TRANSPORT AXIS AND SELECTIVE HOUSEHOLDS POLARIZATION: THE CASE OF THE UNDERGROUND LINES IN THE PARISIAN SUBURBS

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ABSTRACT

The starting point for this paper is twofold, including both geographical and theoretical observations. First, since 1970 the Parisian underground network has been encroaching further and further upon the suburbs. No less than 28 new stations were put into service during a thirty-year period. Secondly, accessibility nodes to the city centres are often pointed as attractive to the households and give rise to spatial competitions for residential location. The aim of the paper is thus to identify, characterize and explain the existence of a specific residential attraction around the suburban stations of the “Métropolitain” network, which would preferentially impact certain types of households.

By exploring life-cycle position and social classes data, we wish to find out a selective polarization of the neighbourhoods located near the stations. The statistical exploration is based in six iso-accessibility rings with a pedestrian five-minute thickness and put in relationship the indicators with an access time value to the nearest station. Thereby, we show that the resident households polarization predominantly impacts a reduced part of the population, particularly small, young households and, to a lesser extent, upper classes.

This selective polarization is actually explained by the structure of the housing stock. In fact, a look at the correlations between households and dwellings characteristics proves that the residential attractiveness is not much more than an adjustment of the households in relation to the existing housing offer. This result, however, does not nullify a specific attractiveness that is revealed through the notion of constraint acceptance. Thus, several households accept to live with less space and they outweigh the constraint by accessible or central location advantages. By measuring the ratio of “overpopulation” in the dwellings, we show that their propensity to a constraint acceptance is higher close to the stations than far from them.

Keywords: Paris, accessibility, centrality, suburbs, household polarization.

INTRODUCTION

During the period 1970-1998, the Paris underground network was extended beyond the limits of the city-centre capital. In this "little crown", as the three departments bordering Paris are known, 28 stations were put into service. They induced a differentiated accessibility to Paris: neighborhoods directly linked to Paris (major economic and cultural centre of the Region) are supposed to have become more attractive than the other, no or poorly connected.

This paper examines the distribution of households around these transport axis. It raises two questions. First, how and to what extent the suburban underground that are directly connected are socially skilled? Then, is this specialization is the result of a specific attraction (for the neighborhood or the character of network node)? We characterize the neighborhoods served by the extended lines of the Paris network, and then we discuss the main existing work around this issue. We then analyze, from a serie of variables from the Population Census, the geographic distribution of resident households around the stations. We finally put these data in conjunction with the existing housing stock.

ACCESSIBILITY TO THE CENTRE

Central-directed extensions of the underground lines

The expansion of the underground lines to the suburbs of Paris must be related with two main orientations of the regional policies which have regularly been described as a constant comings and goings of hesitations between the polycentric temptations of the Malthusianism and the strengthening of the power and centrality of Paris (Cornu, 1972; Fourcaut, Flonneau, 2005). The first orientation was based on the idea that the weight of the city-centre, at the regional and national scale, was a social and economic danger. The aim of the initial urban and economical guidelines was to reduce or at least stabilize the population and employment in the centre of a booming capital. At an urban scale, six administrative and economical “restructuring centres” were defined, namely Créteil, Bobigny and Nanterre. They were bound to be quickly connected to Paris. Those centres were finally reached by the underground lines, respectively in 1974 and 1985. The objective was not, in such cases, to meet a social demand expressed by the population. These projects did not appear even among the operations designated as priorities in the five-year plans of the RATP (Régie Autonome des Transports Parisiens) in the 50’ and 60’: the future development of the RER (Réseau Express Régional) had probably a blocking effect on developments in the underground system (Larroque, Margairaz, Zembri, 2002). But they would ultimately be crucial in the strategic documents at regional and national levels, as the revision of SDAURP (Schéma Directeur d’Aménagement et d’Urbanisme de la Région Parisienne) in 1969, or the Sixth Plan for the Modernization and Equipment for the period 1971-1975. As we read in the preamble to the extension project of line 5 to Bobigny, which would serve socially marked neighbourhoods, brownfield and railway: "the population and jobs that are located there would not have justified to themselves (the project) if, after the administrative reform of 1964 in the Paris region, it had been decided not to make Bobigny (...) the capital of the new

Department of Seine-Saint-Denis" (RATP, 1979b: 5). These extensions are part of larger projects which have forced a more rigorous temporality, accelerated the period between project and commissioning: extensions of Créteil (line 8, 1974), Bobigny (Line 5, 1985), La Défense (line 1, 1992) and the University of Saint-Denis (line 13, 1998) belong to this category of priority operations realized within ten to fifteen years and have found their justification in the political, administrative and economic decentralization. The latter had also initiated, in the early 60', the establishment of RER lines meant to be a regional backbone of the transportation system.

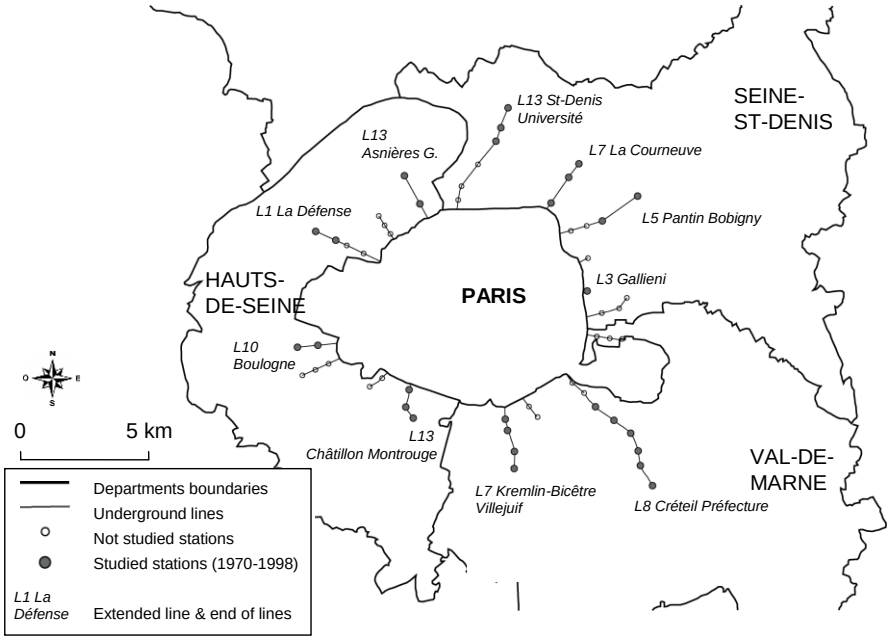

Figure 1 – Suburban extensions of the Parisian underground network (situation in 1998).

The second broad orientation, less proactive in terms of city-planning, tried to increase services between Paris and its surroundings in order to resolve problems arising from the significant increase in radial commuting and traffic congestion. This group of extended lines answered a social demand induced by an increasingly intense population growth that reached all the surrounding communities of Paris. The new lines aimed at serving residential neighbourhoods and this aspect gave a logical justification, nonetheless insufficient to impose an automatic emergency agenda during the project elaboration. Many stations appeared with several decades of lagging behind the initial projects. The extension of line 13 in Clichy is exemplary in this respect: inaugurated in 1980, he was declared of public utility on 1 January 1930. The extension of line 4, south of Paris, to Bagneux Montrouge, was proposed in 1919, was then declared of public utility in 1930, but is only now underway. The station Mairie de Montrouge is expected to open in 2011 in a different place from that envisaged in the first half of the twentieth century. A pre-existing social demand, accompanied by incessant local claims, is part of the slow emergence of the suburban stations of the network, but with a different temporality.

The underground network, in its suburban part, therefore shows both sides of the growth in the Paris region (Figure 1): centrality or peripheral expansion, strengthening of the built

environment on a few main areas, fragile attempts to shape the urban foms after the Second World War. In different ways, the two sets lead to an incomplete linear mosaic whose purely radial form underlies all guidelines defined so far. The latter, also based on claims of municipal councilors who earn a symbolic and political respectability, usually get support from people anxious for greater ease in commuting to their first economic and cultural hub of the region. With a high density in the core, with its 243 stations scattered over an area of 105 sq km, the network becomes more scattered outside the administrative boundaries of Paris, and interconnections with other networks are almost non-existent: a unique correspondence between underground and RER (station La Défense Grande Arche), another between underground and tramway (station Bobigny Pablo Picasso), but no connection between two underground lines exist so far in the suburbs. The partitioning is a reality of suburban underground, inseparable from its dependence on historical, geographical and functional relationship to the central Paris area.

Accessibility to the centre as a competition

This subordination of a heavy network in relation to the city centre requires that we think about the Parisian centrality (including the inner suburbs), which goes against all theories and discourses on polycentric development and urban expansion in margins. The importance of a central location is not annihilated by the transportation and communication modes (Carroué, 2000; Burgel, 1999). Many authors have described in detail the central areas reconquest by some segments of the population (Smith, 1999; Butler, 1997; Mendes, 2006) or by economic actors (Beckouche, Vire, 1998). They illustrated an evolution whose image, in the Paris case, "reduces, if not revoke, the persistent belief in the Parisian polycentrality" (Burgel, 2006). Being accessibility defined as a "capability for the centrality of territory" (Wenglenski, 2003), we hypothesize a spatial differentiation can be induced by the emergence of an underground station, regardless of the socio-historical and political process that caused its construction. The faster access to a town centre that continues, despite the process of peripheral expansion as the largest centre of employment in the region (Burgel, 1999), is supposed to result in a context characterized by a competition between actors, households and activities, and an increase of urbanity. Urbanity, defined "as productive situation, involves the co-presence of the maximum social objects in a combination of minimal distances" (Lévy, 1994). We present in what follows these two interrelated aspects: Parisian centrality, accessibility as an centrality attraction factor.

The centrality of Paris did not got weaker

The spatial distribution of the regional population and residential densities would be almost sufficient to show the power of the central area of the Paris region: Paris, which represents 1% of the conurbation area, includes 20% of the regional population, one quarter of its primary residences, a residential density greater than 20,000 inhabitants / km², that is to say, twenty-two times higher than the regional average (Burgel, 2006b). Also, the capital received between 1999 and 2003, 22,000 new inhabitants, or 13% of regional growth. This growth, mainly due to natural increase, continued unabated in the three years that have followed

since Paris shows a gain of 44,000 inhabitants between 1999 and 2006 (APUR, 2008). In contrast to beliefs that, from the trends of the second half of the twentieth century, considering the loss of inner cities, Paris has been showing some stability that lasted from early 1980. The 150,000 departures recorded between 1990 and 1999 represent a tiny amount compared to the previous five intercensal periods (Korsu 2006). Urban sprawl and suburbanization are not the result of a decline of centres, but a renewal illustrated by the evolution of heavy household size: Paris, which lost 51,000 inhabitants during the period 1982-1999, earned at the same time more than 22,000 households (APUR, 2005). During the same period, among the 293,000 new inhabitants of the Region that belonged to the highest categories, a third came to live in the city centre that represented only one fifth of the regional population.

The overview describes recent urban intensification in the central part of the greater Paris area (Beaucire, Meyer, Surowiec, 2003). It is supported by observations made on all French metropolitan areas: negative migration in the central cities, but even more in the suburbs during the period 1990-1999 (Chavouet, Fanouillet, 2000). In addition, the evolution of the central employment and economic activity is significant: for 1% of the regional area and 20% of the population, Paris accounted for 33% of regional employment in 1999 (Bouvier, 2003). If a relative spreading of activity has been found in the Paris region, it does not upset so far the general distribution of employment in the Paris Region, and the centrality maintaining of Paris is a reality (Burgel 1995; Beckouche, Damette, Vire 1997). The rise of the offices, particularly in the central area, which is consistent with a stronger service sector, is undeniable. It is not only the result of a supposed weakening of the centre, but above all a very strong market tightness (Polese, Coffey, 1984). In Paris, between 2000 and 2001, the price per m² of office had increased by 30% (Crouzet, 2001). In London and in Paris, a numerical increase of more skilled jobs has been observed, and also a decrease in other socio-professional groups.

Works on mobility wholeheartedly agree with these observations. Certainly, they show most often the lower capacity of attraction (IAURIF, 2006), but Paris still captured, in 1999, 27.4% of home-work commuting (Berroir *et al*., 2004) and 20% of active residents in the inner suburbs (Gilli, 2002). In addition, considering equivalent jobs, a job-centre located near Paris has a longer range (more distant radiation) than a pole located far from the centre. Not only the fringes of the Île-de-France increased between 1990 and 1999 the number of employed persons working in Paris (IAURIF, 2006), but this attraction is now higher than the regional boundaries (Baccaïni, 1993). Paris has become the largest employment centre for the inhabitants of Rouen, Orléans, and Amiens (cities located more than 100 km from Paris), outside their own employment area (Gilli, 2002).

This large share of regional mobility captured by the city centre is due to its weight in terms of jobs: in 1999, Paris was still 32% of all regional jobs (Massot, Proulhac, 2005), and the proportion rose to 65% if we include the adjacent municipal territories (Aguilera, 2005). Paris remains, with the Hauts-de-Seine, the only department of the Region that shows a ratio jobs / active residents greater than 1 (equal to 1.42, 1.12 for the Hauts-de-Seine). When measured on the jobs clusters scale, the employment rates is more mixed: only Paris and Roissy

Airport show employment rates higher than 1. These rates contrast with those, still below 0.67, of the poles located within a radius of 70 km from the capital (Gilli, 2002).

Table I – Geography of displacements by underground from Inner Suburbs to Paris and Suburbs.

Origin-Destination	Percentage in 1976	Percentage in 2001-2002	Evolution (%)
Inner Suburbs > City Centre	77.9	75.5	+ 5 %
Inner Suburbs > Inner Suburbs	20.9	23.8	+ 23 %
Inner Suburbs > Outer Suburbs	1.2	0.7	- 35 %
Total	100	100	+ 8 %

Here, we consider all journeys with the undergound as the main transport mode when moving. Calculations based on the number of trips. Source : EGT 2001-2002 , calculations from L. Proulhac (LVMT).

These data are broadly confirmed when looking at the territories near Paris. Thus, the work (Massot, Proulhac, 2005) on the mobility in the Val-de-Marne (a suburban district near Paris) in 2001 showed that 44% of daily trade flows with the Paris department had its origin or destination. Their share increased, if we isolate public transport, to 52% of daily trips. These figures reflect the privileged position of Paris in all trips, compared to lower concentrations elsewhere though, with the rest of the Île-de-France Region, travel is steadily increasing (+ 0.72% per year) for 20 years.

In addition, observation of commuters shows that the existence of urban sprawl on the margins of the Paris Region, with the formation of large clusters of suburbs, is not incompatible with the presence of an internal fringe turned to Paris (Gilli, 2002). The capital has a very strong bias for commuting, involving more than 20% of people in the inner suburbs. And in fact, nearly half of traffic (46.7%) for Paris (all modes taken together), are the result of suburban commuters (Orfeuil, Massot, 2006). In the case of the underground network, the proportion of Paris-suburbs trips using this mode is 39 % (EGT data).

Accessibility and the centrality attractiveness

The socio-cultural attraction of the centrality for the new middle classes (Butler, 1997) completes the picture and finally involves the position of individuals in the lifecycle: the suburbanization, as an individual act, is strongly correlated with the arrival of an additional child (Wiel, 2002) but does not prevent that 44% of households living in large suburban houses can make the desire to live in downtown if the opportunity would be offered (Charmes, 2002). The new middle classes seek a happy residential central location, including the United States as has been shown for young service class professionals (Camagni, 1996). This "enhance of prestige of the centrality" (Burgel, 1999) is generally referred to with the expression of "downtown gentrification" and was originally analyzed in terms of ecological models (Burgess, 1925).

Here, we will not examine the foundations of these "selective recentralization forces" (Barata Salgueiro, 1994). The mere fact that direction, control, management, upper classes, production of new real estate (housing and offices) confirm the predominance of the centre is sufficient. There lies the significance of gentrification process which, to be recognized globally, correspond to an infinite variety of configurations improperly grouped under that term, or are part of a vast globalized phenomenon, "both physical, economic, social and cultural" (Hamnett, 1984, 1996). Gentrification can articulate with the re-centralization of the overall investment in major cities and with the accumulation of capital in the tertiary economy; it can also be put in the context of the transformation of family forms, the individualization, the increasing share of dual-income households, and the rising of the service class, which began in the early twentieth century and intensified during the post-Fordist and post-industrial periods. But in all cases, it is only the reproduction, at the internal space of the large cities of the conurbation, of the metropolization and the subsequent development of capitalism (Sassen, 1991, Lash, Urry, 1994), and the polarization of economies and societies (Bidou-Zachariasen, 2003). The Inner-London is characterized by a relative over-representation, in relation to its region, of: higher and intermediate managerial / administrative / professional workers, and low wages (on state benefit unemployed, lowest grade workers) (Butler, 2005).

Works that analyze the residential location as an objective of individual strategies and deep competition confirm these observations. The hypothesis of what is usually referred to as “occupational upgrading” (Butler, 2005) is based on the idea that households who live or are about to live in nearby suburbs seek proximity to an underground station. This desire can be linked to a real demand for accessibility (daily or, at least, frequent use of the proximity of Paris) or motivated by mere convenience : the infrastructure may influence the location choice, even without a daily use of the network (Bertolini, Spit, 1998; Michailovsky, 2006). Although we do not plan to follow individual trajectories, but rather to analyze contrast and local developments falling in metropolitan issues, we return here on what underlies the assumption in individual terms: the search of an accessible residential location exacerbates the spatial competition of the households. If accessibility is the "ability to centrality (Wenglenski, 2003), it contains at least the germs of an equal economic and socio-cultural attractiveness than the central areas. This feature has been stressed repeatedly in works on the location strategies of residential suburban households, analyzed from their speeches and practices or from interviews with real estate agents. They also contradict the idea that transportation should reduce inequality (Dupuy, 2004), especially because the competition for space is strongly correlated with accessibility. This idea was recently confirmed by the observation of a gentrification process around some transport infrastructure (Herce Vallejo, 2004), especially the underground lines near Paris (Kaufmann *et al*., 2005). These places would be also, for the buyers and for the real estate agents, a substitute for the centrality of Paris (Michailovsky, 2006).

We therefore formulate a hypothesis (Table I). There is a polarization of households around the points of access, which is selective and tends to approximate the characteristics of households served by the network and the Parisian households. This merger would be visible through both family profile and lifecycle position, and across the socio-economic

development. But Parisian households are characterized by a lower size than suburban, they are younger and have fewer children, and also there is a relative over-representation of higher classes.

Table I – Hypothesis.

Analyzed items	**Hypothesis**
Family profile and life-cycle position	Smaller households Lower birthrate Overrepresentation of young households Under-representation of families with young children
Socio-economic and activity	Over-representation on the higher categories, including youth (social mobility) Higher level of education

METHODOLOGICAL CONSIDERATIONS

Data

The study is based on data from the Population Census (RGP) for 1990 and 1999. The scale we use is the IRIS (cutting established by INSEE, each IRIS has got roughly 2,000 inhabitants).

Variables

Three types of variables are explored in this study. From the 1999 housing file, these variables allow us to relate the characteristics of households with available housing. Within the study area, 355,000 units are recorded and characterized by their size (measured by the number of rooms) and type (whether it is a housing block, flats or detached houses). The socio-demographic composition variables are used to help us to characterize the household size (number of children per couple, couples with 0 and 4 children, one-person households) and age (age structure of population, age of the household reference person). The variables of social categories help us to characterize levels and qualifications of individuals belonging to popular, middle and upper classes defined by (Korsu, 2006). Finally, we use the variables characterizing their housing type (apartment building housing, individual housing) and size (rooms).

Geographical constraints

The construction of the study area has led to five previous geographical treatments.

First, the access time to the stations (ATS) and the access time to Paris (ATP) are the key variables for all analysis. The selected variables are all evaluated based on the proximity of

neighbourhoods to the network nodes. The proximity to the central area of Paris is used to control the variable distance to the undergound: the objective is to ensure that the observation of the spatial distribution is done with an equivalent distance to Paris.

The construction of the access time variables has been made from accessibility isochrones around the stations. These isochrones range from 0 to 30 minutes of walking up to a pedestrian at a standard speed of 4 km/h (Bornstein, Bornstein, 1976). The access time is calculated taking into account the road network. It is not the distance as the crow flies. Six 5-minute slices were distinguished: 0-5', 5-10', 10-15', 15-20', 20-25' and 25-30'. An indicator of access time to the nearest station (ATS) was then applied to each geographical unit (IRIS). The same process was used to the ATP variable (access time to Paris), but increasing this time the maximum to 100 minutes. For this variable, the times are grouped into four classes called ATP1 (near Paris), ATP2, ATP3 and ATP4 (near Paris), each of them containing (quite) the same number of IRIS.

The third geographical imperative is the aggregation of data from the 28 stations concerned. A single station is theoretically obtained to account for spatial structure at the metropolitan level. The overall analysis is coupled with a more detailed analysis around each line ending, but we do not speak here about this.

We have considered all the area located within 30 minutes of the underground stations analyzed. But we must ensure that every point in this area is closer to one of these 28 stations than to any other network stations (older stations, suburban trains). By doing this, we eliminate some areas using the same principle of the isochrones, all points that are closer to one another as a network of 28 stations. By this method, we guarantee that every point of the study area is closer to “our” network than any other not studied network.

Finally, since the geographical unit is the IRIS, it can’t be cut. The access time variables (ATS and ATP) are an average, weighted by the internal distribution of residential areas, obtained through the use of the MOS database (Land-use occupation, IAURIF, 1999). The study area thus obtained is about 9,000 hectares in 1999 and covers approximately 755,000 inhabitants (Figure 2).

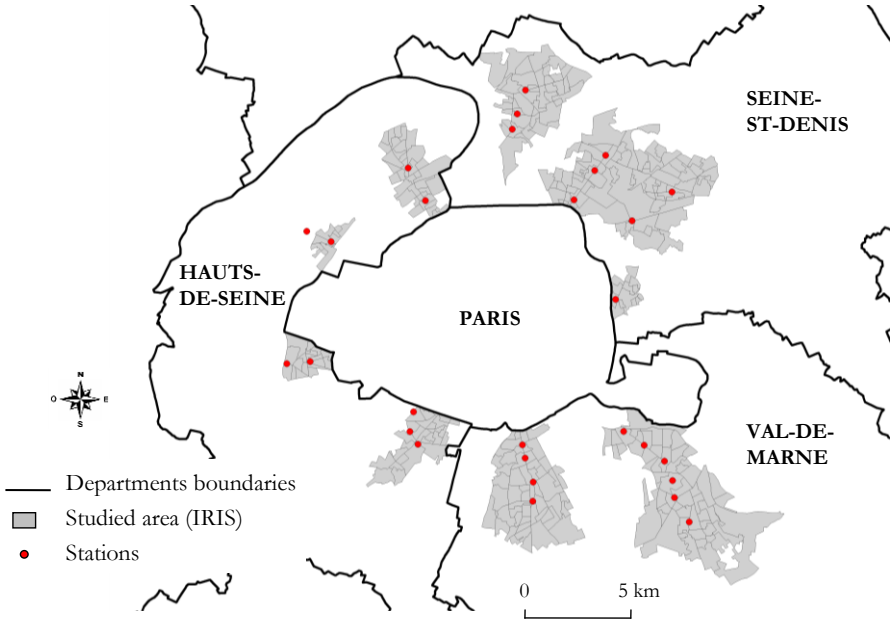

Figure 2 – Suburban stations and studied area, composed by 331 IRIS.

RESULTS

We now present the results on the distribution of households, primarily based on their demographic characteristics, then from the social categories.

Young people and small households near the stations

Household size can be analyzed through the number of children per couple and the share of one-person households. Figure 3 shows the 1990-1999 evolution of the average number of children per couple. It shows a gradual increase of the share of couples with children along with the distance to the stations, and this distribution is strengthening during the period. At over 20 minutes from the station, the value went up from 1.01 to 1.13 in the period, and this evolution tends to create a more regular gradient. Combined with the distance to Paris, the results are relatively similar, though not regular: the average number of children per couple increases with the distance to the subway, passing in 1999 from 0.96 to 1.21 (ATP 1), from 0.85 to 1.07 (ATP 2) from 1.02 to 1.07 (ATP 3) and 1.10 to 1.22 (ATP 4). In contrast, the share of couples with 4 children decreases as the distance to the subway shrinks, from 5.3% (in areas more than 20 minutes to the nearest station) to 3.5% (less than 10 minutes). The IRIS with the lowest share of couples with at least 4 children are on average more distant from both the station (over 17 minutes) and Paris (more than 50 minutes). Conversely, the IRIS where couples with at least 4 children are best represented average 13.7 minutes to the nearest station and 38 minutes from Paris. This relationship continues, albeit imperfect, regardless of the distance from Paris considered: less than 3.3% near the station, 4 and 7% at a reasonable distance (ATP 1), then reaching or exceeding the 6% (ATP 3 et ATP 4).

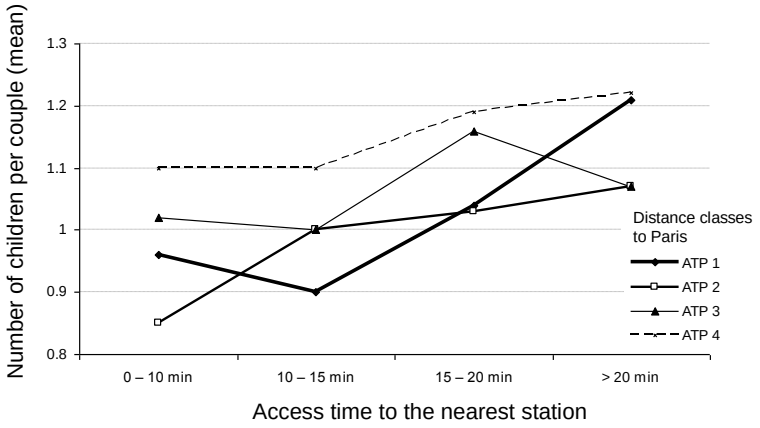

Figure 3 – Average number of children per couple, by access time to the station and to Paris. Source: INSEE/RGP, 1999.

Table I – share of one-person households in the total of households, according to ATS and ATP variables (1990-1999, %).

ATS value	1990				1999			
	ATP 1	ATP 2	ATP 3	ATP 4	ATP 1	ATP 2	ATP 3	ATP 4
0-10’	42,0	39,5	34,4	29,9	42,6	42,7	37,2	33,9
10-15’	40,1	32,3	31,7	28,2	43,2	36,1	36,2	32,4
15-20’	32,7	29,4	26,7	22,7	36,9	32,7	30,5	27,8
> 20’	25,6	26,8	22,1	25,3	27,6	31,0	27,8	28,6

ATS : Access time to the nearest station. ATP : access time to Paris. Source : INSEE/RGP, 1990-1999.

One-person households are usually overrepresented in inner cities. That is why the number of households increased in Paris between 1982 and 1999 while the overall population decreased. The average size of households passed during the same period from 1.95 to 1.87 persons. Taking into account the distance to the underground, the share of one-person households lets see a strong and steady polarization, in both 1990 and 1999. Between these two dates, the curve was not marked but the proportion generally increased. They range from 25 to 37% with the approximation to the station in 1990, and from 29 to 40% in the next census.

Data processing is used to make a population pyramid including the entire population of the 331 studied IRIS (1999 data), and separate into three sets of IRIS, characterized by the value of the ATS: 0-15 minutes, 15-20 minutes and over 20 minutes. The pyramid reveals a slight overrepresentation near the stations of individuals aged 25-39 (Figure 5, A and A ') and an overrepresentation of individual aged 5-19 in more remote areas (Figure 5, B and B '). The overrepresentation corresponds to 7,424 people aged 25-39 "too" close to the underground from a theoretical case in which the proportion would be equal in all areas. It amounts to a 7,312 “excess” of people aged 5-19 living far from the station. These proportions remain low relative to the population living in the 331 IRIS considered: these 7,000 additional inhabitants correspond to about 5% of the age groups involved. The distribution of these over-representation, however, is doubly significant, in an interpretive point of view because they relate to two specific age groups, in a statistical point of view because they are the only ones to be superior to the standard deviation observed on the

pyramid, about 3% for all classes of distances. Above all, it quite clearly assimilated the characteristics of the city centre, with an over-representation of people aged 25-39 and an under-representation of people aged 5-19.

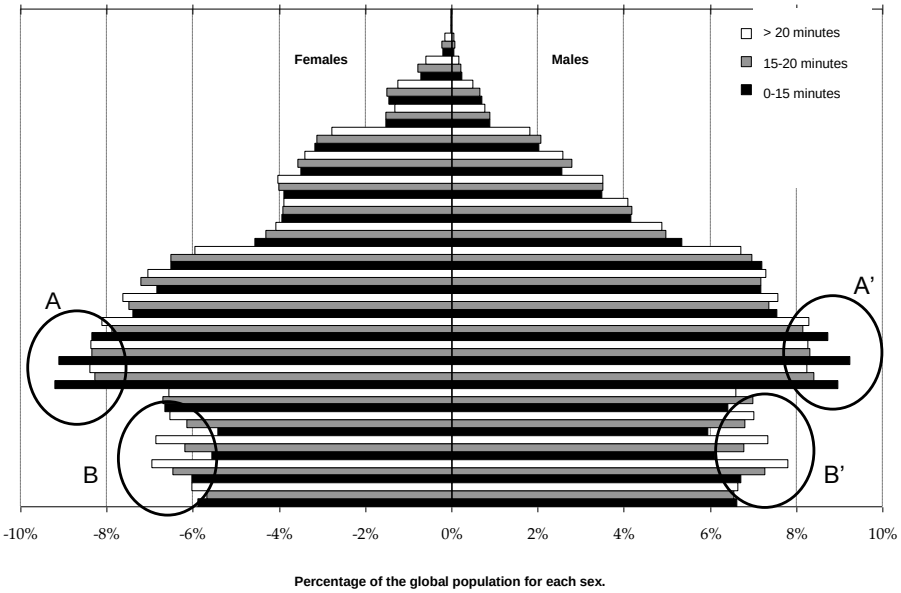

Figure 5 – Population pyramid of the 331 studied IRIS, by ATS. Source: INSEE-RGP, 1999.

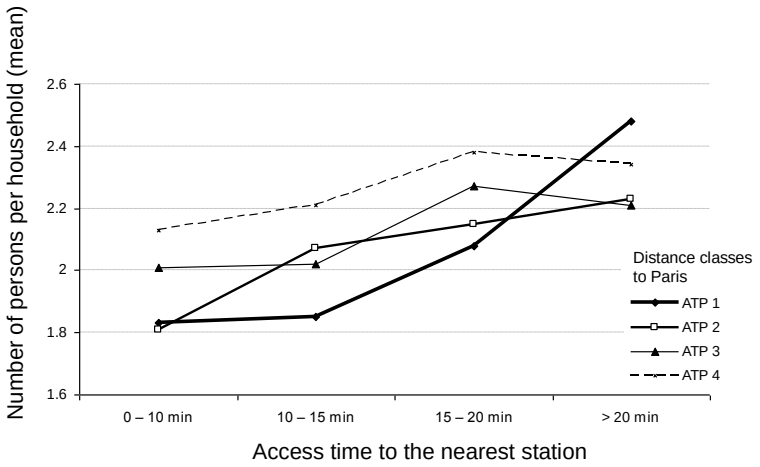

Figure 6 – Average size of households living in flats, according to ATS and ATP (1999).

The situation we have just outlined clearly illustrates a very generalized gradient of the presence of young and small households and the predominance of individuals aged 20 to 30, couples without children and one-person households. It draws a global structure effectively summarized by the distribution of the average size of households living in flats (Figure 6).

Social classes distributions

We now explore the indicators of socio-economic activity and household residents. We discuss here in turn the distribution of social groups, skill levels and activity, mainly applied to the household reference person.

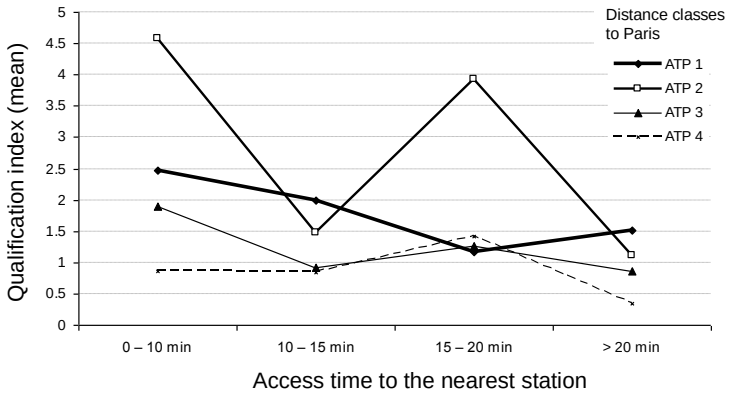

Figure 7 – Index of qualification applied to reference persons of households aged 20-29 and living in flats, according to ATS and ATP. Source : INSEE/RGP, 1999.

First, we propose a Qualification Index (QI) which calculates the ratio College Graduates / Non-Graduates. We take into account the age (young: 20-29 years old), status (reference person of household), and we consider only those who live in flats (apartments buildings). In Paris, the QI is equal to 5.73. Figure 7 shows the results in the 331 IRIS. They are almost the same as previously for ATP 1 and ATP 2: irregular gradient, particularly marked by a sign up near the underground station (0-10 minutes). The gradient completely disappears along with the increasing distance to Paris (ATP 3 ATP and 4). There is a disproportionate representation of graduates near the stations, compared to non-graduates, and the differentiation is not marked elsewhere.

The share of middle categories appears indifferent to the distance to the underground network and to Paris: it ranges from 34 to about 41% and shows no clear distribution. In contrast, the spatial distribution of the higher classes and categories of popular shows such a staging, although not systematically. The higher classes (Figure 8) opposed to the general vicinity of the metro (0-10 minutes) to more distant IRIS, except for ATP4: 30 to 13% (ATP 2), 18 to 11% (ATP 1). Popular categories, in turn (Figure 9), follow the reverse distribution: they reach or exceed the 50% to more than 20 minutes from the network (ATP1 and 2), have significantly lower values in nearer areas.

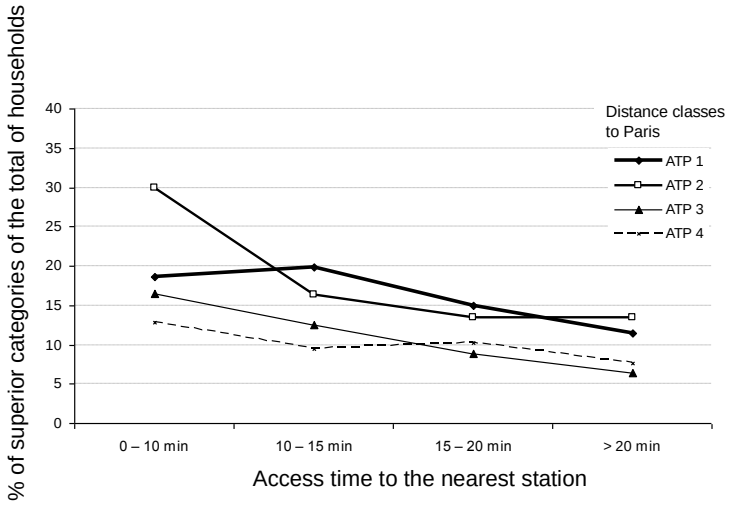

Figure 8 – share of high classes in the reference person of households, according to ATS and ATP (1999).
Source : INSEE/RGP, 1999.

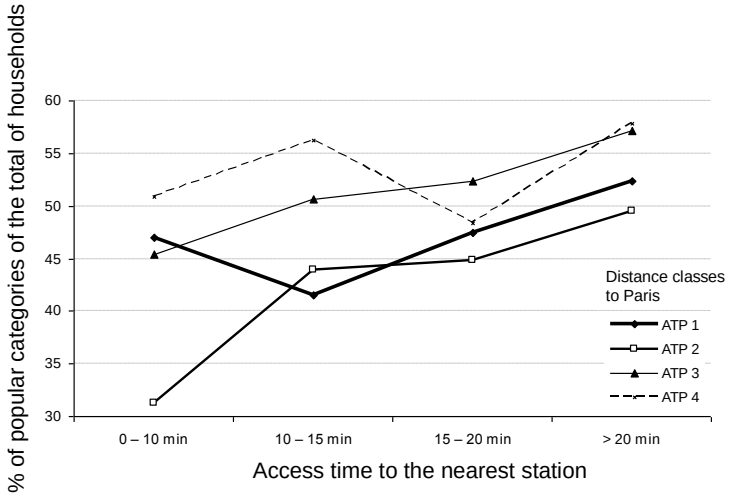

Figure 9 – share of popular classes in the reference person of households, according to ATS and ATP (1999).
Source : INSEE/RGP, 1999.

HOUSEHOLDS ADJUSTMENT AND SPECIFIC ATTRACTIVENESS?

Households fit to the housing market

Correlation between household characteristics and housing size

Census data allow us to cross directly the number of rooms in each dwelling with the age of the household reference person. The result of this cross clearly appears: in the 331 IRIS considered the share of household reference persons aged 15-34 is equal to 51% in 1-room dwellings and only 12% in the 4-room dwellings. It reaches 6% of larger-sized homes. The relationship is reversed in the case of people aged 35-49 and 50-64: those aged 35-49

increase from 26 to 48% from 1 to 4 rooms, and those aged 50-64, with a lesser presence of children and reduced needs in terms of surface, increase from 14 to 29%. This reading of an adaptation of the age groups to the home sizes is reflected in IRIS: IRIS in which the average number of rooms per dwelling is highest are those in which the share of youngest household reference persons (aged 15 to 29 years) is the lowest (Table II): 6.8% of households whose homes are on average more than 3.5 parts are young households, the proportion increases progressively 12.4% in the IRIS whose average dwelling size is smaller (from 2 to 2.49 parts).

Table II – age of reference person and average number of rooms per dwelling in the IRIS (1999).

Average number of rooms in the dwellings	**Share of households in which the reference person is aged 15-29**
2 à 2.499	12.4 %
2.5 à 2.999	10.0 %
3 à 3.499	7.4 %
3.5 and more	6.8 %

The same calculations can be implemented from the variables indicating the presence of children in the household. The number of children per household, made in connection with the number of housing parts, shows a strong relationship between the proportion of couples without children and the number of rooms in the dwelling. The corresponding percentages are 81% and 1%, respectively to the 1-room and to the 4-room dwellings; other classes tend instead to increase their share as the housing expands, except for households of couples with one child, who reach their maximum (28%) in 3-room dwellings.

Of course, the figures also reflect a higher share of households composed by couples without children in the IRIS with smaller dwellings: they represent 50% of households in IRIS with an average number of rooms per dwelling lower than 2.5, and only 41.8% in IRIS where it exceeds 3.5 rooms. Couples with 4 children follow the opposite path to the increase in the average size of dwellings, from 3.4 to 5.8% of households. Evolving 1990-1999, the same observations can be made: reduction of couples without children in the IRIS with small dwellings, increase elsewhere, while 4-children households are increasing almost everywhere.

Table III – couples with no children and average number of rooms per dwelling.

Average number of rooms (/dwelling)	**Share of couples without children in the total of couples**	
	1990	1999
2.5 à 2.499	51.3 %	50.0 %
2.5 à 2.999	45.9 %	47.2 %
3 à 3.499	39.6 %	42.5 %
3.5 et plus	38.1 %	41.8 %

Detached houses are excluded. Source : INSEE/RGP, 1990-1999.

Near the underground, low-sized homes

The role of housing characteristics, and in particular their size measured by number of rooms in the geographical configuration of both demographic and family data, can be confirmed through the analysis by linear regression. These regressions were made by considering the family variables as dependent variables on the one hand, and the distance indicators (ATS and ATP), the average number of rooms per dwelling as explanatory variables in the other hand. The calculations are weighted by the total population of each IRIS.

Without repeating here the whole of the selected indicators, the main lesson of this analysis is that, despite the reality of geographical distributions analyzed so far and which led to a relatively clear socio-spatial specialization, the distance to the network and Paris completely disappears, compared to the importance of the size of dwellings in the determination of the household profiles. Starting from the age groups 25-39 in the total population of IRIS (Table III), the proportion of couples without children in the global couples households (Table IV) and the share of one-person households in the total of households (Table V), distance to the station is never significant (columns Pr> t), the distance from Paris is significant only for some indicators (households without children and one-person households), and especially dwelling size is considered one of the main determinants.

38% of the variation in the share of people aged 25-39 (Table III) is explained by the factors explored but only the number of rooms is significant, with a satisfactory estimated standard (-0.66, <0.0001) . These factors explain only 18% of changing share of households without children (Table IV), and again only the number of housing parts is significant (estimate standard of -0.34, <0.0001). Finally, when they explain 60% of the share change of one-person househoulds, once again it is mainly by the housing (- 0.71, <0.0001), although the distance to Paris has got a slight influence in the result (- 0.11, <0.0001).

What was shown is that, beyond a selective attraction for the underground, the relationships can be summarized as follows: smaller dwellings are located near the underground stations, and it is where the dwellings are smaller that the resident households are precisely smaller, and those with few children, and also the youngest. However, is the attraction of the station completely refuted? At this stage, not, because it is necessary to submit such data in the perspective of distance to the underground and use the notions of constraints, acceptance of these constraints and overcrowding.

Table III – Results of linear regression with, as a dependent variable the share of 25-39 years in total individuals (1999).

		Estimated param.	Estim. Stand.	Pr > t
R²	0,3813			
Intercept		0,47722	-	< 0,0001
Control variables				
ATP		0,00008102	0,04465	0,3728
ATS		0,00213	0,05591	0,2816
Average number of rooms		- 0,07691	- 0,66034	< 0,0001

Source : INSEE/RGP, author's calculations.

Table IV – Results of linear regression with, as a dependent variable the share of households of couples without children in total households of couples (1999).

		Estimated param.	Estim. Stand.	Pr > t
R²	0,1758			
Intercept		0,82812	-	< 0,0001
Control variables				
ATP		- 0,00098044	- 0,16969	0,0036
ATS		0,00538	0,04441	0,4599
Average number of rooms		- 0,12637	- 0,34078	< 0,0001

Source : INSEE/RGP, author's calculations.

Table V - Results of linear regression with, as a dependent variable the share of households with one person in total households (1999).

		Estimated param .	Estim. Stand.	Pr > t
R²	0,5956			
Intercept		0,72744	-	< 0,0001
Control variables				
ATP		- 0,00031297	- 0,10554	< 0,0001
ATS		- 0,00155	- 0,02491	0,5526
Average number of rooms		- 0,13452	- 0,70678	< 0,0001

Source : INSEE/RGP, author's calculations.

A special attraction is still detectable

So far, several characteristics of neighbourhoods located near a station and with an equivalent distance to Paris have been highlighted: high population densities, balance of

small households and to a lesser extent, upper classes to the detriment of the working classes, predominance of small dwellings. When people, in a context of strong competition for residential location, are seeking to live in one place, it can be assumed, in the event that the housing market did not offer an accommodation that exactly matches their needs (surface area) or resources (housing prices), these people accept constraints they would not suffer if they moved away from the place they want.

A first validation can be made here, by comparing the shares of 4-people households living in a housing of 1, 2 or 3 rooms, depending on the distance to the station (Table VI). Few households of 4 persons live in such low-sized dwellings, but 2.39% of them are located within 10 minutes from the nearest station, against only 0.41% above 20 minutes, and the percentage decreases in each distance class considered. Where housing have got 2 rooms, the structure is similar but with slightly higher figures: 11.68% of 4-people households living within 10 minutes of a metro station live in a house with 2 rooms, while the percentage is equal to 4.99 % beyond 20 minutes. The relationship is still preserved for the 3-room dwellings – but not in the 4-room dwellings.

Table VI – 4-person household, number of rooms and distance to the subway (1999).

ATS value	Share of 4-person households in each iso-accessibility class (ATS), living in a dwelling with…		
	1 room	**2 rooms**	**3 rooms**
0-10 minutes	2.39 %	11.68 %	36.39 %
10-15 minutes	1.25 %	9.04 %	35.04 %
15-20 minutes	1.06 %	6.46 %	34.87 %
> 20 minutes	0.41 %	4.99 %	34.19 %
Suburbs (a)	0.5 %	3.2 %	21.9 %
New Parisians (a)	5.5	17 %	32.5 %

(a) : from (KORSU, 2006). Source : INSEE/RGP, author's calculations.

The figures presented here are mostly intermediate between the values calculated by (Korsu, 2006) new-Parisians. Accepting the constraint here seems to play a less obvious role than in Paris, but its horizontal stratification shows that it is real. To complete the analysis and validate it with equivalent distances to Paris, we can submit the data to the ATS/ATP cross matrix. We present here only the case of 4-person households. The relationship between the shares and the ATS value is maintained for the 1-room dwellings (Table VII).

Table VII – share of 4-person households living in 1-room dwellings, according to ATS and ATP variables (1999).

1999 (%)	ATP1	ATP2	ATP3	ATP4
0 – 10 min	4.12	1.81	2.40	1.27
10 – 15 min	2.33	0.97	0.59	1.40
15 – 20 min	0.63	0.92	1.83	0.76
> 20 min	0.36	0.42	0.34	0.50

Near the station (0-10 min.) and Paris (ATP 1), 4.12% of total 4-person households live in a 1-room dwelling. Source: INSEE/RGP, 1999.

CONCLUDING DISCUSSION

The first lesson is that there is a selective social polarization around the extended lines of the Parisian underground network. This observation translates into a trend, not systematic but almost a gradation of the presence of certain characteristics of households depending on the distance to the nearest station, regardless of the distance from Paris - it is only in areas farthest from Paris that the relationship fades. But this trend actually affects a much more significant variables, like the household size and the age of the reference person, i.e. their position in the life cycle. Households are more readily organized in a concentric pattern according to their size than to their incomes. This trend, identified for household needs of the smaller area, increased over the period 1990-1999. It is greatly related to the housing structure. The more smaller homes we will find in a neighbourhood, the more small will be the households living there. It is a tautological assertion, however, it deserves to be highlighted, because these very small homes are located near the underground. Social housing, whose size is usually greater than the private housing stock, tend to eventually remove some of the classes for which the ultimate opportunities to live near the network consists in accepting strong constraints of living space.

This conclusion encourage us to focus our attention to the other variables when we study the social composition of neighborhoods served by transport infrastructures: changes must be approached from the variables of family structure and not solely on the basis of occupations, social groups and income levels. Very few studies focusing on transportation and demographic variables. In addition, these studies require further investigation beyond the single quantifying spatial distributions. The methods used in the analysis of gentrification may be fruitful: it would identify, using questionnaires and semi-structured interviews, the relationship between residents located near the suburban stations, and Paris and its Paris residential market. Are they daily users of the central city and, especially, are they excluded from the residential market because of the prices of the real estate? Being the peripheral location, near a network node, a gateway to the city centre, is it a substitute for the central residential location?

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