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Home-working, Telecommuting and Journey to Workplaces: Are Differences among Genders and Professions Varying in Space?

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Abstract

The aim of this paper is to assess differences on home-based working and telecommuting behaviour among genders and professions considering age groups, household statuses, car access location within the city and travel distances. The analysis is based on a sample of more than 30,000 workers responding to the 2001 origin-destination survey data in Quebec Metropolitan Area. Main findings indicate a gender effect intertwined with professional status; an anisotropic effect related to the actual locations of both home and workplace; and, that older workers are more likely to telecommute than younger ones, with the exception of lone parents which are seeking for more flexibility. Those findings are in line with previous work and indicate that furthering our understanding of telecommuting implies integration of several dimensions of person's working conditions and socio-economic status.

Keywords: telecommuting, home-based work, commuting distances, gender differences, professional status, teleworking, binomial logistic modeling.

1. Introduction

The aim of this paper is to assess differences on home-based working and telecommuting behaviour among genders and professions considering age groups, household statuses, car access and travel distances. The analysis is based on a sample of more than 30,000 workers responding to the 2001 origin-destination (OD) survey data in the Quebec Metropolitan Area (QMA), Canada, a mid-size agglomeration, the 7th of the country by its population. Moreover, this paper puts specific emphasis on linking differences in telecommuting to specific locations of the respondent's workplace in the city.

For the purpose of this study, teleworking is defined as working at home rather than the regular workplace for at least one day per period of two weeks. Following definitions of Choo *et al.* (2005), this includes various types of teleworkers: (1) salaried employees of an organization,

generally called telecommuters, (2) primary home-based business workers, and (3) people working at home without any other regular workplace, called home workers. It is near to impossible to distinguish between categories 1 and 2 using the 2001 OD survey for QMA; they are therefore agglomerated for the purpose of this research. Moreover, people working on the road without fixed location are excluded from this study.

Telecommuting has long been identified as a strategy for reducing travel time and cost, road congestion, energy consumption, and air pollution. Following previous work, Mokhtarian & Varma (1998) have established the benefits of telecommuting for individuals, mainly in terms of reduced vehicle-miles travelled. However, the likelihood of long-term aggregated system-wide impacts of teleworking seems less obvious, mainly in regard to the small amounts of telecommuting occurring today in North-American cities. In a recent research based on a longitudinal (10 years) survey of 218 California State employees, Mokhtarian *et al.* (2004) find that one-way commute distances were higher for telecommuters, that average telecommuting behaviour was lowering over time, but that quarterly total commute distances were lower for telecommuters that for non-telecommuters. It is therefore difficult to assess the real impact and/or motivation of telecommuting. Employees' motivations for teleworking are unclear (Bailey & Kurland, 2002), as well as the effect of work-related factors like managers' willingness to promote its generalization (concerns about cost and control). Is it related to job satisfaction and productivity? Is it related to family constrains? Is it a way for reducing inconvenience of long trips for younger families which want to access home ownership and should go farther away on the outskirts? Is it a threat for productivity? Those are questions of paramount importance for understanding socio-economic mechanisms behind this developing phenomenon (and reluctance to promote it) in order to assess its potential impact on reducing travel demand. According to Yen (2000), telecommuting is considered the most promising substitute of work trips, eventually providing a good strategy for reducing transportation demand. However, using it for designing public policies implies a better understanding of this emerging behaviour and of its socio-economic foundations, differentiating large, mid-size and small cities, because their traffic constrains are very different. This research wishes to contribute at improving knowledge on telecommuting for QMA.

This paper is structured as follows. Section 2 makes some references to previous work in order to clarify some definitions used for this study and to specify our research hypotheses. Section 3

presents the specific methodology of the QMA 2001 OD survey, gives some indication of the prevalence of telecommuting in that region and describes operational attributes retained in order to model the propensity for telecommuting. Section 4 presents results and discusses our main findings. Finally, Section 5 concludes the paper, putting emphasis on future work.

2. Previous work and hypotheses

To the best of our knowledge, the most recent literature reviews of telework research were published by Shin *et al.* (2000) and Bailey & Kurland (2002). The practice of telecommuting was developing in North-America during the last quarter of the 20th century. It has been lauded in many different ways: decreasing real-estate costs for organizations, improving quality of life for workers, facilitating work-family balance, reducing air pollution and traffic congestion. At the end of 20th century, there were more than 11 million telecommuters in the U.S. (Bailey & Kurland, 2002). Telecommuting is often defined as working outside of the conventional workplace and communicating with it by way of telecommunication or computer-based networks, including wireless devices. This has several implications on business management (especially supervision of employees) and it presage important changes in labour organization.

However, defining teleworking is not an easy task. One has to distinguish self-employed business owners and contractors from full-fledged employees. This leads to fussiness related to various intermediate states, thus to demographic characteristics of teleworkers differing largely among studies, probably also in line with peculiarities in survey methods and in the various ways questions are asked (Pratt, 2000). Olszewski and Mokhtarian (1994) report a large proportion of mid-level professionals in their study involving State of California's employees. In the U.S., Bailey and Kurland (2002) report on differences linked to gender: full-time employees who telecommute are more likely to be male, slightly younger and making higher income, while part-time employees which are teleworking, are doing that more informally, being predominantly female, older, and earning less. Several previous studies suggest that job suitability is certainly of paramount importance to establish who is likely to telecommute. However, job suitability must be complemented by status and power that are intertwined with occupation types and freedom of planning tasks. In the literature, both professional and clerical positions are deemed suitable. However, clerical workers having less control over their time schedule, they may encounter greater difficulties to convince their supervisors of its appropriateness.

With a population of roughly 683,000 inhabitants (2001 Canadian Census), the Quebec Metropolitan Area covers 3,154 square kilometres and is namely characterized by an extensive road network which greatly facilitates motorized movements and prevents most congestion problems. By 2000, the average household income stood at 50,230 Can. $ (58,630 $ for Canada as a whole) while per capita income stood at 27,939 $ (29,769 $). Its work force is mainly devoted to retail business, services, government, administration, education, insurance and health care. Having few manufacturing activities, it is likely the kind of urban agglomeration where telecommuting could develop rapidly.

Following previous findings in the literature, this research aims at testing the following hypotheses for QMA:

(H1) Occupying less power-oriented jobs in larger proportions, women are less likely to telework than men.

(H2) Younger people are more likely to adopt this new behaviour.

(H3) Professional status of workers is of paramount importance in their ability/willingness to telecommute.

(H4) Actual location of the workplace (type of neighbourhood) plays a role on the proportion of teleworkers.

(H5) Remote home location increases the likeliness of telecommuting.

3. Methodology

From September 18th to December 17th of 2001, the Ministry of Transport of Quebec (MTQ) and the Quebec City Transit Authority (RTC) were conducting a large OD survey in the QMA. It was involving 68,121 persons (about 8% of total population) living in 27,839 households and reporting 174,243 trips they made to reach activity places during a typical week day (Monday to Friday). Each household has its home located on a 1:20,000 map using street addresses. Each person belongs to a specific household and is characterized by his/her age, gender, occupation (worker, student, retired, unemployed, etc.), and ownership of transportation resources: car, driver license, bus pass. An original programming done by the authors was used in order to assign a role to each member of every household: *lone adult*, *child* (less than 16 years or less than 21 years and still at school), *adult living in couple* (husband, wife, father and mother), and *adult living in multiple adults households*. Each workplace was located with methods

yielding accuracy of spatial references at a very precise geographical scale (either identifying the specific building or the city block).

In the QMA, trips using private cars (as driver or passenger) predominates over other transportation means (73.3% using cars, 13.2% using various bus systems, 11.4% walking, 1.7% others). Moreover, with a highway network totalling 21.7 kilometres per 100,000 inhabitants, the QMA is certainly among the most over-equipped cities of North-America, a factor explaining the high dominance of car travel.

Among the 68,121 persons responding the 2001 O-D survey, 32,455 were workers (part-time and full-time – students are excluded even if they hold a part-time job). Of them, 30,084 were reporting a specific workplace (2,371 are without fixed workplace), 952 of them being home-based workers (about 3.3% of workforce). Every worker was asked to disclose the frequency of home-working and telecommuting he/she was experiencing during the preceding weeks. Answers were later aggregated into six categories: never working at home (88.4% of respondents), working at home about 1 day per two weeks (4.9%), 1 day per week (1.6%), 2 or 3 days per week (1.2%), and 4 days or more per week (0.6%). Each worker was asked to describe his/her type of job in his/her own terms. These job descriptors were later aggregated to categories forming a hierarchy of decreasing power and control of duties and scheduling. Some of them are distinguishing groups of occupations with similar level of authority. They are: (1) heads of hierarchy (managers; owners; self-employed persons), (2) supervisors and professionals (foremen; professors; doctors; dentists; lawyers; engineers; other professionals), (3) highly qualified employees (technicians; accountants; etc.), (4) unskilled employees (office clerks; administration employees; etc.); (5) qualified workers (plumbers, electricians, etc.); (6) unskilled workers (manoeuvres; blue-collars; salespersons; etc.), and (7) other workers (e.g. militaries). Persons were qualified according to their specific role within their household: lone persons, spouses (husbands/wives), lone parents, and other adults living in a multiple adults or in a multi-generational household. The number of cars per household was asked during the OD survey. Finally, each workplace was assigned to a neighbourhood (called "arrondissement") using a point-in-polygon relationship.

Cross-tables relating each attribute of workers and the six categories of home work were built and a Chi-Square statistics was computed in order to test for the significance of dual relationships. Table 1 relates frequency of home work to genders (14,838 men; 14,326 women). Table 2 is considering monthly bus pass holders (6% of workers have one). Table 3 shows distribution of driver license holders (95.1% of workers hold it). Table 4 shows relationship with

the age of respondents (6.6% are 15 to 24 years old; 18.5% are between 25 and 34; 32.7% from 35 to 44; 17.2% are 45 to 49; 15.1% from 50 to 54; 9.3% are 55 to 64; 0.7% are 65 years old and more). It is clearly an aging workforce were baby-boomers dominate. Table 5 reports on the professional categories listed above. Table 6 is considering role within the household (9.2% lone persons; 62.7% spouses – men and women; 3.1% lone parents; 25.0% other adults). Table 7 distributes workers according to workplace neighbourhoods.

Building contingency tables can be useful to explore relationship. However, to test the actual significance of links, one has to control for concomitant relationships. This can be done using multivariate regression techniques that can assess the marginal effect of one attribute while taking constant the effect of co-factors. For this study, we decided to build binomial logistic model of the probability of doing some teleworking. The dependent variable contrasts the peoples having a regular workplace and working at home on an irregular basis (1 day per 2 weeks, 1 day per week, 2, 3 or 4 days a week) from those who do not work at home. For the purpose of these models (Tables 9 & 10), only those 30,018 workers having a fixed workplace are considered.

Results and discussion

Telecommuting patterns show significant relationships with gender (Table 1 – higher proportion of females are working entirely at home; higher proportion of males are occasionally working at home – telecommuting), ownership of bus pass (Table 2 – people working at home are not willing to buy it), drivers license (Table 3 – car drivers are telecommuting in somewhat larger proportions), and age (Table 4 – younger workers seldom work at home and the proportion of telecommuters increases with age – about 16% among the 55-64 years old and 27% among the elderly).

Relationships with professional statuses (Table 5) show that proportion of telecommuters is strongly related to qualifications and decisional status of the person, yielding higher levels of telecommuting for managers, self-employed persons, professors and lawyers than for office clerks, technicians and non-qualified workers. This last relationship is very strong suggesting that job empowerment (especially ability to control time schedule and to put priorities on duties) is of paramount importance for the development of telecommuting. However, having higher family constraints, lone parents are seeking more flexibility on their work agenda (Table 6): 12% are

experiencing some level of teleworking on top of 3% of them which are home-workers. Again, the difference appears more significant among male than among female workers, suggesting a better control of the first group on their work schedule.

Table 1 Frequency of home work by gender (Quebec CMA, 2001)

Gender		Frequency of home work						Total
		Never	1 day per 2 weeks	1 day per week	2 or 3 days per week	4 days + per week	Working at home	
Men	Count	13062	803	271	175	93	434	14838
	% Men	88.0%	5.4%	1.8%	1.2%	.6%	2.9%	100.0%
Woman	Count	12718	616	208	173	93	518	14326
	% Women	88.8%	4.3%	1.5%	1.2%	.6%	3.6%	100.0%
Total	Count	25780	1419	479	348	186	952	29164
	% Total	88.4%	4.9%	1.6%	1.2%	.6%	3.3%	100.0%

Pearson Chi-Square 35.9 (p: 0.000)

Table 2 Frequency of home work according to bus pass ownership (Quebec CMA, 2001)

Bus Pass Holder		Frequency of home work						Total
		Never	1 day per 2 weeks	1 day per week	2 or 3 days per week	4 days + per week	Working at home	
No	Count	24162	1340	465	329	178	938	27412
	% No pass	88.1%	4.9%	1.7%	1.2%	.6%	3.4%	100.0%
Yes	Count	1618	79	14	19	8	14	1752
	% Holders	92.4%	4.5%	.8%	1.1%	.5%	.8%	100.0%
Total	Count	25780	1419	479	348	186	952	29164
	% Total	88.4%	4.9%	1.6%	1.2%	.6%	3.3%	100.0%

Pearson Chi-Square 47.7 (p: 0.000)

Table 3 Frequency of home work according to driver license ownership (Quebec CMA, 2001)

Driver license		Frequency of home work						Total
		Never	1 day per 2 weeks	1 day per week	2 or 3 days per week	4 days + per week	Working at home	
Yes	Count	24486	1383	465	334	180	898	27746
	% Drivers	88.3%	5.0%	1.7%	1.2%	.6%	3.2%	100.0%
No	Count	1293	36	14	14	6	54	1417
	% Non drv.	91.2%	2.5%	1.0%	1.0%	.4%	3.8%	100.0%
Total	Count	25779	1419	479	348	186	952	29163
	% Total	88.4%	4.9%	1.6%	1.2%	.6%	3.3%	100.0%

Pearson Chi-Square 24.7 (p: 0.000)

Table 4 Frequency of home work according to age (Quebec CMA, 2001)

Age group		Frequency of home work						Total
		Never	1 day per 2 weeks	1 day per week	2 or 3 days per week	4 days + per week	Working at home	
15 to 24	Count	1850	26	13	10	4	17	1920
	% 15-24	96.4%	1.4%	.7%	.5%	.2%	.9%	100.0%
25 to 34	Count	4849	234	80	55	28	144	5390
	% 25-34	90.0%	4.3%	1.5%	1.0%	.5%	2.7%	100.0%
35 to 44	Count	8358	512	166	109	59	300	9504
	% 35-44	87.9%	5.4%	1.7%	1.1%	.6%	3.2%	100.0%
45 to 49	Count	4434	282	74	49	32	158	5029
	% 45-49	88.2%	5.6%	1.5%	1.0%	.6%	3.1%	100.0%
50 to 54	Count	3844	228	91	74	35	130	4402
	% 50-54	87.3%	5.2%	2.1%	1.7%	.8%	3.0%	100.0%
55 to 64	Count	2302	131	52	44	25	168	2722
	% 55-64	84.6%	4.8%	1.9%	1.6%	.9%	6.2%	100.0%
65 +	Count	143	6	3	7	3	35	197
	% 65+	72.6%	3.0%	1.5%	3.6%	1.5%	17.8%	100.0%
Total	Count	25780	1419	479	348	186	952	29164
	% Total	88.4%	4.9%	1.6%	1.2%	.6%	3.3%	100.0%

Pearson Chi-Square 395.9 (p: 0.000)

Table 5 Frequency of home work according to professional status (Quebec CMA, 2001)

Professional status		Frequency of home work						Total
		Never	1 day per 2 weeks	1 day per week	2 or 3 days per week	4 days + per week	Working at home	
Manager	Count	1225	169	42	25	9	24	1494
	% Managers	82.0%	11.3%	2.8%	1.7%	.6%	1.6%	100.0%
Owner/Self-employed	Count	333	43	20	13	9	79	497
	% Owners	67.0%	8.7%	4.0%	2.6%	1.8%	15.9%	100.0%
Foreman	Count	1079	63	15	14	3	19	1193
	% Foremen	90.4%	5.3%	1.3%	1.2%	.3%	1.6%	100.0%
Professor	Count	724	125	117	80	51	5	1102
	% Professors	65.7%	11.3%	10.6%	7.3%	4.6%	.5%	100.0%
Doctor/Dentist	Count	326	33	9	4	1	6	379
	% Doctors	86.0%	8.7%	2.4%	1.1%	.3%	1.6%	100.0%
Lawyer	Count	132	36	9	9	1	5	192
	% Lawyers	68.8%	18.8%	4.7%	4.7%	.5%	2.6%	100.0%
Engineer	Count	329	40	6	3	2	6	386
	% Engineers	85.2%	10.4%	1.6%	.8%	.5%	1.6%	100.0%
Other professional	Count	2818	468	110	96	48	165	3705
	% Professionals	76.1%	12.6%	3.0%	2.6%	1.3%	4.5%	100.0%
Technician	Count	1753	68	10	11		15	1857
	% Technicians	94.4%	3.7%	.5%	.6%		.8%	100.0%
Accountant	Count	344	36	12	3	2	33	430
	% Accountants	80.0%	8.4%	2.8%	.7%	.5%	7.7%	100.0%
Other qual. employees	Count	6062	213	64	42	22	211	6614
	% Qualif. emp.	91.7%	3.2%	1.0%	.6%	.3%	3.2%	100.0%
Unskilled employees	Count	6240	81	35	27	25	189	6597
	% N-q. emp.	94.6%	1.2%	.5%	.4%	.4%	2.9%	100.0%
Qualified workers	Count	1483	7	10	4	3	51	1558
	% Qualif. wrk.	95.2%	.4%	.6%	.3%	.2%	3.3%	100.0%
Unskilled workers	Count	1438	5	4	2	4	10	1463
	% N.q. – wrk	98.3%	.3%	.3%	.1%	.3%	.7%	100.0%
Other workers	Count	1488	32	16	15	6	134	1691
	% Others	88.0%	1.9%	.9%	.9%	.4%	7.9%	100.0%
Total	Count	25774	1419	479	348	186	952	29158
	% Total	88.4%	4.9%	1.6%	1.2%	.6%	3.3%	100.0%

Pearson Chi-Square 3567.3 (p: 0.000)

Table 6 Frequency of home work according to role in the household (Quebec CMA, 2001)

Role in the household		Frequency of House work						Total
		Never	1 day per 2 weeks	1 day per week	2 or 3 days per week	4 days + per week	Working at home	
Lone person	Count	2344	122	47	31	23	108	2675
	% Lone persons	87.6%	4.6%	1.8%	1.2%	.9%	4.0%	100.0%
Husband/Wife	Count	16038	981	308	236	110	609	18282
	% Spouse	87.7%	5.4%	1.7%	1.3%	.6%	3.3%	100.0%
Lone parent	Count	781	77	14	10	6	32	920
	% Lone parents	84.9%	8.4%	1.5%	1.1%	.7%	3.5%	100.0%
Other person	Count	6617	239	110	71	47	203	7287
	% Others	90.8%	3.3%	1.5%	1.0%	.6%	2.8%	100.0%
Total	Count	25780	1419	479	348	186	952	29164
	% Total	88.4%	4.9%	1.6%	1.2%	.6%	3.3%	100.0%

Pearson Chi-Square 96.6 (p: 0.000)

Table 7 Frequency of home work according to place of work (Quebec CMA, 2001)

Neighbourhood		Frequency of House work						Total
		Never	1 day per 2 weeks	1 day per week	2 or 3 days per week	4 days + per week	Working at home	
Rural Area	Count	1618	51	23	17	7	143	1859
	% Rural Areas	87.0%	2.7%	1.2%	.9%	.4%	7.7%	100.0%
La Cité	Count	6636	487	122	90	40	119	7494
	% La Cité	88.6%	6.5%	1.6%	1.2%	.5%	1.6%	100.0%
Les Rivières	Count	4521	207	62	47	12	67	4916
	% Les Rivières	92.0%	4.2%	1.3%	1.0%	.2%	1.4%	100.0%
Sainte-Foy - Sillery	Count	4530	321	118	79	37	115	5200
	% SFS	87.1%	6.2%	2.3%	1.5%	.7%	2.2%	100.0%
Charlesbourg	Count	1214	68	24	13	18	86	1423
	% Charlesbourg	85.3%	4.8%	1.7%	.9%	1.3%	6.0%	100.0%
Beauport	Count	1501	47	29	17	16	62	1672
	% Beauport	89.8%	2.8%	1.7%	1.0%	1.0%	3.7%	100.0%
Limoilou	Count	1480	63	28	23	14	60	1668
	% Limoilou	88.7%	3.8%	1.7%	1.4%	.8%	3.6%	100.0%
Haute-Saint-Charles	Count	535	24	5	11	7	64	646
	% HSC	82.8%	3.7%	.8%	1.7%	1.1%	9.9%	100.0%
Laurentien	Count	1414	47	27	13	15	132	1648
	% Laurentien	85.8%	2.9%	1.6%	.8%	.9%	8.0%	100.0%
C.-Chaudière-Ouest	Count	349	12	1	3	2	43	410
	% CCO	85.1%	2.9%	.2%	.7%	.5%	10.5%	100.0%
C.-Chaudière-Est	Count	766	34	17	11	7	26	861
	% CCE	89.0%	3.9%	2.0%	1.3%	.8%	3.0%	100.0%
Desjardins	Count	1216	58	23	24	11	35	1367
	% Desjardins	89.0%	4.2%	1.7%	1.8%	.8%	2.6%	100.0%
Total	Count	25780	1419	479	348	186	952	29164
	% Total	88.4%	4.9%	1.6%	1.2%	.6%	3.3%	100.0%

Pearson Chi-Square 766.0 (p: 0.000)

Table 8 Frequency of home work according to availability of car (Quebec CMA, 2001)

Car Availability		Frequency of House work						Total
		Never	1 day per 2 weeks	1 day per week	2 or 3 days per week	4 days + per week	Working at home	
No Car	Count	1172	36	15	13	10	62	1308
	% No car	89.6%	2.8%	1.1%	1.0%	.8%	4.7%	100,0%
One car	Count	10075	560	191	139	80	406	11451
	% One car	88.0%	4.9%	1.7%	1.2%	.7%	3.5%	100,0%
Two cars +	Count	14533	823	273	196	96	484	16405
	% Two cars +	88.6%	5.0%	1.7%	1.2%	.6%	3.0%	100,0%
Total	Count	25780	1419	479	348	186	952	29164
	% Total	88.4%	4.9%	1.6%	1.2%	.6%	3.3%	100,0%

Pearson Chi-Square 33.9 (p: 0.000)

Significant differences appear also when considering workplace locations within the city (Table 7). People working near the city centre (La Cité and Sainte-Foy-Sillery) are more willing than others to consider telecommuting. People working in the suburban (Haute-Saint-Charles, Laurentien, Chutes-de-la-Chaudière East and West) and rural areas show higher levels of home-based working. Finally, car availability (at the household level) impacts positively on telecommuting (Table 8); home-based work being more prevalent for people living in non-motorized household.

Table 9 Logistic Binomial Model of Telecommuting (Quebec CMA, 2001)

INDEPENDENT VARIABLES	B	S.E.	Wald	df	Sig.	Exp(B)
GENDER Woman versus Man	-.245	.047	26.774	1	.000	.782
AGE (Ref. 15 to 24)			21.008	6	.002	
25 to 34	.463	.156	8.807	1	.003	1.590
35 to 44	.611	.152	16.150	1	.000	1.842
45 to 49	.546	.155	12.431	1	.000	1.726
50 to 54	.622	.155	16.174	1	.000	1.862
55 to 64	.566	.161	12.272	1	.000	1.760
65 and older	.512	.292	3.065	1	.080	1.668
ROLE IN THE HOUSEHOLD (Ref. : Lone person)			19.757	3	.000	
Husband / wife	-.027	.086	.100	1	.752	.973
Lone parent	.278	.133	4.331	1	.037	1.320
Other person	-.233	.099	5.580	1	.018	.792
DRIVER LICENSE Yes versus No	.166	.145	1.308	1	.253	1.180
BUS PASS HOLDER Yes versus No	-.149	.107	1.950	1	.163	.861
AVAILABILITY OF CAR (Ref. : No car)			5.248	2	.072	
One Car	.260	.146	3.144	1	.076	1.296
Two cars or more	.335	.155	4.665	1	.031	1.398
PROFESSIONAL STATUS (Ref. : Manager)			1636.912	14	.000	
Owner / self-employed	.141	.140	1.006	1	.316	1.151
Foreman	-.741	.129	33.209	1	.000	.476
Professor	1.071	.097	121.071	1	.000	2.920
Doctor / Dentist	-.301	.173	3.053	1	.081	.740
Lawyer	.675	.176	14.642	1	.000	1.964
Engineer	-.295	.167	3.110	1	.078	.745
Other professional	.210	.083	6.477	1	.011	1.234
Technician	-1.309	.130	101.154	1	.000	.270
Accountant	-.225	.164	1.893	1	.169	.798
Other qualified employee	-1.170	.092	163.525	1	.000	.310
Unskilled employee	-1.862	.107	305.069	1	.000	.155
Qualified worker	-2.451	.218	126.387	1	.000	.086
Unskilled worker	-2.802	.268	109.666	1	.000	.061
Other worker	-1.383	.143	93.440	1	.000	.251
LOCATION OF WORK PLACE (Ref. : Rural Areas)			30.643	11	.001	
La Cité Neighbourhood (Québec Old Centre / Old suburbs)	.451	.122	13.576	1	.000	1.570
Les Rivières Neighbourhood (New suburbs / Sh opping centres)	.315	.128	6.101	1	.014	1.370
Sainte-Foy – Sillery (Business district / Old suburbs)	.471	.124	14.341	1	.000	1.601
Charlesbourg (Old suburbs / New suburbs)	.383	.150	6.508	1	.011	1.467
Beauport (Old suburbs / New suburbs)	.215	.153	1.970	1	.160	1.240
Limoilou (Old suburbs)	.392	.150	6.854	1	.009	1.480
Haute-Saint-Charles (New suburbs / Urban Fringe)	.317	.196	2.618	1	.106	1.373
Laurentien (New suburbs / Urban fringe)	.144	.155	.862	1	.353	1.155
Chutes-de-la-Chaudière-Ouest (New Suburbs / Urban fringe)	-.258	.274	.889	1	.346	.772
Chutes-de-la-Chaudière-Est (New suburbs)	.309	.175	3.128	1	.077	1.362
Desjardins (Old suburbs)	.296	.153	3.736	1	.053	1.345
EUCLIDEAN DISTANCE FROM HOME TO WORK (Km)	.011	.004	6.247	1	.012	1.011
EUCLIDEAN DISTANCE OF HOME FROM CENTRAL AXIS (Km)	-.009	.005	3.356	1	.067	.991
CONSTANT	-2.738	.248	122.110	1	.000	.065

Dependent variable: Having a non-home fixed workplace and working at home at least 1 day per 2 weeks
Nagelkerke R Square: 0.17 (p: 0.000) – 75% of cases are well classified considering a cut point at 0.1

Table 10 Logistic Binomial Model of Telecommuting - Gender interaction (Quebec CMA, 2001)

INDEPENDENT VARIABLES	B	S.E.	Wald	df	Sig.	Exp(B)
GENDER Woman versus Man	-.479	.149	10.340	1	.001	.619
AGE (Ref. 15 to 24)			25.611	6	.000	
25 to 34	.497	.153	10.552	1	.001	1.644
35 to 44	.648	.149	18.898	1	.000	1.912
45 to 49	.600	.152	15.590	1	.000	1.822
50 to 54	.682	.152	20.190	1	.000	1.977
55 to 64	.632	.158	15.966	1	.000	1.882
65 and older	.652	.281	5.380	1	.020	1.920
ROLE IN THE HOUSEHOLD (Ref. : Lone person)			19.435	3	.000	
Husband / wife	-.042	.084	.249	1	.617	.959
Lone parent	.271	.131	4.285	1	.038	1.312
Other person	-.233	.096	5.861	1	.015	.792
DRIVER LICENSE Yes versus No	.147	.144	1.043	1	.307	1.158
BUS PASS HOLDER Yes versus No	-.108	.106	1.035	1	.309	.898
AVAILABILITY OF CAR (Ref. : No car)			5.396	2	.067	
One Car	.276	.145	3.630	1	.057	1.318
Two cars or more	.343	.153	5.019	1	.025	1.409
PROFESSIONAL STATUS (Ref. : Manager)			860.483	14	.000	
Owner / self-employed	-.298	.168	3.126	1	.077	.742
Foreman	-1.200	.171	49.060	1	.000	.301
Professor	.923	.130	50.526	1	.000	2.517
Doctor / Dentist	-.372	.217	2.937	1	.087	.690
Lawyer	.441	.229	3.698	1	.054	1.554
Engineer	-.407	.171	5.653	1	.017	.666
Other professional	.103	.097	1.128	1	.288	1.109
Technician	-1.303	.157	68.656	1	.000	.272
Accountant	-.399	.254	2.468	1	.116	.671
Other qualified employee	-1.110	.121	84.845	1	.000	.330
Unskilled employee	-1.722	.126	187.445	1	.000	.179
Qualified worker	-2.983	.264	127.292	1	.000	.051
Unskilled worker	-3.241	.314	106.643	1	.000	.039
Other worker	-1.564	.172	82.882	1	.000	.209
PROFESSIONAL STATUS * WOMAN (Ref. : Manager)			67.308	14	.000	
Owner / self-employed	1.014	.293	11.970	1	.001	2.756
Forewoman	.968	.258	14.119	1	.000	2.632
Professor	.230	.197	1.368	1	.242	1.259
Doctor / Dentist	.097	.340	.081	1	.776	1.102
Lawyer	.708	.353	4.012	1	.045	2.030
Engineer	-.221	.636	.121	1	.728	.801
Other professional	.327	.171	3.676	1	.055	1.387
Technician	.034	.268	.016	1	.900	1.034
Accountant	.312	.337	.858	1	.354	1.366
Other qualified employee	-.001	.187	.000	1	.994	.999
Unskilled employee	-.165	.213	.605	1	.437	.848
Qualified worker	2.132	.427	24.981	1	.000	8.436
Unskilled worker	1.395	.564	6.112	1	.013	4.036
Other worker	.268	.294	.832	1	.362	1.308
EUCLIDEAN DISTANCE FROM HOME TO WORK (Km)	.007	.004	3.679	1	.055	1.007
EUCLIDEAN DISTANCE OF HOME FROM CENTRAL AXIS (Km)	-.012	.004	7.663	1	.006	.989
CONSTANT	-2.269	.222	104.678	1	.000	.103

Dependent variable: Having a non-home fixed workplace and working at home at least 1 day per 2 weeks
Nagelkerke R Square: 0.169 (p: 0.000) – 74.5% of cases are well classified considering a cut point at 0.1

Table 9 presents a logistic binomial model of the propensity to telecommute. Dependent variable is binary: 1 for workers having a fixed workplace and working at home at least one day per period of two weeks; 0 for any other worker. Independent variables are related to personal attributes (gender, age, role in the household), access to transportation resources (driver license, bus pass, cars held by the household), professional status, location of workplace, distances from home to work and to central axis in the agglomeration (from Old Quebec to Laurier Shopping

Centre). Non-significant relationships are filled in grey. The significant relationships with access to transportation resources found in Tables 2, 3 and 8 disappear when considering locations, distances and professional statuses. Therefore, we may conclude that access to transportation means is not instrumental in the decision to telecommute, and that dual relationships comes from structural effects (e.g. households in remote areas are motorised; most highly qualified workers do have a driver license, etc.).

Significant relationships hold with gender (ceteris paribus and in line with H1, women are far less likely to telecommute than men, meaning that there is gender effect on top of professional status), age (younger workers, 15 to 24 years old, are far less prone than others to telecommute; telecommuting is more prevalent among older workers – H2 is then rejected), household status (lone parents are more likely to commute than lone persons; married persons do not differ from lone persons; workers living in multiple adults households are far less likely to telecommute). Professional status is certainly the most important attribute that should be used to model propensity to telecommute (Wald statistic is 1636 with 14 degrees of freedom). To ease comparison among professions, the reference is put on managers (16.4% of them are telecommuting – Table 5). Having to control other employees, foremen are twice less likely to telework (odds ratio is .476). Among the highly qualified professionals, professors and lawyers are the best candidates for telecommuting; odds are respectively at 2.9 and 1.9. Powerless categories of employees (technicians, unskilled employees, qualified and unskilled workers) are far less likely to telecommute, their odds ratios are drastically decreasing when lowering their level of education. Except for some peculiarities linked to the specific nature of duties, the relationship with empowerment seems instrumental, thus strongly supporting H3.

Location of work places has a significant effect. The reference is put on rural areas. Odds of adopting telecommuting are higher when workplace is close to the city centre. New suburbs and agglomeration outskirts do significantly differ from rural areas in their proportions of teleworkers. This decreasing gradient of telecommuting when going apart from city centre is in line with H4. Finally, increasing Euclidean distance between home and workplace imply higher proportion of telecommuters (probability increases at a rhythm of nearly 1% for each Km of distance). However, distance between home and central axis of the agglomeration do has exactly the reverse effect, in clear contradiction with H5. Nevertheless, the odds ratio of this last distance

is probably underestimated because it is multi-colinear with location of workplaces (most of them being on the central axis) and distance from home to work.

Model of Table 10 was set to handle this multi-collinearity issue while considering a possible cross-effect of gender and professional status. When controlling for professional statuses of women, effect of gender is amplified (odds ratio of .619 for women/men) and remains significant. However, some peculiarities of women duties in the labour market appear (self-employed women are more prone to adopt telecommuting behaviour when their male counterpart do not; forewomen behave very differently than foremen (2.632 versus 0.301); the same comment apply for professors (there is no significant differences among gender among this group). More important is the inversion of odds ratios for qualified and unqualified workers. Women of those powerless categories are far more willing than their male colleagues for considering telecommuting (Odds ratios at more than 4). It seems that the relationships postulated by H3 and H1 still hold, but are far more complex than preliminary expectations. That is congruent with previous findings of Bailey & Kurland (2002, p. 386): "Olson & Primps (1984) report that clerical workers lost full-time permanent status, medical benefits, and vacation when they converted to telework, and their already low autonomy became further restricted. Professionals in that study, by contrast, were offered teleworking arrangements more in line with a job enrichment perspective, such that their autonomy, already high, expanded by working at home."

Removing workplace neighbourhoods help clarify the actual role of distance (Table 10). Telecommuting is increasing with distance between home and regular workplace, but at a rhythm that is lower than in the previous model; however, it is decreasing quickly as home is farther from the central axis of the agglomeration. That seems to indicate an anisotropic spatial relationship within the agglomeration that may well be related with directional effects (lateral trips versus journeys directed towards city centre) on actual journeys to work already found by Vandersmissen *et al.* (2003) for this same region. Peculiarities of the actual motorway network may be responsible for such an effect. Does it hold for other cites of that size?

Conclusion and research perspectives

Preliminary results indicate that modelling telecommuting is not a simple task. At the individual level, one has to consider specific conditions involved in the negotiation between an employee,

his/her supervisor and his/her employer. However, this study demonstrates that large OD surveys can yield interesting results at a city-wide level. Both models are highly significant, most coefficients are in line with expectations.

For this particular research, we were testing five hypotheses:

(H1) *Occupying less power-oriented jobs in larger proportions, women are less likely to telework than men* is partly supported by empirical data. However the relationship is not so simple because, ceteris paribus, less empowered women are teleworking more than their male colleagues. Is it their choice or an indication of degradation on their working conditions?

(H2) *Younger people are more likely to adopt this new behaviour* is absolutely not supported by the facts and is rejected. In QMA, trends indicates that older workers are working at home in larger proportions.

(H3) *Professional status of workers is of paramount importance in their ability/willingness to telecommute* is supported by facts, but should be interpreted with due care because it includes a gender effect, it is closely related by the exact nature of duties and empowerment, as well as to the will of organisations to favour this kind of labour relationship.

(H4) *Actual location of the workplace (type of neighbourhood) plays a role on the proportion of teleworkers* is supported by empirical results. Even for a low-congestion agglomeration like QMA, it seems that centrally located workplaces increase the propensity to adopt telecommuting behaviour. Because our models are controlling for professional status, it seems reasonable to conclude that the marginal effect of this location factor is rooted in reality. However findings of Table 10 indicate that the odds are affected by a directional effect. Further research is needed in order to clarify the meaning of this finding.

(H5) *Remote home location increases the likeliness of telecommuting* is absolutely not supported by empirical investigation; the gradient in the proportion of telecommuter is decreasing when distance of home from city centre is increasing.

Due to peculiarities of data, this study has some limitations. Firstly, we do not have indication of the level of income of workers. Secondly, full-time and part-time employment regime should be

distinguished; that will be done in a later step. Thirdly, Euclidean distances could be replaced by road distances or travel time; we expect that using more precise assessment will provide better understanding of directional bias, eventually leading to an experiment similar to that of Vandersmissen *et al.* (2003). Fourthly, taking into consideration the identification of the employer can improve the analytical capacities of our model; we have this information for a sample of workers in our database. Finally, the exact nature of the question about telecommuting should be improved, in line with recommendations of Joanne Pratt (2000) in order to enhance results for future OD surveys within QMA.

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