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Models of Commuting Times: A Comparative Analysis of Two Southern Metropolises, Delhi and Bogota*

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ABSTRACT

This paper combines two approaches to study the duration of home-to-work journeys. A statistical analysis based on a Heckman selection model allows us to distinguish two distinct processes: the 'choice' to work at home or outside, and the constraints specific to commuting to the workplace. The individual and contextual factors favouring home-based work are first examined, then those affecting the duration of actual home-to-work journeys. Some variables usually associated to commuting times are effective only in the initial choice of working outside home. This model is tested in the context of two Southern metropolises, Bogota and Delhi, using data from identical surveys. This comparative analysis highlights two sets of factors influencing daily commuting: some generic variables with similar effects in both cities, and some variables reflecting social and cultural characteristics of home-based work or the spatial pattern of housing and employment in the metropolitan areas.

Introduction

In addition to tenure and type of housing, the location of the dwelling, in an inevitably discriminatory urban structure, plays a decisive role in the residential strategies of households. In both the regions of the North as well as

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South "location is an essential variable in residential strategies. It expresses the different scales of the spatial practices of city dwellers, and one cannot reduce its role to that of just another attribute of the dwelling" (Bonvalet & Dureau 2000: 149). A number of empirical studies, carried out on major agglomerations in France[1] and Quebec (Thomas & Villeneuve 1998), show the extent to which residential location contributes to differences in journey times to the workplace, in addition to the characteristics of the individual (sex, age, education, socio-economic group, etc.) and the household (size, type, number of working members, the presence of children, etc.). While it is now accepted that these factors must be taken into account in order to understand commuting behaviour, yet it is difficult to summarise the results of different studies as they often differ considerably. Following Gordon, Kumar and Richardson (1989), Thomas and Villeneuve suggest that "the spatial structure of the places studied has a role to play". They propose that consideration should be given to the "influence of the particular arrangement of the places of residence and work", and that "the specific way the environment being studied is organised locally" should be taken into account (1998: 242–243). This paper proposes to contribute to this contextual analysis.

The choices of places of residence and work are a direct reference to urban configurations. They are an expression of the choices of individuals and households from among the range of possibilities determined by the spatial distribution of the different segments of the housing stock in relation to the other components of the city (in particular jobs). Depending on the degree of fluidity in the housing market, choices favouring certain locations have repercussions to a greater or lesser extent on residential mobility. The size of the city and the extent of the inequalities prevailing upon the transport systems determine how accessible different parts of the city are to different social groups. Here too the inhabitants are in very different situations when it comes to the possibilities they have for making their daily journeys. The location choices made by city populations and the resulting practices of residential mobility and daily mobility are thus made in these local contexts of specific spatial, temporal and social combinations.

To determine the effect of different categories of factors (the characteristics of individuals, households and spatial structures) on home-to-work journey times, we have adopted a comparative stance in our consideration of Bogota (the capital of Colombia) and Delhi (the capital of India), two Southern metropolises, which are spatially organised in very distinct ways. By applying the same survey procedure to these two metropolises (Dupont

and Dureau 1996), we were able to bring together the conditions of a comparison on which variability in definitions and measurements had little effect. The existing contrasts between the spatial structures of these two metropolises are certainly of heuristic interest in making progress in understanding the effects of residential location. Lastly, in the major Southern metropolises affected by profound inequalities, where not all of the metropolitan area is accessible, choice of place has particularly decisive consequences. The effects of this are probably more visible here than in Northern metropolitan contexts.

In addition to proposing a comparative perspective, this paper is original in that it applies the same model of simultaneous equations to distinguish working at home from economic activities involving the requirement of commuting to work. Living at the workplace, or working at home, is a frequent practice which obeys specific logic. Such a practice conditions the completion of journeys, and we subsequently analyse these journey times. In line with the requirements of the statistical method and the problems raised by the distribution of the journey times, this breakdown of the analysis is also fully justified by the theoretical concern of distinguishing two distinct but not totally independent processes: the choice or the obligation to work away from the home and the constraints specific to travelling every day to the workplace. This approach has the theoretical advantage of drawing a distinction between the two kinds of logic that govern commuting to work and which belong to two distinct spheres. Firstly there is the household, which is not only a dwelling unit but also a productive unit governed by family rules of organisation. It provides work for the household members, a roof for the working members, and to a lesser or greater extent keeps at home those who concentrate on the tasks of reproduction. Secondly, there are the market and the public sector, which obey their own demands regarding the location of the jobs they provide. From this twofold perspective of an international comparison coupled with a breakdown of the analysis, the approach we propose sheds new light on daily mobility practices, questioning some of the conventional conclusions concerning the effect of certain individual variables on journey times between the home and the workplace.

Applying the Comparative Analysis

Contrasting Metropolitan Contexts

Bogota and Delhi, which in the mid-1990s had populations of 5.5 and 9.5 million respectively, are representative of the current dynamics of a number

of major metropolises in Latin America and South Asia. Despite very different national contexts[2] the demographic and spatial dynamics of these two capitals are part of similar processes of metropolisation. In particular, the slowdown in the growth of the core cities has benefited the development of outlying towns, bringing about increased circulation of populations in the metropolitan area. However, these metropolitan developments occur within institutional frameworks that are very different as far as urban and regional planning are concerned: whereas Delhi and its region have been subject to an interventionist policy of town and country planning and land development, in Bogota the regulatory framework is considerably more permissive.

These contrasts in the methods of public intervention are reflected in the particular characteristics of the urban configurations in question. Delhi is an agglomeration without spatial continuity, with sudden breaks in the urban morphology and very clearly characterised and highly differentiated urban sectors, some of which are separated by physical barriers. In contrast, in Bogota only the limit of the District and the city boundaries determining the limit of legal urban development introduce an element of segmentation in the way the metropolitan area is regulated. Bogota shows more spatial continuity; the city is structured by its major roads, with gradients which are sometimes considerable but which never go as far as the sudden contrasts seen in Delhi. The Colombian capital is characterised by the existence of specialised corridors for different activities such as trade, business and industry. This high degree of specialisation results in the marked concentration of employment zones. In Delhi, on the other hand, economic activities spread out throughout the metropolitan area. This includes industrial production, which takes place not only in the major planned industrial zones but also in the form of small-scale units, which can be found in the old city centre as well as in a number of illegal settlements and also in the urbanised villages on the periphery.

There are also differences in the socio-spatial organisation of the two metropolises. In Bogota, an old tradition of segregation, speculative mechanisms and the behaviour resulting from an increasing feeling of insecurity have given rise to considerable differentiation between the rich north and the poor south. In the Indian capital, the population living in the different sectors of the city appears to be much more heterogeneous. It would however be misleading to conclude that residential and social segregation here is less pronounced; but it does not occur on the same scale as in Bogota. In Delhi, great socio-economic diversity in the population and housing within the same zone can easily go hand in hand with very marked segregation phenomena at a much finer scale.

However, the illegal forms of urbanisation converge. Despite a town planning policy that was supposed to be very strict, the development of Delhi in fact leaves much scope for illegal forms of urban development such as unauthorised colonies in the outlying zones and squatter settlements. From this point of view, Delhi's situation is similar to that of Bogota: the illegal colonies and settlements are home to almost half of Delhi's population, which is as much or even more than in Bogota and other Latin American capitals. Paradoxically, the control that the Delhi Development Authority has over the land has not been able to prevent the proliferation of squatter settlements in all sectors of the capital, including the central zones; whereas in Bogota a liberalist attitude and the laws of the real estate market have pushed the illegal occupants of land to the fringes of the city.

Lastly, in the mid-1990s, neither of these two metropolises had a metro or tramway-type public transport system, but there were significant disparities in the methods used for travelling around the city on a daily basis. In Bogota, in 1995, 78 per cent of the journeys were made by motor vehicles (three-quarters of these were by bus, 20% by privately-owned cars and 5% by taxis); only 22 per cent of the journeys were made on foot and the use of non-motorised mechanised transport was negligible (Chodai et. al. 1996). In 1993 in Delhi, where there were fewer buses per inhabitant than in Bogota, the population relied more often on walking (32% of journeys) and a greater range of mechanised transport was used. Buses were favoured in 62 per cent of the cases of people using mechanised transport, with the rest made up in equal proportions of cars or two-wheeled motorised vehicles, bicycles or other low-capacity vehicles, either powered mechanically or pulled by animals or men (Madhugiri 1996).

The spatial organisation of each metropolitan area, the distribution of jobs and the different types of housing, but also socio-cultural factors, strongly influence the daily mobility of the residents of these cities and their specific characteristics.

Data Characteristics

The data analysed here were collected in the course of two socio-demographic surveys carried out in 1993 in Bogota and in 1995 in Delhi, as part of a comparative research project designed to examine the mobility patterns and urban transformations taking place in these two major metropolises of the developing world (Dupont & Dureau 1996).

The process of metropolisation at work in the two capitals requires the broadening of the spatial framework beyond the administrative limits of the central urban agglomeration. This covers the whole of the metropolitan area: the District of Bogota and seventeen outlying municipalities in the one case, and the Territory of Delhi and a ring made up of six outlying towns in the other. The surveys were carried out in a number of neighbourhoods or zones purposely selected in order to account for the diversity of types of housing and locations of the neighbourhoods, both central and outlying to varying degrees. Eleven zones in Bogota and six in Delhi were included in the study. In neither case can we claim that this sample was representative of the whole of the metropolis; the objective was not to render the entire socio-economic and spatial diversity of the city but to highlight the processes at work and shed some light on the factors influencing them while taking into account the local context.

The socio-demographic surveys in the sample households were carried out using similar questionnaires in the two metropolises.[3] It recorded information on daily home-to-work journeys for each working member of the household. The journey was described in terms of the precise location of the destination, the mode of transport used and the duration of the journey. The characteristics of the daily journeys were complemented by information on residential mobility: the previous place of dwelling and the year of arrival in the current one. The samples analysed here concern working people with a fixed place of work, and included 1,613 individuals in Bogota and 2,183 in Delhi.[4]

In analysing journeys to the workplace this study focuses on the duration of the journey (journey time) rather than the distance covered. Admittedly, the journey time stated by the informant is only an imperfect indicator, which mixes a number of disparate phenomena such as traffic problems, which in some cases can interfere with the analysis. This is also subject to judgement bias, which was revealed on several occasions when comparing the perceived time with the actual time taken (O'Farrel & Markham 1974; Bailly 1979; Kaufmann 2000). However, the duration as perceived by the people making the journeys better reflects their daily commuting experience, considering for example the existence of significant inequalities in access to fast modes of transport in cities of developing countries. By focussing on duration, we come closer to the time budgets introduced in the choices made by households.[5]

Choice and Methods of Statistical Analysis

In the course of the analysis, several of the methodological options, initially chosen to work around technical difficulties, proved to entail more fundamental questions on the logic of the domestic economy—the household functioning as a production unit as well as a residential unit at the same time—as opposed to that of the job market and its location. The difficulties encountered, and the choices made, required some reflection: we had to question whether it was correct to apply the usual statistical models since the unusual characteristics of the distribution of the 'journey time' variable might be the cause of uncertain or contradictory conclusions.[6]

This distribution reveals three unusual characteristics. The first is the informants' tendency to round off figures when stating journey times, which appears more prevalent in the case of longer trips. In other words, the precise value in minutes of the duration to be analysed is an artefact. It therefore seemed to us to be more realistic to split these measurements up into blocks of ten minutes. The second unusual characteristic of this distribution lies in its truncated nature. There are no negative times and zero duration does not represent an actual journey. The third unusual characteristic, a corollary of the previous characteristic, concerns the significant relative weight of working people who stated that they did not travel to work: in Bogota this category of zero duration is the highest occurring frequency. This situation is not specific to the two metropolises studied. The presence of home-based workers is universal and found as much in most market economy societies as in societies where the family economy plays a considerable role. This statistical 'anomaly' in the distribution of commuting times, which does however describe a common and decisive practice, is rarely taken into account in the available statistical models of the duration of home-to-work journeys. This omission can probably be partially explained by the absence of simple and immediate solutions, something that we faced directly.

Different statistical processing was tested: a simple comparison of means and variances, applying ordinal logistic model and duration models. The tests carried out confirm that these processing methods are unsatisfactory.[7] The most obvious obstacle to the application of these statistical procedures lies in the atypical distribution of the journey times and in the failure to respect the hypotheses required for the application of the regression or variance analysis models. At this stage, any analysis is faced with a dilemma: either consider all working people, in the knowledge that not respecting the hypotheses runs

the risk of leading to erroneous conclusions in determining commuting times; or include only those workers who have to travel to the workplace, while acknowledging that selecting this category is not a random but an endogenous process, which represents another risk of analytical bias.

The solution to this problem lies in the association of two equations (one for selecting the individuals included in the analysis and the other corresponding to the phenomenon being analysed), which is the method proposed by Heckman (1979). Since this solution solves both the theoretical and the statistical problem, we opted for it. The first equation models inclusion into the group of workers working outside the home. The second equation, conditional on the first, models the duration of actual journeys made from home to workplaces, which is situated outside the home. Rather than working out the best prediction of journey times we chose to test progressively certain hypotheses on the strategies of individuals and families regarding the respective locations of the workplace and the home. Throughout our construction of this two-equation model, our choices were also influenced by the desire to make a comparative analysis of the two metropolises: we used similar variables and categories and introduced the variables in an identical order.

As the results, presented later, show, a different configuration of the factors in each of the two processes considered in the model is at work. One kind of logic is family-based; the other is related to the market economy, or in many cases salaried employment. Workers may be included in the sphere of domestic activity for two reasons. Firstly, because the domestic tasks of reproduction are carried out by some of its members (in particular women), who as a result are not able to participate in other activities for financial gain; additionally, the household may mobilise workers from outside the home, who may be unpaid, for this non-commercial production. Secondly, members of the household are involved in producing goods and services for the market in the home, in cases where the family labour force is appropriate or where the means of production are on the house premises.

Despite the relevance of the distinction between work within and outside the home, and more generally of the heuristic qualities of the model presented here, it remains partially unspecified, even though it includes the usual range of individual and household characteristics. Part of this lack of specification is due to statistical noise or secondary effects which are difficult to model (reporting errors, detours caused by the flow of the transport network, a mixture

of reasons for commuting, etc.). Nevertheless, this lack of specification is also a sign of an unobserved heterogeneity, and it is not possible to know at what level of analysis this plays a part. A last important unusual characteristic of the analysis of home-to-work commuting behaviour is to associate the characteristics observed at various aggregation levels: individual, household and neighbourhood. The statistical solution currently used[8] takes into account the non-independence of the observations within the same household or neighbourhood. Nevertheless, we acknowledge the necessity of subsequently constructing mixed or multilevel models in order to bring out the specific effect of the different contextual characteristics (of the household and neighbourhood).

Working at Home: A Specific Logic

Does working at home obey its own logic, partly distinct from the logic which determines the duration of the journey? This distinction is not often made when analysing commuting behaviour[9] despite the fact that several authors have stressed the specific nature of this practice and its relevance in any analysis. In their study of the spatial structure of men's and women's home-to-work commuting in the Montreal area, Lemelin and Gatignol (1999: 206) consider working at home to be "a fictitious destination because this situation corresponds to a zero distance and this reflects a behaviour which is distinct from that of people who travel to work, even if this is within their area of residence". Orfeuil (2002) also encourages us to go into more depth when investigating activities practised at home: "there are probably complex choices (much more complex than the naive problem of substitution) between activities carried out at home and activities carried out outside the home, but there remains much work to be done in this field". These are some of the aspects of these choices that the proposed model includes.

Working at home is far from a negligible practice, although it is more widespread in Bogota (27% of working people) than in Delhi (11%). This practice is not exceptional, in either Southern or Northern cities. A study of the disadvantaged populations of Niamey showed that one quarter of the poor working population worked at home, with this proportion increasing to a third of those living in housing estates on the periphery (Diaz Olvera, Plat and Pochet 2000: 336–337). In the working-class settlements of Mexico studied by Salazar Cruz (2002), the practice of women working at home is also a common one that is part of "the optimal use of the time resource". To quote only one example from the industrialised countries, in the Île-de-France region

in around 1991, "for 41% of craftsmen and shopkeepers and 30% of service employees there is a blurred geographical distinction between their homes and their workplaces" (Baccaïni 2002: 126).

This distinction is imperative, but not quite clear. Combining residence and work in the same place in fact encompasses a number of diverse situations, which for the sake of convenience are grouped together here as 'working at home'. It will not always be possible to know whether economic activities have been brought to the place of residence or the household has chosen to live at the workplace. One can find situations as varied as a shop or workshop occupying part of the dwelling in working-class neighbourhoods, an agency or an office set up at home by professionals working in the service sector, sub-contracted manufacturing or assembly activities carried out at home, or the production of dairy products from a domestic farm, as well as domestic employees living with their employers and even cases where a place to sleep is provided in the shop or workshop for some employees or unpaid helpers. The 'home' implied in such a residence-workplace pairing does, therefore, not necessarily correspond to the worker's family unit. Similarly, any form of social relationship during the production process is possible: this could be surviving forms of the domestic economy, as it could be an informal economy or one involving sub-contracting work or wage earners.

Despite this heterogeneity of situations, the proposed model can be used to shed some light on the factors favouring work at home while at the same time contributing to the journey time model. The regression used here involves three categories of factors: socio-demographic characteristics, those of the job and the location of residence—the latter also reflecting, to some extent, the type of housing and the possibilities for accessing places where work is available (Table 1).

Demographic and Social Variables: Domestic Economy Still Present

In the two metropolises, as elsewhere, sex is discriminatory when related to work force participation, but it has a more marked influence in Delhi than in Bogota. According to the 1991 census the female participation rate in the labour force was only 7 per cent in the Territory of Delhi, whereas in Bogota in 1993, 39 per cent of the women were engaged in occupational activities. Furthermore, in the city of Delhi sex has a slightly greater influence on the choice of working at home: the probability of leaving the home to go to work is multiplied by 2.4 in Delhi for men (compared to women) and by 2 for men

Table 1

Working Outside the Home: Selection Model
(Logistic Regression: Odds Ratio)

Variable	Bogota		Delhi	
Sex: Male vs. female		1.9 ***		2.4 ***
Age: under 30 vs. over 30		2.5 ***		0.9
Relationship to household head	*Head of household (reference)*		*Head of household (reference)*	
	Spouse	0.6 ***	Spouse	0.4 ***
	Child, grandchild	2.3 ***	Child, grandchild	0.6 **
	Other relative	2.5 ***	Other relative	0.8
	Unrelated person	0.1 ***	Unrelated person	0.1 ***
Status in employment	*Employer (reference)*		*Employer (reference)*	
	Self-employed	0.3 ***	Self-employed	0.5 **
	Public sector employee	19.1 ***	Public sector employee	70.6 ***
	Private sector employee	8.1 ***	Private sector employee	5.1 ***
	Unpaid helper	0.4 ***	Unpaid helper	0.4 **
	Domestic employee	0.3 ***		
Socio-economic group	*Directors, managers (reference)*		*Manual workers (reference)*	
	Professionals	0.9	Directors	2.0
	Small business owners	0.1 ***	Professionals, management,	
	Small independent producers	0.1 ***	technicians	1.4
	Management, technicians	3.8 **	Clerical workers	22.7 ***
	Employees in administration,		Shopkeepers, sales assistants	0.4 ***
	trade and commerce	3.6 ***	Transport workers	5.9 *

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Table 1 contd...

Variable	Bogota		Delhi	
	Skilled workers	2.6	Farmers, livestock farmers	0.1 ***
	Unskilled workers	1.1	Personal services	0.9
	Domestic employees	0.1 ***		
Location of residence	*Centre (reference)*		*Centre (reference)*	
	Periphery: inner suburbs	1.7 ***	Periphery: inner suburbs	0.4 ***
	Periphery: outer suburbs	2.2 ***	Periphery: outer suburbs	0.3 ***
Selection Model Used				
Sex	Male	1.6 ***	Male	3.0 ***
Relationship to household head	Child	2.2 ***		
	Unrelated person	0.2 ***	Unrelated person	0.03 ***
Status in employment	Self-employed + domestic employees + helpers	0.2 ***	Unpaid workers	0.1 ***
Socio-economic group	Directors + professionals	3.4 ***	Shopkeepers+ farmers	7.7 ***
	Management, technicians + employees + manual workers	6.4 ***	Clerical workers + transport workers	0.5 **
Location of residence	Periphery: inner suburbs	1.7 **	Periphery: inner suburbs	0.4 **
	Periphery: outer suburbs	1.4	Periphery: outer suburbs	0.3 **
	83% of concordant responses		90% of concordant responses	
	Number of cases (working people) 1613		Number of cases (working people) 2183	
	27% of working people based at home		11% of working people based at home	

Note: Significance levels 1%(***), 5%(**), 10%(*)

in Bogota. As far as occupation is concerned, women in Delhi are less emancipated from the home than women in Bogota.

Whereas in Delhi income and age have no influence on the probability of working at home, young people (under 30s) in Bogota go out to work more than their elders do: the probability of working outside the home is multiplied by 2.5. This tendency is confirmed, only in Bogota, by a greater probability of the children of the household head to go outside the parental home to work.

Choices of the residential location of the household result in highly differentiated situations when it comes to the daily mobility of its members, whether the choice is made by the household head or more collectively (Dureau 1999). The differences between the two metropolises are a direct reflection of the difference in family and residential practices operating. In Delhi, all the members of the household are much less likely to work outside the home than the household head: this situation is particularly pronounced in the case of people who are not related to him (domestic employees and other workers who live at their workplace). In Bogota, the same conclusion applies to those not related to the household head, in similar proportions and probably for the same reason. For the majority of them, it is less the choice to work where they live than being obliged to live with the family that employs them. In contrast, with the exception of the spouse, all the other members of the household are 'pushed' into working outside the home (children and other people related to the household head); in other words, they are less often kept there by the household's productive activities.[10] In both cities working household heads' spouses have a higher probability of working at home than the heads. This applies to a considerably greater extent in Delhi, but the situations in the two cities are surprisingly comparable in spite of the differences in the contexts.

Of course, whether an occupational activity is carried out at home is closely dependent on the nature of the activity and the status in employment of the worker. In Bogota, in contrast to salaried employees (more than 90% of whom work outside the home), there are self-employed people, unpaid helpers and domestic employees, two-thirds of whom work at home. In Delhi too, one finds a contrast of a similar kind (although the categories are not exactly comparable). Almost all salaried employees carry on their activity outside the home (all of those in the public sector and 96% of those working in the private sector), whereas 40 per cent of unpaid helpers, 30 per cent of self-employed workers and 18 per cent of employers work at home. In Delhi the status of government employees is more specific (we shall come back to this

point when addressing commuting times). Status in employment is therefore highly discriminatory when it comes to the choice of working in or outside the home in these two metropolises.

Residential Location: Effects Reversed by Urban Structures

To test for a possible effect of residential location, the metropolitan areas of the two capitals were divided into three concentric zones: centre, near periphery (or inner suburbs) and far periphery (or outer suburbs). These account for 3 per cent, 65 per cent and 32 per cent respectively of the sampled working people in Delhi and 34 per cent, 50 per cent and 16 per cent of those in Bogota respectively. It should be remembered at this point that the results presented apply to the neighbourhoods in which the surveys were carried out and not to the whole of the two metropolises. Despite the limitations of sampling, the effects demonstrated still reveal certain residential and economic strategies.

In both Bogota and Delhi, whether the residence is central or outlying has a significant effect on the location of the occupational activity, with the centre contrasting with the two outlying suburban zones. However, in the zones included in the Delhi survey, it is in the centre that the probability of working outside the home is at its highest, while the contrary is the case in Bogota. In Delhi, the proportion of people working at home increases as one moves away from the centre: the probability of working outside the home is three times less likely for those living in the far periphery than for those living in the centre. In Bogota, it is in the distant suburbs that the probability of working at home is the lowest, with the minimum being recorded in the outlying municipality of Madrid (14%). Surrounded by land used for the intensive cultivation of flowers, Madrid provides a large number of paid jobs for unskilled workers—attracting many migrants—and a housing stock made up of very small dwelling units, which are not suitable for carrying out economic activities at home. Enclosed by greenhouses, the town grows by becoming denser, with new dwellings being built within an unchanging perimeter through the subdivision of existing old dwellings and the addition of extra floors. The availability of paid jobs and the constraints of the housing stock combine to make it unlikely that people will carry out a self-employed activity at home. This example can be likened to the case of the central squatter settlement of Nehru Stadium in Delhi. Here too, the small size of the dwellings and the availability of jobs on the neighbouring building sites encourage residents to work outside the home. In addition, like in Madrid, this situation is the result of a residential strategy: the choice of residential location is affected by the local availability of jobs.[11]

The importance of the contextual factors and residential choices is therefore clear, and these are combined with the effect of family models discussed above. Working at home is dependent on a set of constraints (family, occupational, the physical characteristics of the dwelling) and on a choice, linked to the availability or otherwise of a paid job and to families' modes of economic reproduction. Having to go to work outside the home is not down to chance, and neither is it necessarily perceived to be a benefit.

In Conclusion: The Household, a Unit of Social Reproduction and Economic Production

Constructed in order to provide a comparison between Bogota and Delhi, the selection model for work in or outside the home demonstrates the general character of certain effects. Overriding socio-demographic variables such as sex and status of the spouse, plus a fundamental economic variable such as status in employment, have similar effects in the two cities. The differences observed are an expression of the fact that the family plays a more important role in economic rationales and practices in Delhi than it does in Bogota. It confirms also that sex has a greater influence on roles' differentiation in Delhi. As far as the place of residence is concerned, it has the opposite effect, owing to the differences in the urban structures of the two metropolises, but they are expressions of the same logic. The distinction of working at home and the analysis of its influencing factors remind us that the household is not only a residential unit for the family and a unit of social reproduction, but also a unit of economic production.

Duration of Home-to-Work Journeys

Having predicted the probability of choosing to work at home or outside the home, we now focus on analysing the duration of home-to-work journeys. In this model the journey time is conditioned by the preliminary choice of working outside the home.[12]

First observation: the mean duration of home-to-work journeys observed in Bogota is appreciably longer than in Delhi (39 minutes compared with 29 minutes), even though the Bogota sample comprises proportionally more surveyed people from the centre (already discussed). This difference is a reflection of the greater spatial concentration of jobs in Bogota and the fact that they are geographically structured into major specialised corridors. In contrast, in Delhi the distribution of jobs, found in a number of outlying zones,

Table 2

Factors Influencing Commuting Times (stated in blocks of ten minutes) for People Working Outside the Home (Heckman model coefficients)

Variable	Bogota		Delhi	
Model 1	*Constant term (intercept)*	*4.1*	*Constant term (intercept)*	*3.1*
Individual Characteristics				
Model 2: Sex	*Female (intercept)*	*4.2*	*Female (intercept)*	*3.1*
	Male	- 0.1	Male	- 0.1
Model 3: Age	*30 years and over (intercept)*	*4.2*	*30 years and over (intercept)*	*3.2*
	Under 30 years	- 0.0	Under 30 years	- 0.2 *
Model 4:	Controlling for "Age"		Controlling for "Age"	
Relationship with	*Head of household (intercept)*	*4.2*	*Head of household (intercept)*	*3.2*
household head	Spouse	+ 0.1	Spouse	- 0.2
	Child, grandchild	- 0.3	Child, grandchild	+ 0.2
	Other relative	+ 0.4	Other relative	- 0.2
	Unrelated person	+ 1.6 **	Unrelated person	+ 0.2
Model 5:	Controlling for "unrelated person"		Controlling for "Age"	
Status in employment	*Employer (intercept)*	*2.7*	*Employer (intercept)*	*2.1*
	Self-employed	+ 0.7	Self-employed	- 0.3
	Public sector employee	+ 1.2 ***	Public sector employee	+ 1.8 ***
	Private sector employee	+ 1.6 ***	Private sector employee	+ 1.1 ***
	Unpaid helper	+ 2.8 ***	Unpaid helper	- 0.3
	Domestic employee	0.8		

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Table 2 contd...

Variable	Bogota			Delhi		
Model 6:	Controlling for "unrelated person"			Controlling for "Age"		
Socio-economic group	*Small business owners and independent producers (intercept)*	*2.8*		*Small business owners and independent producers (intercept)*	*1.9*	
	Directors, managers, professionals	+0.8	*	Directors, managers, professionals	+1.4	***
	Manual workers	+1.5	**	Manual workers	+1.4	***
	Employees in administration, trade and commerce	+1.7	***	Clerical workers, sales workers	+1.9	***
	Domestic employees	+2.2	***			
Household characteristics	Size of household	+0.2	*	Size of household	-0.0	
	Number of working people	- 0.2	*	Number of working people	-0.0	
	Number of students	+0.2		Number of students	+0.2	
Characteristics of the Dwelling						
Model 7:	*Tenant (intercept)*	*4.1*		*Tenant (intercept)*	*2.7*	
Tenure of dwelling	Owner	- 0.1		Owner	+0.7	***
	Other tenure	+1.4	**	Squatter	-0.4	*
Model 8:	*More than 5 years (intercept)*	*3.8*		*More than 5 years (intercept)*	*3.1*	
Household head's duration of residence in dwelling	5 years or less	+0.7	**	5 years or less	+0.0	
Characteristics of the Residential Zone						
Model 8:	*Centre (intercept)*	*3.4*		*Centre (intercept)*	*2.7*	
Location of residence	Periphery: inner suburbs	1.4	***	Periphery: inner suburbs	+0.6	***
	Periphery: outer suburbs	-0.4		Periphery: outer suburbs	-0.2	
	Distance from centre	+0.0		Distance from centre	-0.0	

Note: Significance levels 1%(***), 5%(**), 10%(*)

favours proximity between the place of dwelling and the workplace. However, in the two metropolises the situations of commuters are extremely heterogeneous, as shown by the coefficients of variation, which in both cases are high and of the same order of magnitude (0.78 and 0.83 respectively). The comparative analysis of the duration of the journeys considers individual demographic variables, characteristics of the economic activity, those of both the household and the dwelling and, finally location (Table 2).

Individual Demographic Characteristics: Role Limited to Domestic Sphere

Sexual discrimination does influence the choice of working at home, to the same extent in the two cities, but it does not influence journey times in any way. In other words, possible variations in journey times[13] are in fact the expression of social roles which favour greater female involvement in activities based in the place of dwelling. This observation for the entire sample does however hide an occasional effect of gender in certain specific situations. For example, home-to-work journeys in an outlying zone of Bogota (Bosa-Soacha) are notably longer for women. Position in the household and type of household also interfere with the specific influence of sex: in Bogota female heads of household are characterised by very long journey times whereas women belonging to 'complete' households (nuclear, extended or complex) spend less time going to work than the male working members of the household (most often their husbands).

Age (recorded in two broad categories[14]) does not have a significant effect on journey times in Bogota, and its effect in Delhi remains marginal. As far as relationship to the household head is concerned, this does not change the time that working people in Delhi spend in commuting to work. However, in Bogota the members of the household not related to the head are penalised by journeys that are 16 minutes longer. Where these are not domestic employees sleeping in their employer's home, these individuals are the 'big losers' when it comes to a choice of place of residence, which favours the related members of the household.

If we compare these initial results with those obtained for the selection model, we find that these individual variables have a less discriminatory effect on the journey time than on the decision to work outside the home. These individual traits (age, sex and relationship to the household head) are expressions of contrasting roles and statuses within the household; they contribute to the way activities are shared between the home and outside. On

the other hand, they have only a marginally discriminatory effect on the distance, expressed in time, between the workplace and the home.

Discriminatory Employment Status in the Two Cities, with Socio-Economic Group Playing a More Important Role in Bogota

In both metropolises, the status of the salaried worker, particularly in the public sector, results in a considerably longer home-to-work journey time: compared to those of employers, the commuting times of public sector employees in Delhi are 18 minutes longer and those of private sector employees 11 minutes longer. In Bogota there is less of a difference for public sector employees: compared to that of employers the journey time is 12 minutes longer for public sector employees and 16 minutes longer for private sector employees. The geographical distribution of residents compared with that of jobs and the specific nature of the public sector and private sector are different in the two capitals. In Delhi a number of housing quarters have been built for government employees in the central zone and its southern extension, and the main public administration buildings are also concentrated in the central zone of the capital (in particular the ministries). However, not all public sector employees live in these government accommodations. A number of them have chosen more outlying neighbourhoods, in particular first-time buyers who consequently live some distance from their workplace. The surveys carried out in Delhi are more of a reflection of the situation of the latter; indeed, although it includes housing quarters for government employees, the sample of selected zones is under-representative of the central zones (only 3% of the working people in the sample) in comparison with the outlying zones.

The government accommodation system that exists in Delhi has no equivalent in Bogota. In the Colombian capital, public and private sector employees are distinguished from the other working people at the same income level essentially in terms of their access to loans, which enable them to acquire housing in categories from which non-salaried workers are excluded.[15] The residential geography of employees is a product of the logic of the real estate market and the associated mechanisms of socio-spatial segregation. Furthermore, salaried employment is more concentrated in the central zone and just around it than other jobs, and this is even more the case for the public sector.

Socio-economic group is partly a reflection of status in employment since it was ascertained using three variables describing the activity carried out: status, branch of industry and occupation. For comparative purposes the

same categories were used in the two cities, with the only difference being the category 'domestic employee', which could not be recorded separately in Delhi (it is included in the socio-economic group of 'manual worker'). In the Indian capital, within the same category of status in employment, occupational category has no statistically significant effect on the journey time. For the categories similar to those in Bogota it is above all the effect of status in employment included in the occupational category that is reproduced, with a distinctive increase in journey times for public sector employees. What stands out particularly in Delhi is the smaller range of differences between socio-economic groups than that observed in Bogota and, more generally, the overriding nature of status in employment over the other characteristics of economic activity. This result shows that socio-spatial segregation operates on a more subtle level in Delhi than in Bogota: in other words, the mixture of socio-economic groups in the different zones makes the socio-economic group variable less discriminatory when it comes to journey times. The social hierarchy does not seem to play such a direct and clear part in daily mobility as it does in Bogota (this is also confirmed by the absence of any clear effect of income on journey times, which was tested in Delhi). In Bogota, the relationship between the hierarchy of socio-economic groups and journey times is very clearly graduated: the further down the social ladder one goes the longer the journey time between the home and the workplace, in proportions which are both considerable and statistically significant. As a result, domestic employees and other casual labourers take on average an extra 21 minutes to go to their workplace than employers and self-employed people (which is almost twice as long as the latter), and 12 minutes longer than managers. Status and qualification result in a hierarchy of commuting time which is a product not only of the marked socio-spatial segregation in Bogota (where income level determines which residential area is accessible) but also of the degree of freedom in the choice of work location (self-employed people, employers and professionals have some flexibility, others do not) and, as far as salaried employees are concerned, of the spatial distribution of their job within the metropolitan area. Residential strategies do exist, even for the poorest people in Bogota (Dureau 2000b), but they operate within the system of constraints discussed above, accentuating the inequality of the socio-economic groups.

In short, it is status in employment rather than occupation that has an effect on residential practices, and which also restricts them. It also permits some flexibility in the location of work, with the better-off categories having the widest choice. Nevertheless, minimising daily journey times is not always

a deciding factor when it comes to residential choices (for example, the desire for better quality of life, even if this implies a very long way from main work places, can be the overriding concern).[16]

No Global Effect of Composition of Household

One must take into account the fact that the choices made within the household between different categories of daily journeys (those made by the working members and those made by students), and also between the different members, may depend on the constraints of the composition of the household and consequently may have a bearing on the journey times. In Delhi none of the four variables characterising the composition of the household—size, presence of students, number of working members and proportion of working members—has any measured effect on this phenomenon. In Bogota journey time increases slightly with an increase in the size of the household,[17] but this is rather to be expected given the complex compromises necessary between the different members.

Property Owners Pay the Price of Longer Journey Times

The duration of residence, in the dwelling and tenure, reflect certain residential choices, which are themselves dependent on the distribution of the segments of the housing stock in the metropolitan area and the fluidity of the land and real estate markets. Residential mobility could, if such were the objective of the household, correspond to moving closer to the workplace. However, some tenure such as ownership contributes to restricting this. Once the choice in favour or working outside the home has been made, the duration of residence in the dwelling (more than 5 years) does not affect the journey times in Delhi, whereas in Bogota people who have recently moved spend an extra 7 minutes travelling to work. The socio-economic rigidity of the urban space in Bogota appears to make it difficult for people to live close to the workplace; on the other hand, better access to the workplace may encourage relative residential stability.

The influence of the tenure of the dwelling is more far-reaching. In Delhi being a property owner (the tenure of the majority, accounting for 60% of cases) results in a significant increase in journey times (+7 minutes) compared to tenants, and even more (+11 minutes) compared to that of squatters. The location choices of the latter are often the result of a strategy of living close to sources of employment opportunities, in particular in industrial zones or near building sites. Despite the ambitious urban planning for the Indian capital,

squatter settlements have emerged in all sectors of the city including central positions, such as the squatter settlement of Nehru Stadium which grew up in the immediate vicinity of a building site. In Bogota, the market has in fact proved more 'effective' in controlling the urban area since it relegates illegal land occupation to the outskirts of the agglomeration. This pushing of the squatter settlements to the outskirts results in longer journey times for the people who live there.[18] On average, they spend 14 minutes longer than tenants on the home-to-work journey.

In Bogota, the respective positions of tenants and property owners are less distinct. Being a property owner is not discriminatory of time spent in commuting when one considers this variable in isolation, however it contributes to lengthening journey times by more than 5 minutes when controlling for the relationship to the household head and socio-economic group. A similar result to that discussed above is found in Delhi. This is an expression of the inevitable compromises between residential mobility and daily mobility, and has been highlighted in other metropolises.[19] Becoming the owner of a property involves choices in which factors such as the cost of the dwelling, its size and level of comfort and the quality of the surroundings have a part to play. All these considerations are likely to take precedence over access to places of work; residential mobility linked to access to property ownership will thus result in longer home-to-work journey times.

Residential Location: Contrasts Created by Urban Structures

In order to test the effect of residential location on daily mobility, the model introduced two measures: on the one hand, the distance from the centre and the division into three concentric zones and, on the other hand, a concordance indicator for the residential and working zone.

Testing the effect of distance between the neighbourhood of residence and the centre shows that this has no influence on home-to-work journey times. On the contrary, this reveals the important role of employment opportunities in the zone, but also suggests that there are inequalities in access to different modes of transport and therefore to different travelling speeds. For people working outside the home accessibility to places of work is of course a factor which determines journey times: the location of productive activities and the transport system determine the map of accessible employment for a certain time-distance from the place of dwelling. From this point of view, the two metropolises provide very different conditions. We have already highlighted the differences in the spatial distribution of housing and economic activities.

As far as modes of transport are concerned, the differences are also considerable. In Bogota the vast majority of the working people in our survey who work outside their home (68%) use public transport (mainly buses) to go to work, with the rest travelling either by private car (13%), two-wheeled vehicle (8%) or on foot (11%). In Delhi by comparison only 37 per cent of the working people in our survey go to work by bus, with walking playing a much more important role (26% of working people), as does two-wheeled transport (16% of working people travel by bicycle and 12% on a scooter or motorcycle). The use of a private car remains a minority form of transport for commuting, with only 8 per cent of the working people using this mode of transport. In both metropolises, it is commuting by bus which involves the longest journey times (an average of 48 minutes in Bogota and 43 in Delhi), and commuting on foot which involves the shortest (8 and 10 minutes respectively), whereas journeys by car take on average 30 minutes in each case. The reason why the fastest modes of transport in terms of speed do not result in the shortest times is because the working people choose their mode of transport depending on the distance to be travelled—at least as far as their financial constraints will allow.

The extent of the inequalities in access to transport in the populations of big Southern metropolises has been observed in a number of studies (Diaz Olvera, Plat and Pochet 1998, 2000; Figueroa, Godard and Henry 1997; Henry 1996): being assigned to live in outlying zones, their lack of access to urban facilities and restrictions of spatial mobility are concomitant factors of social immobility. The situation in the different neighbourhoods included in our survey in Bogota offers a striking illustration of this: the people living in the illegal outlying zones (Bosa, Soacha) spend on average 30 minutes longer on transport to reach their workplace than those living in the centre, in particular the affluent population of El Nogal who are in the most favourable position. However, they are not the only residents whose journey time is twice as long as those living in the central neighbourhood of La Perseverancia: they share this unenviable situation with the residents of another central neighbourhood, La Candelaria. When it comes to transport to the workplace, just as in the case of housing, precariousness is not limited to those living in outlying zones. Poverty is more visible in the periphery, in the form of hectares of illegal urban development, but it is also present in the slum dwellings in the historical centre (*inquilinatos*).

By introducing the variable 'Working in the neighbourhood of residence', we get a better idea of residential strategies in connection with the location of

employment opportunities. In Bogota, as expected, working in the same neighbourhood as one lives cuts the journey time in half. It is also to be closer to the workplace that affluent families have moved to El Nogal, which is near a major business district, and that migrants prefer the municipality of Madrid where they can work for the floriculture industry in the western municipalities. If one compares each residential location in Bogota with a central neighbourhood (La Perseverancia), the furthest outlying zones are not necessarily penalised: it is the working people living in the inner suburbs, not the outer suburbs, that spend the longest on their daily journeys to the workplace (on average 14 minutes longer per journey than those living in the central zone). The distance to the centre does not have an automatically proportional effect on home-to-work journey times: if one considers that the fact of working or not working in one's neighbourhood is an indication of the extent to which there are jobs available locally, the result is that those who have to leave their neighbourhood to go to work are faced with longer journeys. Being away from the centre becomes a handicap for those who cannot find work locally, but at the same time people living in some far outlying zones have shorter journeys because of the availability of local employment opportunities.

A similar set of interactions is at work in Delhi. Only living in the inner suburbs implies longer journey times, and the difference is not great: journeys here are on average 6 minutes longer than those of people living in the central zone. If the covariates 'socio-economic group' and 'tenure' are controlled in the model and kept constant, this effect disappears and it is residential location in the outer suburbs that has a significant effect, with journeys being 6 minutes shorter than those made by people living in the central zone. This shows the favourable effect of locally available employment in the outer suburbs, which in this case is the result of a deliberate policy of creating new towns equipped with major industrial zones: a policy of decentralisation and land use planning which contributes to providing local jobs for the population residing there. Since it includes the new industrial town of Noida, our survey clearly reflects this phenomenon. In the metropolitan area of Delhi, as elsewhere, living away from the centre results in a wide variety of situations when it comes to home-to-work journeys. In Noida for example, alongside those who have found work locally (71% of people working outside the home), live people who make long centripetal journeys to the workplace. The situation of these commuting workers serves as a reminder of a risk well known in France: when employment becomes scarcer in the new towns their distance from the main city core—initially a deliberate aim of planners—quickly contributes to

their depreciation. In contrast, in the neighbourhood of Nehru Stadium the fact of being located in Delhi's central zone goes hand in hand with a clear reduction in journey times. For city centre's squatters (who make up the vast majority of those living in this survey zone), settling near sources of employment does however result in high residential insecurity, with a real risk being involved, as shown by the destruction of this squatter settlement in May 2000.

For working people compelled to daily mobility, sex, age and relationship to the household head are therefore less important than the variables that take into account the nature of occupational integration and the spatial distribution of jobs outside the home. The first variables are above all a reflection of the different roles within the household (where choices are made between the sexes for example), and the second variables are an expression of the positions established by those involved in the market economy or working in the public sector. The distinction between two different kinds of logic at work, identified previously by examining work at home, is confirmed. As for individual socio-economic differentiation, this has an effect through the social discrimination of different areas, particularly in Bogota.

Conclusions

This study brings out several original conclusions. Some owe to the comparative perspective between two metropolitan areas that are very different in terms of the way work is organised within the family and in terms of the scale of social discrimination in the urban space. Others have been inspired by the statistical requirements of analysing journey times, the atypical distribution of which has revealed practices that are common but nevertheless absent from the models usually proposed. These have resulted in the construction of a model made up of two simultaneous equations distinguishing the factors determining the location of work inside or outside the dwelling from those affecting the home-to-work journey times of people who work outside the home.

Certain characteristics that are usually associated with time spent in commuting actually operate at the household level, in which the members opt for the 'domestic' work or the job market. From this point of view, Delhi and Bogota present peculiarities, which reveal the contrast between these two forms of economic organisation. The duality between the spheres of domestic activity and commercial activity has been confirmed by the analysis of the mere journey times, on which the characteristics expressing the family roles have little

impact. It is status in employment that appears to be decisive here, reflecting the location and spatial concentration of employment (that of salaried employees and, in Delhi, above all, of public sector employees), and the extent to which working people have a choice in where they work.

Beyond the logic of the family and the market, a third component plays a part. This is the scale of socio-economic discrimination in the metropolitan area, which is an expression of the logic specific to each city and the way it is laid out. The socio-economic differentiation of the population in Delhi is geographically subtler than it is in Bogota, and implies that it is easier to live closer to the workplace. This can be seen as a result of a type of urban development, which despite all planning efforts is eventually more tolerant and less segregative than the liberal attitude prevailing in Bogota. In any case, the specific expression of this is the less restricting effect that belonging to a given socio-economic group has on the home-to-work journey time. Whether the result of town and country planning policy or economic development, the emergence of outlying centres of employment has a similar effect. As a result, some inhabitants who live a long way from the centre and who find a job locally spend relatively less time travelling to work. This serves as a reminder that moving closer to the workplace can be one motive, among other considerations, for centrifugal residential mobility.

Considering the analytical value of distinguishing between working at home and outside the home, it would be profitable to repeat this exercise in other metropolitan situations, including Northern metropolises, where in the same way the inhabitants are faced with the same choice. Another promising research approach for improving our understanding of daily mobility practices is to introduce multilevel analysis in the model of two simultaneous equations that was tested here. Such a solution would enable us to provide a more rigorous analysis of the specific effect of each contextual characteristic (of the household or neighbourhood) on top of the effect of the individual variables.

Notes

1 See inter alia: Baccaïni (1997, 2002), Orfeuil (1995), Berger and Beaucire (2002); Pochet and Routhier (2002).

2 In the early 1990s Colombia, with a population of 34 million, was already largely urban, with more than 70 per cent of the population living in towns and cities. In contrast, India was still profoundly rural: in 1991 only 26 per cent of its population of 844 million lived in towns and cities.

3 A detailed presentation of the methodology used in the surveys can be found in Dureau and Florez (1999) and Dupont and Prakash (1999).

4 Weighting factors were applied when processing data.

5 See in particular Zahavi's law (1980) of "constancy of transport times" in cities in developed countries, despite urban spread that increases distances.

6 In their appraisal of studies measuring the effect of family status on the distances travelled between the home and the workplace, Thomas and Villeneuve (1998) stress the divergent character of the published results.

7 The method of using an ordinal scale of duration and including the zero value came up against the problem of inconstancy of the coefficients for each ranked category. As far as the duration models were concerned, they only allowed the positive values to be taken into account, thereby excluding those working at home; their application conditions were not fulfilled.

8 Calculating robust estimators for the equation for the journey times of individuals working outside the home.

9 Those who work at home are often assigned a zero commuting distance and included in the same analysis model as those working outside the home (Baccaïni 2002), or put together with the other workers who work in the municipality where they live (Berger & Beaucire 2002).

10 This result for Bogota confirms the findings of Salazar Cruz (2002) in the working-class neighbourhoods of Mexico: it is working daughters who have the greatest daily mobility and working wives who have the least mobility.

11 Details of the Madrid case are given in Dureau (2000a: 86–88) and those of the squatter settlement of Nehru Stadium can be found in Dupont and Sidhu (2000: 175–178).

12 The equation used to make this selection (comments about its logit form were presented earlier) was introduced in its probit form in each model of the duration of journeys from the home to the workplace.

13 Calculated from the raw data on duration, which includes the 'zero duration' of people working at home.

14 The relationship between age and duration of commuting is not linear, and furthermore variance is inconstant. We therefore decided to split age into two categories: under and over 30 years, the pivotal age of working life.

15 The only exception appears to be military staff, but because it was not possible to include military residential quarters in the survey, this situation is not represented in our sample.

16 For Bogota see Dureau (1999 and 2000b), and for Delhi see Dupont and Sidhu (2000).

17 This effect is still visible after individual variables (relationship to the household head and socio-economic group) have been introduced.

18 In the 'other' category in the questionnaire, if one excludes home-based workers living with their employer, the remaining people are mostly squatters.

19 See the case of Paris and Ile-de-France in Berger and Beaucire (2002) or Baccaïni (2002), and cases of African cities in Godard (2002).

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