 (9.75) | 64 (9.51) | 6.27 |
| *Blue-collar* | 3 132 (29.91) | 329 (48.89) | 10.50 |
| | | | |
| ***Characteristics of the spouse*** | | | |
| *Foreign nationality* | 940 (8.98) | 144 (21.40) | 15.32 |
| *Level of education* | | | |
| *No diploma* | 1 330 (12.70) | 159 (23.63) | 11.95 |
| *CEP or brevet diploma* | 1 642 (15.68) | 125 (18.57) | 7.61 |
| *CAP or BEP diploma* | 2 328 (22.23) | 143 (21.25) | 6.14 |
| *Baccalaureate / A-level* | 1 706 (16.29) | 80 (11.89) | 4.69 |
| *University diploma* | 3 467 (33.10) | 166 (24.67) | 4.79 |
| *Not labor-market participant* | 2 314 (22.09) | 184 (27.34) | 7.95 |
| | | | |
| ***Household characteristics*** | | | |
| *Mean age of household head and his spouse* | 40.8 | 40.2 | - |
| *Number of children* | | | |
| *None* | 2 969 (28.35) | 220 (32.69) | 7.41 |
| *One* | 2 655 (25.35) | 167 (24.81) | 6.29 |
| *Two* | 3 049 (29.11) | 144 (21.40) | 4.72 |
| *Three or more* | 1 800 (17.19) | 142 (21.10) | 7.89 |
| *Housing size* | | | |
| *< 40 m²* | 183 (1.75) | 33 (4.90) | 18.03 |
| *40-70 m²* | 2 499 (23.86) | 239 (35.51) | 9.56 |
| *70-100 m²* | 4 567 (43.61) | 276 (41.01) | 6.04 |
| *100-150 m²* | 3 224 (30.78) | 102 (15.16) | 4.05 |
| *> 150 m²* | 2 520 (24.06) | 23 (3.42) | 3.27 |

Figures give the mean value for continuous variables and frequency for discrete variables. Figures in brackets are percentage of full sample for the second column and percentage of unemployed persons for the third column.