Modeling the Mobility Decision of Small and Medium Size Firms in Urban Areas: An Application to the City of Hamilton, Ontario

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1 INTRODUCTION

The concern about sustainable planning of cities over the past few decades has generated a considerable volume of empirical literature on the emerging urban form and its causes. Earlier efforts to assess the urban development process were based on building and using aggregate urban land use models. These simulation tools are based on zonal socio-economic data and have been used to address policies that relate to the planning process of cities. However, due to their aggregate nature, most of these models have been criticized for lacking the behavioral realism in imitating the complexities of the city development process (Miller et al., 2004). Recent thinking during the past decade and a half calls for the adoption of a micro-analytical approach, whereby change in urban form is driven by the collective behavior of individual actors (persons, households, firms, developers, etc.) and their location decisions. Therefore, the total process of urban development is decomposed into subprocesses and within these the main actors (agents) and their decision behavior is identified and analyzed (Wegener and Spiekermann, 1996).

In accordance with the latter paradigm, we focus our attention on analyzing processes that drive the evolution of business establishments in the urban context. Our overall objective is to devise an agent-based microsimulation model that can be used to study and assess the interplay between the local economy and urban form with an application to the City of Hamilton in Ontario, Canada.

We adopt the firm demographic approach to investigate the causes that lead to establishment failure, formation, mobility, location choice and growth/decline. In this paper we focus on the mobility behavior of business establishments. We specify and estimate

multinomial logit models by economic sector to predict the probability of staying, moving within the city (relocating) or leaving the city (out-migrating). We attempt to fill the gap in the literature by studying the establishment mobility behavior in the City of Hamilton. The modeling framework we provide can serve as a prototype for similar studies in other cities.

Here is a brief description of the remainder of this paper. In the next section we provide a theoretical background to overview the location theories and factors influencing business establishment mobility. Section three describes the city of Hamilton and the dataset used in the analysis. Section four discusses the formulation and specification of the discrete choice model we use to study the mobility behavior of business establishments by economic sector. Section five presents the estimation results. Finally, the last section provides a conclusion and direction for future research.

2 THEORETICAL BACKGROUND

The mobility of business establishments is one of the basic firmographic processes that influence the spatial distribution of economic activities and employment in the city. It is defined as the action of leaving the current location to relocate elsewhere in or outside of the city. The analysis of establishment mobility aims to understand the underlying factors that push establishments to leave their current location. According to Bade (1983), establishments have a strong preference to remain in situ and will only move in situations of high locational pressure caused by location deficiencies. Wissen (2000) notes that location deficiencies (push factors) may arise as a result of changing market orientation, space requirements, technological change, location costs, accessibility problems, local policy and labor market mismatch. Such factors are also highlighted elsewhere in the literature (See for example Brouwer et al. 2004, Dijk and Pellenbarg, 2000)

The migration process of business establishments is the outcome of two subprocesses that includes the mobility of establishments (relocation) and the location choice problem. While some studies have addressed the latter problem in the urban context, little has been done to analyze establishment mobility at this geographical scale, as indicated by the absence of empirical studies on the topic. Our review to the literature also indicates a shortage of recent empirical studies to analyze establishment mobility at the regional level. According to Pellenbarg et al. (2002), firm migration research received more interest from policy

makers rather than scientists. The need to solve practical planning problems or stimulate economic and employment growth was the main driving force for such an interest. Pellenbarg et al. (2002) conduct a historical review of firm relocation studies. They note that the majority of empirical studies took place during the 1970s, since firm migration was perceived as a panacea for regional development during that time. However, the idea that regions should create the conditions for innovation and creation of new economic activities that will retain firms in the region has changed this perception. Research in recent years was geared toward the issue of sustained economic growth, where migration from the firm's perspective is considered a locational strategy for removing restrictions to growth. The key point here is that firm relocation studies are rare in general and are not well addressed in the urban context in particular.

Brouwer et al. (2004) among others note that business establishment mobility has been explained via three types of factors that include: (1) firm internal factors such as the establishment size and age, (2) firm external factors such as market size and (3) location factors such as characteristics of regions. These factors are the outcome of employing three location theories that include: the neo-classical theory, the behavioral theory and the institutional theory. Dijk and Pellenbarg (2000) and Pellenbarg et al. (2002) provide a critical review of these theories. Following these reviews, we will shed light on the main themes underlining each theory in the discussion to follow.

The neo-classical location theory treats the firm as a profit maximizer and classifies sites into profitable and unprofitable locations. The classification is based on the difference between a least-cost surface and a revenue surface. The former can be derived from aggregating surfaces generated by (1) the transportation cost of industry inputs and outputs (2) labor cost and (3) market size. In this setting, one can define the boundaries of the spatial margins to profitability. These boundaries can then be used to model the relocation decision of firms under the assumptions of rationality and perfect information. Here, a firm moves from the current location to a new one when the first is no longer inside the spatial margins to profitability (i.e. revenue is less than cost) and the second might be profitable (i.e. revenue exceeds cost).

While the neo-classical theory sets a useful benchmark in defining the optimal behavior of firms in economic terms, it discards the internal dynamics of the firm. This limitation led to the development of a

behavioral theory that is based on the more realistic notion of limited information and bounded rationality. Accordingly, the firm is treated as an agent and its optimizing behavior is replaced with one that is satisfycing. The behavioral theory treats the firm as a decision maker by focusing on the decision making process of entrepreneurs. Here, the perception of geographic configuration is what people use in their spatial decision-making. Accordingly, limited information, limited ability, perception and uncertainty all lead to a large spatial bias in relocation decision-making. Also, the theory assumes that most of the moves take place at short distances because closer locations are more familiar and easier to imagine than distant locations. Pellenbarg et al. (2002) note that push reasons leading to firm mobility can be related to both firm internal and external factors. Internal factors are related to the size and age of the firm. The need for more floorspace to expand, given the change in size, can push the firm to relocate. Also, age of the firm can explain the mobility behavior in cases when the current location of older firms is not attractive any more. On the other hand, external factors may include limited accessibility to site, deterioration of the building, environmental considerations, limited labor supply or high location cost.

The institutional location theory, or what is known as the "geography of enterprise", assumes that the society's cultural institutions and value systems are the driving forces of any economic activity. The firm is viewed as an interacting entity that has to negotiate with various institutions (suppliers, governments, unions, etc.) to guarantee the endurance of its economic activity. Therefore, locational behavior is influenced by the outcome of the investments the firm has made through its negotiations. While the institutional location theory is best suited for large corporations that have more negotiating power, it can have an impact on the relocation of small and medium size (SME) firms. According to Pellenbarg et al. (2002), governments and real estate markets are two institutions that can impact the mobility behavior of SME firms. While the former can be more influential in the regional context through regulating subsidies, tax reduction and environmental standards, the later plays a critical role in the urban context. The intra-urban migration behavior of SME firms is influenced by the demand for commercial property and its spatial characteristics. Therefore, the change in supply of real estate via the development of commercial and industrial floorspace, office space or industrial sites can pull firms and encourage them to relocate.

The three theories highlighted above provide a solid background for studying the mobility behavior of firms. However, we believe that the behavioral theory can be the most influential when developing agent-based firmographic models. The agent-based approach assumes that the business establishment is the decision maker and therefore its mobility behavior is more likely to be dependent on its internal characteristics. Yet, other locational and external factors may interfere and can exert an influence on the mobility decision. Therefore, external and location factors remain important determinants and should not be dismissed from the analysis.

3 STUDY AREA AND DATA

3.1 Study Area

The city of Hamilton in Ontario Canada is the focus of our study. The city is located approximately 60 Km southwest of Toronto and has evolved around the southwest harbor of lake Ontario. The Niagara escarpment separates the city into a lower coastal area between the escarpment and the harbor to the north and a highland beyond the escarpment to the south. While early urban development took place on the lower city, the continuous population and economic growth over time led to urban development above the escarpment. Recently, the city was amalgamated with the municipalities of Ancaster, Dundas, Flamborough, Glanbrook and Stoney Creek.

The city's population is 504,513, as reported in the 2001 Canadian census. According to the Statistics Canada Business Register, the city had around 12,000 business establishments and 223,000 jobs in 2002.

3.2 Data

We study the mobility behavior of the 1996 small and medium (SME) size business establishments with less than 200 employees. Unlike large establishments, SME account for the majority (99%) of the establishment population in Hamilton and are believed to be more footloose due to the lower cost required for their infrastructure. The data on SME establishments is extracted from Statistics Canada Business Register (BR). The sample is constrained to the 1996 self-owned non-incorporated (NIP) SME businesses since we aim to model the annual mobility behavior in the devised model and such information is only available for this group of establishments in the BR. General statistics from exploring the BR data reveal that NIP establishments accounted for 86% of the SME establishments in 1996. The exploration also suggests

that 79% of SME establishments had employment size less than or equal to 10, 93% of which are NIP establishments. Accordingly, the NIP population is deemed appropriate for our objectives since it accounts for the majority of the SME establishments. However, the absence of the incorporated (IP) establishments from the extracted sample will undermine our knowledge of what role organizational structure has on the mobility behavior of establishments.

4 THE MOBILITY MODEL

4.1 Model formulation

The model we seek to develop will be used to determine if an individual business will choose to stay at its current location, relocate to a different place within the city or will leave the city between 1996 and 1997. We use random utility theory to model the mobility behavior of business establishments. In this respect, the utility U_{ij} of a given alternative j for an individual establishment i can be expressed as a composite of a systematic utility V_{ij} and a random error term ε_{ij}

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

If we know that the systematic part of the utility is a linear-in-parameters function that can be measured with observed information and we make the assumption that the unobserved random errors are independent and identically distributed (IID) as Gumbel, then one can show that the probability of choosing alternative j over any of the other available alternatives can be expressed as:

$$P_{ij} = \frac{\exp(V_{ij})}{\sum_{j=1}^{J} \exp(V_{ij})} \tag{2}$$

The probability in equation 2 is the well-known conditional multinomial logit (CMNL) model. The assumption of an IID structure for the random error terms in equation 1 gives rise to the independence from irrelevant alternatives (IIA) property in equation 2. Under this property, business establishments are assumed to perceive the stay, relocate and leave alternatives as unique choices such that each is evaluated independently from the other. This assumption is deemed valid since intra-urban and inter-regional mobility of establishments occurs for different reasons despite the fact that both actions suggest a departure from the current location. Therefore, the IID assumption holds in our

context and equation 2 can be used to model the three outcomes: {*Stay*, *relocate* and *leave*}.

4.2 Model specification

The specification of the stay, relocate and leave systematic utilities of the CMNL model in equation 2 is based on the available data that were extracted from the Business Register (BR). We follow the theoretical framework discussed in section 2 to devise covariates that reflect internal characteristics of the establishments as well as location factors. Table 1 lists the covariates used in the specification of the stay (S), relocate (R) and leave (L) utilities of the logit formula. Internal factors include establishment size, age, growth rate and economic sectors. Location factors, on the other hand, consist of a number of categorical variables that reflect the morphology of the city. We also use local competition as a measure of location pressure. This variable is combined with a variable measuring the distance between the old location of the establishment in 1996 and its new one in 1997. Finally, we use a variable that measures the level of geographical clustering of business establishments to account for the effect of agglomeration economies.

With regard to the size of the establishment (*Size96*), we expect that small establishments can move more easily to a new location than large establishments. Dijk and Pellenbarg (2000), note that employment size can be used to capture the effect of moving cost of the establishment. They argue that the cost of moving for small establishments is expected to be much lower than for large establishments. This suggests that as size increase the propensity of mobility will decrease. However, they also argue that this might not always be the case since small establishments tend to pay market rent, whereas medium sized and large establishments may be able to negotiate discounts for large sites or are subject to governmental incentives such as subsidies. This suggests that while large establishments may have higher relocation cost in absolute terms; this cost might be lower in relative terms. To control for this effect, we introduce the Size96 squared covariate in the model. The size variables are specified in the utility functions of the relocate and leave outcomes.

The log of the age (*Log(Age)*) variable is used to examine the hypothesis that older establishments have a higher inertia compared to young establishments. As noted by Maoh (2005), young establishments are more susceptible to failure and face more stress compared to old establishments. Therefore, they are expected to have a higher mobility rate in an attempt to adjust to changes in the local market. However, the

Table 1: Variables used in the specification of the logit models

Variable	Description
Size96	Employment size of business establishment *i* in the year 1996
$Size96^2$	Employment size of business establishment *i* in year 1996 squared
Log(Age)	Log of establishment's *i* age
Growth	Employment growth rate defines as (Size97 - Size96)/ 0.5*(Size97 + Size96)
$Industry_k$	1 if business establishment i belongs to economic sector with SIC code k, 0 otherwise
Suburbs	1 if business establishment *i* is located in any of the outer municipalities that includes: Dundas, Ancaster, Stoney Creek, Flamborough or Glanbrook, 0 otherwise
LHAM	1 if business establishment *i* is located below the escarpment excluding the CBD, 0 otherwise
UHAM	1 if business establishment *i* is located above the escarpment, 0 otherwise
LC	Local competition defined as ratio of the total number of employees of establishments in the same k 2-digit industry of establishment *i* to the number of employees of establishment *i*. Total number of employees is measures from all business establishments of sector k within a 1500 meter radius around establishment *i*
D_{od}	Euclidean distance between the 1996 location *o* of a relocating establishment *i* and its new 1997 location *d*. This is used to define the variable $DLC = D_{od}/LC$ as in Table 2
Agglo	Total number of establishments in the same k 2-digit industry of establishment *i* within a 1500 meters radius around establishment *i*

adjustment and the ability to penetrate the market are not commonplace among new establishments. Baldwin et al. (1997) assert that over half the new Canadian firms that failed in the first decade of their life fail within the first two years of operation. Older establishments, on the other hand, have overcome the market adjustment phase and already succeeded in penetrating the local market. As time passes, they are able to distinguish their products and services and thus gain control over the market. The variable *Log(Age)* is expected to retain a negative sign, when specified in the utility function of the relocate and leave outcomes.

Growth is introduced in the model to examine if the change in establishment size induces mobility. Dijk and Pellenbarg (2000) argue that the need to move to another location is related to the growth pattern of the firm over time. Wissen (2000) empirically quantifies this relation and finds that growth increases the probability of moving. A counter argument might be that growth increases the propensity of inertia. Here, growth can be a manifestation of success for small establishments that are able to grow and accommodate few employees without the need to relocate. Therefore, it is hard to determine a priori the effect of growth on mobility for SME establishments. Following Wissen (2000), we devise the growth variable as shown in Table 1 and introduce it in the utility function of the relocate and leave outcomes.

The final set of firm internal factors is presented by a number of sectoral dummies that reflect the type of industry at the 2nd and 3rd digit of the SIC codes. The dummies were introduced to distinguish between the mobile and inert industries. They are also used to control for the heterogeneity in the mobility behavior of establishments. For brevity, details on the dummies are not presented in Tables 1 and 2.

Location factors are introduced in the model to identify which parts of the city are more at risk of changing their location attractiveness. We divide the city into four geographic areas that are categorized by the following dummies: (1) Central Business District (*CBD*), (2) land below the escarpment (*lower Hamilton*), (3) land above the escarpment (*upper Hamilton*) and (4) outer municipalities (*suburbs*). The CBD dummy, which equals 1 if the establishment is located in the CBD and 0 otherwise, is dropped from the final specification of the model since the *suburbs* variable is used instead. Both variables complement each other when specified individually in the utility function of the relocate

outcome. However, the *suburbs* variable is deemed more appropriate for the specification of the model since it provides a better model fit.

Other things being equal, the variable *Agglomeration* is used to examine if the benefits attained from agglomeration economies increase the probability of inertia. The positive relation between agglomeration economies and the success of business establishments is well documented in the literature. Therefore, the clustering of business establishments is expected to reduce location stress and increase the propensity of staying at the same location. Our agglomeration variable is based on counting the number of establishments within 1500 meters from business establishment *i*. The count only includes establishments with the same 2-digit industrial sector as establishment *i*. We experimented with counts of establishments within different distance values that ranged between 500 and 3000 meters. Our analysis suggested that agglomeration based on 1500 meters radius produces the most significant results. Agglomeration is used as an alternative specific variable in the utility function of the stay outcome.

The composite variable (D_{od}/LC) is introduced in the model to test the hypothesis set forth by Bade (1983) regarding the relation between locational pressure and the propensity of mobility. He argued that mobility could only take place under high locational pressure that arises from locational deficiencies. In the urban context, local competition or the market power effect can be thought of as a major locational deficiency that will push the establishment to move long distance. The variable D_{od}/LC measures the additional distance of relocation for every unit increase in local competition. The variable is specified in the utility function of the relocate outcome and is expected to increase the propensity of relocation. Following Lerman and Liu (1984), local competition exerted on establishment *i* is defined as the ratio of employment of establishment's *i* rivals to the employment of establishment *i*. Rivals are establishments with the same 2-digit industry as establishment *i* that are located within a radius of 1500 meters from establishment *i*. The value of 1500 meters is based on experimentation with different values, as in the case of the agglomeration variable.

5 ESTIMATION RESULTS

We estimated equation 2 to model establishment mobility by economic sector as shown in Table 2. The size parameter in the different models suggests that as the size of the establishment increases the propensity of moving decreases. However, the size-squared parameter

Table 2: Estimation results of multinomial logit models

		M		C		C&T		W		R		S	
Variable	Utility*	*Beta*	*t-stats*	*Beta*	*t-stats*	*Beta*	*t-stats*	*Beta*	*t-stats*	*Beta*	*t-stats*	*Beta*	*t-stats*
Constant	R	1.38	3.13	2.09	4.85	1.91	2.58	1.64	3.08	1.48	4.02	2.08	13.95
Size96	R, L	-0.08	-2.43	-0.57	-5.47	-0.33	-1.10	-0.33	-3.53	-0.22	-5.12	-0.04	-3.98
Size96^2***	R, L	0.34	1.71	7.25	3.94	1.34	0.38	2.87	2.46	2.21	4.06	0.16	3.85
Log(Age)	R, L	-1.49	-7.86	-1.09	-6.98	-0.94	-2.72	-0.82	-3.72	-1.19	-8.37	-0.89	-14.90
*Growth***	R, L	0.78	1.82	-0.11	-0.30	-2.15	-1.12	-0.83	-1.66	-0.43	-1.43	-0.08	-0.63
Suburbs	R	-1.77	-3.45	-3.52	-6.66	-3.02	-3.03	-2.05	-3.35	-4.46	-7.15	-2.40	-12.36
LHAM	S	2.15	3.61	1.16	2.70	1.08	1.43	1.43	2.69	2.46	6.95	1.85	11.45
UHAM	S	1.82	3.53	1.81	4.26	4.11	2.32	3.51	3.24	2.79	6.88	2.05	11.68
*DLC****	R	0.88	4.47	18.39	7.59	20.84	4.29	3.31	4.20	44.52	8.38	1.74	7.68
Agglo	S	0.03	1.53	0.04	3.90	0.07	1.50	0.07	2.58	0.04	5.71	0.01	11.74
No. Obs		541		1057		254		440		1188		3990	
L(0)		-594.344		-1161.233		-279.048		-483.389		-1305.151		-4383.463	
L(B)		-140.656		-226.021		-52.902		-113.964		-296.177		-1338.486	
Pseudo ρ^2		0.763		0.805		0.810		0.764		0.773		0.695	

Key:

M = Manufacturing; C = Construction; C&T = Communication and Transportation; W = Wholesale trade; R = Retail trade; S = Services

* Utility: S = Stay; R = Relocate; L = Leave; ** Growth in the manufacturing model is specified for only the relocate utility; *** Values of parameters are in thousands

implies a non-linear relationship between size and mobility. The results suggest that, other things being equal, mobility in our sample is more prominent among very small and very large establishments. This relation is evident for all types of establishments except for communication and transportation establishments. These findings coincide with the arguments made by Dijk and Pellenbarg (2000) about the effect of establishment size on mobility.

The models suggest that mobility decreases with age. Wissen (2000) and Brouwer et al. (2004) reported similar results about the effect of age on mobility. In our view, the result from the age parameter is a reflection of the life cycle of the establishment. We believe that young establishments perceive mobility as a strategy that will enable them to acquire a niche in the local market. Therefore, relocation can be thought of as part of the gambling that the establishment is willing to endure in order to penetrate the market. On the other hand, old establishments already retain market power and exhibit the skill and knowledge to adapt to market changes at a much faster pace. Therefore, old establishments are less likely to relocate or out-migrate, other things being equal.

The parameters for the variable *Growth* are significant in the manufacturing and wholesale trade models and marginally significant in the retail trade model. Growth increases the probability of relocation for manufacturing establishments in Hamilton. This is the case since growth of manufacturing establishments might be associated with an expansion in floorspace to accommodate new machinery and labor. As a result, the establishment is more likely to move in search for larger floorspace that could accommodate its new requirements. The results from the wholesale and retail trade models are the opposite of the manufacturing case. The negative parameter suggests an inverse relationship between growth and the propensity to move (relocate or out-migrate). This could be the case since these types of establishments are not heavily dependent on machinery, as in the case of manufacturing. Therefore, growth could be a reflection of success at the current location. In other words, the business is more likely to remain in situ if the current location is attractive and can allow the establishment to increase profit and grow. This is particularly true for small size retail trade establishments who can afford to have one or more employees on board without the need to expand floorspace.

The results from the location dummies suggest decentralization and suburbanization of establishments in Hamilton. The observed trends are in line with earlier research conducted by Bourne (1989), which

confirmed the existence of decentralization in Hamilton along with other Canadian cities. Our initial attempt to specify the *CBD* dummy in the utility function of the relocate outcome provided clear evidence on decentralization in all the modeled sectors. This is confirmed by the *Suburbs* covariate, which also suggests suburbanization of establishments in the city. While the *Suburbs* and the *CBD* covariates complement each other, the former is used in the final specification of the models because it provides a better fit. Suburbanization could also be discerned from the significance of the *Lower Hamilton* and *Upper Hamilton* covariates. In a nutshell, the results from the location parameters confirm that mobility is more pronounced among the Central Business District (CBD) establishments. We think that these trends are due in part to the change in the real estate market and the way land development practices have been emerging in the city. The high costs of rent and parking in the CBD combined with low demand for goods and services due to low-income residents will continue to push establishments out from the core of the city. On the other hand, new developed land and the availability of free parking in the suburban areas will pull the relocating establishments towards to the edge of the city.

With regards to the *Agglomeration* variable we find that industrial clustering increases the propensity of inertia. This relation is less evident for manufacturing, communication and transportation establishments although the agglomeration parameter for these sectors retains the correct sign. The results also imply that the effect of agglomeration economies is more significant in the case of retail and service establishments. These results meet our a priori expectation and highlight the market share effect that continues to manifest itself in the city. As for location pressure, the estimated models accept the hypothesis that the increase in local competition (location pressure) will push the establishment to move long distance. This result is in accordance with the neo-classical theory and imply that the change in the boundaries of the spatial margins to profitability due to local competition will increase the propensity of moving.

6. CONCLUSION

This paper investigates the underlining factors that drive the mobility behavior of business establishments in the city of Hamilton in Ontario, Canada. We specify and estimate multinomial logit models to study the mobility process of small and medium size establishments using micro data for 1996 and 1997. These data were extracted from Statistics Canada

Business Register. The results from the logit models will be used as the basis for the development of a business mobility module in a firmographic microsimulation system. Such system will be used to simulate the interplay between the local economy and the urban form of Hamilton.

Our analysis suggests that firm internal factors such as age, size, growth and economic sector are very important determinants of mobility. While these factors do not translate into policy, the age and growth variables provide an insight on the relation between the life cycle of the establishment and its willingness to stay or move. On the other hand, the results from the models allow us to draw general conclusions about the relation between public policy and establishment mobility. For instance, the models succeed in emphasizing the decentralization and suburbanization trends in the city. These trends will have a direct impact on the emergence of urban form. The location factors clearly suggest a decline in the attractiveness of sites in the core of Hamilton. As a result, business establishments are moving towards the suburbs due to a number of factors that pull them from the core.

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