

**RESIDENTIAL BUNDLE STRUCTURE
AND MARKET SEGMENTATION :
THE QUEBEC CASE**

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*QUC = CUQ

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SUMMARY OF RESULTS

1. THE MANDATE

The present document summarizes the findings from a recent research on the residential bundle structure of households in the Quebec region for the period 1986-87. In short, the object of the study was to establish through econometric analysis the implicit price of residential attributes for a series of pre-determined sub-markets and to proceed subsequently with a comparative analysis between these, so as to bring to light their similarities and their differences.

2. ANALYTICAL APPROACH

The methodological framework of the study rests on the hedonic approach, which consists in establishing through econometric analysis the marginal contribution (*i.e.* the implicit price) assigned by the market to property values for each residential attribute, using for that purpose the multiple linear regression technique. The latter provides all statistical features to assess the global performance - both explanatory and predictive - of equations and the reliability of the results thereby obtained.

The RÉSIVALU model - which serves as a basis for the present analysis - is built from a data bank that globally includes some 6 400 owner-occupied properties transacted on the territory of the Quebec Urban Community (QUC) between January 1986 and May 1987. The major part of the information comes from the computerized files of the QUC assessment roll for the period considered, which provide a detailed portrait of the transactions and physical characteristics of properties (*building and site*); the global tax burden is also available for each transaction. In addition, the data bank also includes files from the 1986 Federal Census on the basis of enumeration areas (*socio-economic variables*) as well as information on access to downtown, proximity to some services and environmental features of the neighborhood. In its final form, the

RÉSIVALU model totals 23 residential sub-markets and some 56 linear and multiplicative equations, each including between 6 and 60 explanatory variables.

3. RESULTS ANALYSIS

By and large, the RÉSIVALU model proves to be very satisfactory both from the explanatory as well as the predictive standpoints. Implicit prices deriving from it are both stable and realistic, with multicollinearity remaining under control despite the large number of explanatory variables used. For all of the 56 regression equations, the explanatory performance, measured by the adjusted R^2 , stands at 0.8246; besides, its variability among sub-markets proves very low (5.0 percent). The situation is somewhat different with regard to the predictive performance: the standard prediction error (SEE) reaches 10.49 percent of the mean sale price - well within acceptable standards - but displays stronger fluctuations (31.8 percent), with a minimum of 6.02 percent (the Loretteville sub-market) and a maximum of 21.02 percent (the Quebec-Lowertown segment).

No systematic relationship emerges between, on the one hand the predictive or explanatory performance of a sub-model and, on the other hand, the size of the sample or the number of explanatory variables considered in the equation. As an illustration, the best performances (adjusted R^2 of 0.90 and SEE of 6.0 percent) are achieved with the Loretteville sub-model, which includes only 144 observations and 13 explanatory variables. In most cases, the predictive error is appreciably reduced by improving the homogeneity of the sample used, either by focusing on a specific residential type (e.g. bungalows, condos, semi-detached & row) or on a narrowly delineated geographic sector (e.g.: Loretteville, Ancienne-Lorette, St-Émile/Lac St-Charles or the Northern suburbs), or both (e.g. bungalows in Charlesbourg). The price range may also be reduced so as to eliminate the extreme observations that distort the relationship. In all cases, poor predictive performances refer to highly heterogeneous sub-markets (general model-QUC, cottages, plex and Quebec Lowertown). In contrast, homogenous segments with a relatively narrow price range (condos, bungalows - Charlesbourg, Loretteville, Ancienne-Lorette as well as St-Émile/Lac St-Charles) yield excellent performances, from both explanatory and predictive standpoints.

Better performances are also achieved with the lower and medium price range than with the upper price segment. Heteroscedasticity of residuals, a well-known problem in these types of models, is at stake here and is due to the fact that the residential attributes of the more luxury homes (*i.e.* around \$200 000 in our study) are more varied and therefore more difficult to pick up by the model than those which characterize more standard residences. The segmentation of markets, where possible, may reduce the scope of the problem; resorting to a geographical information system can also help identify the missing characteristics and consequently improve the model.

In summary, two analytical approaches are possible: the **macro-spatial** one, involving a large size sample and a widely diversified sub-market (*e.g.* bungalows - QUC), will result in providing useful information - otherwise inaccessible - on implicit prices for a large number of housing attributes; in contrast, the **micro-spatial** one focuses on a relatively narrow market segment and allows for a fair predictive performance to be achieved using only a restricted number of explanatory variables.

Finally, the **intermunicipal comparative analysis** of regression coefficients shows on the whole a great stability of implicit prices, particularly with regard to the physical characteristics of the building (*i.e.* age, liveable area, number of bathrooms, the presence of a fireplace, a dishwasher, a carport and a pool) : their coefficients of variation are systematically lower than 50 percent and stand even below 20 percent for major housing attributes, namely age and liveable area of the property. Furthermore, the estimator of the socio-economic variable (UNIVLVL) also displays a great stability with a coefficient of variation of only 32 percent, while expressing the coefficients as a percentage of the average sale price substantially reduces their variability - particularly with respect to the fiscal and temporal dimensions. Finally, resorting to the multiplicative form provides greater insight into the interpretation of linear coefficients: for example, a bathroom, fireplace, carport and pool respectively add 6.9 percent, 6.0 percent, 6.1 percent and 8.7 percent to the value of a home.

In conclusion, a comparison of the respective performances of the statistical approach and traditional methods suggests the superiority of former, except in the few rare particularly heterogeneous sub-markets (cottages and Lowertown Quebec City) where municipal assessment provides a better estimate of the market value of properties. In a number of cases (bungalows, condos and most of the suburbs), the

performance differential between the two approaches appears substantial and amply justifies resorting to multi-varied methods.

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AN ABSTRACT

As is known, the confection of assessment rolls is of paramount importance in local finance: in Quebec, approximately three quarters of municipal funding come from real estate taxes. But traditional valuation methods actually bear some methodological flaws - namely with respect to comparable sales adjustment procedures - that can cause fiscal inequity. To counter such problems, new data processing methods have been set up which now play an important role - mainly in the United-States - in the professional assessor's array of techniques. Among the latter, the "hedonic" approach remains one of the most popular: it consists in determining, through multiple regression analysis, the incremental value (either expressed in dollars or as a percentage of average sale price) of each residential attribute, be it merely physical or related to the property's location, neighbourhood or environment. The "implicit prices" thus determined directly mirror households' housing preferences and can be used to predict the market value of a residence from its own attributes, hence reducing the subjectivity and inconsistencies often encountered with traditional methods.

It is precisely in that line that the *RÉSIVALU* project, started in 1988 under a C.M.H.C. external research grant, was continued in 1990 with an econometric comparative analysis of various Quebec Urban Community (QUC) residential sub-markets. The data bank used includes 6400 owner-occupied properties transacted on the QUC territory between January 1986 and May 1987. Most information comes from the computerized files of the QUC assessment roll for the period considered, which provide a detailed portrait both of transactions and physical characteristics of houses (building and site); the global tax burden is also available for each property. In addition, the data bank also includes files from the 1986 federal census on the basis of enumeration areas (socio-economic variables) as well as a series of complementary informations on

access to downtown areas, proximity to major employment poles and public equipments and, finally, environmental dimensions. In its final version, the *RÉSIVALU* model totals 23 residential sub-markets and some 56 linear and multiplicative equations, each including between 6 and 60 explanatory variables.

The model performs very well, from both explanatory and predictive standpoints, and implicit prices derived from it prove stable and realistic. Globally considered, it explains over 82 percent of sale price variations and the standard (mean) prediction error reaches 10.5 percent of average price, well within reasonable limits. While the weakest predictive performances refer to sub-markets that are highly heterogeneous and difficult to circumscribe with respect to both type and location (general model for the whole QUC, cottages, plex and Lowertown Quebec City), more homogeneous sub-markets better spatially defined, and offering a relatively restricted price span (condos, bungalows in Charlesbourg, Loretteville, Ancienne-Lorette as well as St-Émile - LacSt-Charles), yield excellent results: for instance, the Loretteville equation, with only 144 cases and 13 explanatory variables, explains 90 percent of price fluctuations with a prediction error of 6 percent. Finally, the medium and lower-price segments of the residential market tend to yield better performances than the upper-price segment (i.e. around \$200 000 in the current study), due to the fact that luxury attributes are more difficult to account for through modelisation than are standard characteristics.

As for the interjurisdictional comparative analysis of regression coefficients performed on a selection of fifteen explanatory variables, it shows that, by and large, implicit prices are highly stable, namely with regard to physical attributes (i.e. age, living area, number of bathrooms, presence of a fireplace, dishwasher, carpark or swimming pool). The coefficient relative to the socio-economic dimension, captured via neighbourhood residents' educational level, also displays high stability; furthermore, the variability of implicit prices relative to fiscal and time variables in particular is substantially reduced when these are expressed as a percentage of average house price. Finally, resorting to the multiplicative form brings more flexibility to the determination of the incremental value of housing attributes: thus, an additional bathroom, a fireplace, a carport

and a swimming pool respectively add 6.9%, 6.0%, 6.1% and 8.7% to the market value of a house.

In conclusion, comparing the respective performances of the statistical, hedonic, approach and traditional methods clearly brings out the relative superiority of the former over the latter, except for a few highly heterogeneous sub-markets (cottages, Lowertown Quebec City) where the traditional approach provides a better estimate of market value than the model does. It is worth mentioning that, in numerous cases (bungalows, condos and most suburban sub-markets), the difference in performance between the two approaches appears substantial and easily justifies promoting computer assisted mass appraisal (CAMA) methods.

1. INTRODUCTION: MANDATE DESCRIPTION AND OBJECT OF STUDY

The present document summarizes the findings from a recent research on the residential bundle structure of households in the Quebec region for the period 1986-87. The research was performed over a 16 month period, from May 1990 to August 1991, and was subsidized under the CMHC external research grant program. Its mandate consisted in drawing up a regional map of property owners' preferences on the territory of the Quebec Urban Community (QUC), starting with a sample of some 6 400 transactions carried out on the territory between January 1986 and May 1987. More specifically, the objectives of the study were :

- to establish through econometric analysis the implicit price of residential attributes for a series of pre-determined sub-markets;
- to proceed subsequently with a comparative analysis between market segments, so as to shed light on their similarities and differences.

The data bank used here is that which was used in developing the basic equations of the RÉSIVALU model (Des Rosiers, 1990; Des Rosiers & Thériault, 1992), under a first external CMHC research grant, in 1988-89. Theoretical as well as econometric issues relative to the use of the hedonic framework have been dealt with in Des Rosiers (1990), where an extensive review of the literature on existing models can be found together with a detailed appendix on the operational definition of variables used in RÉSIVALU.

2. ANALYTICAL APPROACH

2.1 The Hedonic Approach - Theoretical and Methodological Issues

The methodological framework of the study rests on the hedonic approach, which consists in establishing through econometric analysis the marginal contribution (*i.e.* the implicit price) assigned by the market to property values for each residential attribute, using for that purpose the multiple linear regression technique. The latter provides all statistical features to assess the global performance - both explanatory and predictive - of equations and the reliability of the results thereby obtained.

Although the theoretical weaknesses inherent to the hedonic approach as underlined by Rosen (1974) - essentially problems of identification and non-linearity of the hedonic function - still require further investigation, they have somewhat lost part of their importance subsequent to the development, during the last decades, of appraisal models capable of producing relatively precise and stable estimators of implicit prices for major residential characteristics (Straszheim 1987; Bartik & Smith 1987). The main literature relative to the hedonic framework and the use of multiple regression analysis for appraisal purposes is summarized in Des Rosiers (1990 & 1991). The functional form and market segmentation issues are also addressed in the light of past research (Linneman 1980; Jensen 1987; Galloway, Hohm & Perdue 1985; Bajic 1985; Hickman, Gaines & Ingram 1984; Farrell 1984). Finally, findings from the RÉSIVALU model obtained with the general equation and the bungalow sub-market are discussed, which strongly suggest residential preferences of households do differ among market segments.

2.2 The RÉSIVALU Bank

The RÉSIVALU data bank includes some 6 400 owner-occupied properties transacted on the territory of the 13 QUC municipalities between January 1986 and May 1987. The major part of the information comes from computerized files of the QUC assessment roll for the period considered, which provide a detailed picture of the transactions and physical characteristics of houses (building and site); the global amount of municipal taxes is also available for each of the properties transacted. In

addition, the data bank also includes files from the 1986 Federal Census on the basis of enumeration areas (socio-economic variables) as well as a series of information on access to downtown, proximity of some services and neighborhood features. Interaction between data files is made possible via a universal location grid: all properties being assigned a specific spatial code, euclidian distances between each residence and pre-selected reference points (job centers, business centers, primary schools, parks, etc.) can be calculated relatively easily. Thus, the marginal contribution of each housing attribute to market value - be it building characteristics (size, age, quality, etc.), neighborhood features (socio-economic status), location and fiscal factors (access to downtown or services; rate of taxation), environmental or temporal dimensions - may be objectively established.

2.3 Validation of the Bank and Operations on the Variables

First, the databank was validated by eliminating... :

- ...all observations for which the "Sale price/Property assessment" ratio was lower than 0.5 or higher than 1.5: such cases could in fact reflect market imperfections (non *bona fide* sales) as well as substantial discrepancies between file description and the goods actually transacted;
- ...observations for which the declared sale price was lower than \$20 000 or higher than \$200 000, since such cases, despite their low occurrence, may unduly affect the value of regression coefficients;
- ...observations for which missing or aberrant values were detected;
- ...variables with an occurrence of less than 15 in order to avoid including in the model coefficients which, despite their statistical significance, remain risky for predictive purposes.

A certain number of transformations were also performed on variables in order to make them operational within the framework of the samples used. These operations mostly consisted in grouping various categories of variables and in altering if need be their type of codification. It is important to note that these modifications were done "ad hoc" according to the nature of the sample and the type of sub-model developed.

2.4 The Segmentation of Markets

Given the scope of the task which the setting up of an hedonic model of residential values for a territory the size of the QUC implies, it proved necessary, within

the parameters of this report, to focus on a restricted number of residential sub-markets: these should be both characteristic of the structure of demand in the region, yet sufficiently specific to yield good predictive performances. The delicate issue of market segmentation which is paramount to successful modelling is now being addressed. Several statistical procedures such as cluster analysis, discriminant analysis and analysis of variance have been used to help defining optimal homogeneity within residential sub-markets; parallel though, criteria meeting the administrative constraints imposed on the assessor have also been applied.

Consequently, two types of segmentation were selected: the first follows a spatio-administrative logic and makes jurisdictional delimitations the basis of analysis whereas the second type establishes the various sub-markets in accordance with property type (bungalow, cottage, etc.) or legal tenure (condominium). MAP 1 which follows indicates QUC municipal boundaries.

2.5 Choice of Functional Forms

The large sample size as well as the substantial number of explanatory variables in the model may lead to a great variety of solutions with respect both to functional forms of hedonic equations and to mathematical transformations on variables. After several tests and trials, focus was concentrated on two functional forms only for each sub-model, namely the linear and multiplicative ones, each form having advantages and drawbacks with regard to the interpretation of regression coefficients. While the linear form remains more straightforward and simpler to interpret since implicit prices are expressed in constant, nominal terms, the multiplicative form, although more complex, allows for regression coefficients to be expressed as percentage adjustment factors which adapt to any price range. In the latter case, the regression equation - which may include one or more logarithmic terms - can be written as follows :

$$\ln Y = b_0 + b_1 X_1 + b_2 X_2 + \dots + b_i \ln(X_i),$$

and rewritten as :

$$Y = e^{b_0} * e^{b_1 X_1} * e^{b_2 X_2} * \dots * X_i^{b_i},$$

where the « $e^{b_i X_i}$ » and « $X_i^{b_i}$ » terms act as adjustment factors that increase or decrease the accumulated value of other attributes.

In addition, in the case of the linear model, the « APPAGE » variable - whose impact on value is most prominent - can be expressed either in its continuous form or as a dummy, in which case the physical deterioration the aging process exerts on the building can be more accurately measured. This operation proves less useful in the case of the multiplicative model since the adjustment factor of this variable, which undergoes a logarithmic transformation, modifies by itself with the age of the property. Finally, some equations were subject to a quasi-segmentation process so as to improve their performance, by resorting for example to dummy variables for neighborhood or price range features.

2.6 Processing Procedures

The application of the processing procedures followed a multi-stage development :

- (i) First of all, a MLR standard procedure was applied to all variables in order to identify the residential characteristics whose influence on the value of properties was the most determinant and the most stable.
- (ii) An in-and-out stepwise procedure was then applied, whereby variables are selectively introduced into and, eventually, withdrawn from the hedonic equation in accordance with their respective incremental contribution to the explanation of the phenomenon. Here we chose to force the residential attributes which were most significant into the equation - those, in a general way, which had previously been identified as such in the literature - and to have the stepwise method proceed with a preliminary selection of residual variables.
- (iii) In a third phase, the remaining variables were validated on the basis of their degree of statistical significance and multicollinearity - namely by analyzing eigenvalues and variance inflation factors (VIFs) - which made it possible to reduce the problem to an acceptable level.
- (iv) Finally, mathematical transformations were applied to data where appropriate so as to reduce the non-linearity problem.

2.7 The RÉSIVALU Model

The resulting model includes eight categories of explanatory variables (Des Rosiers 1988; Des Rosiers & Dionne 1989) and as many sub-models as market segments considered, each reflecting household profiles and residential choices. Market segmentation, as mentioned earlier, is established both on property type (bungalows, cottages, condominiums, etc.) and administrative boundaries (municipalities). The end-result is a regional map of residential values which constitutes both a decision-making tool for the assessor and the municipal manager and a convenient instrument for the urban and real estate analyst.

Within the framework of this project, 23 residential sub-markets were defined and some 56 linear and multiplicative equations were developed, thus providing a quite comprehensive picture of the residential bundle structure of QUC households for the 1986-87 period. The objective of the project, namely to establish through the hedonic approach the marginal value of residential attributes for the different sub-markets in the region, has therefore been achieved.

3. DEFINITION OF VARIABLES

Although a detailed operational definition of the variables of the RÉSIVALU model, with explanatory notes and programming features, is available on request, a simplified version of this definition is presented here, which includes only the variables actually appearing in the sub-models considered in this paper. The letter between parenthesis following the definition indicates whether the variable is expressed in a dummy (D), metric (M) or rank (R) form.

DEPENDENT VARIABLE	
SALEPRICE : Declared property sale price, in dollars	(M)
INDEPENDENT VARIABLES	
INTERCEPT : Expressed in dollars	(M)

Building characteristics :

BUNGALOW	Single family detached housing - 1 storey	(D)
COTTAGE :	Single family detached housing - 2 or several storeys	(D)
SEMIDET :	Semi-detached property - 1 common wall	(D)
LIVAREA :	Liveable area of the property, in square meters	(M)
* HIGHDENS :	The unit is located in a high density building	(D)
* MEDDENS :	The unit is located in an average density building	(D)
EFFAGE :	Effective, chronological age of the property, in years	(M)
APPAGE :	Apparent age of the property in years	(M)
APPAGE1 :	Age = 1 and 2 years	(D)
APPAGE2 :	Age = 3 to 5 years	(D)
APPAGE3 :	Age = 6 to 10 years	(D)
APPAGE4 :	Age = 11 to 15 years	(D)
APPAGE5 :	Age = 16 to 25 years	(D)
APPAGE6 :	Age = 26 to 50 years	(D)
APPAGE7 :	Age > 50 years	(D)
OLD :	Adjustment factor for a property more than 25 years old	(D)
SUPQUAL :	Quality of construction higher than the average of the sector	(D)
INFQUAL :	Quality of construction lower than the average of the sector	(D)
CLADDING :	Type of outside cladding	(R)
BRICK51 :	Outside cladding made up mostly of brick	(D)
STONE51 :	Outside cladding made up mostly of stone	(D)
ALUMVIN51 :	Outside cladding made up mostly of vinyl or aluminium cladding	(D)
* STOREY :	Number of storeys in the unit	(M)
* VIEW :	The unit is endowed with a panoramic view	(D)

* Indicates variables specific to condo units

BATHROOM :	Total number of toilets and bathrooms, a toilet counting for 0.5 bathroom	(M)
FIREPLACE :	Presence of one or several fireplaces	(D)
FIREPLACE1 :	Presence of one fireplace	(D)
FIREPLACE2 :	Presence of more than one fireplace	(D)
INFCEIL :	Ceiling of a quality lower than standard	(D)
INFLOOR :	Floors of a quality lower than standard	(D)
SUPLUMIN :	Degree of luminosity higher than the average	(D)
INFLUMIN :	Degree of luminosity lower than the average	(D)
DISHWASH :	Presence of a built-in dishwasher	(D)
OVEN :	Presence of a built-in oven doubled or not with a built-in hotplate	(D)
ELECTRIC :	Electrical system made up of only one 220 V. outlet	(D)
VACCUUM :	Presence of a central vacuum cleaner	(D)
KITCAB :	Presence of hardwood kitchen cabinets	(D)
STAIR :	Presence of inside hardwood stairs	(D)
FINBASMT :	Presence of a finished basement	(D)
RENTBASMT :	Basement used completely for rental purposes	(D)
VERANDA :	Presence of one or several verandas exceeding 160 square feet	(D)
LRGVERAND :	Presence of verandas the area of which exceeds 240 square feet	(D)
SOLARIUM :	Presence of a solarium	(D)
BASMTENTR :	Presence of an independent basement entrance	(D)

Outbuildings :

CARPORT :	Presence of a carport	(D)
GARAGE :	Presence of a garage, single or double, attached or detached	(R)
SGLDETGAR :	Presence of a single detached garage	(D)
DBLDETGAR :	Presence of a double detached garage	(D)
SGLATTGAR :	Presence of a single attached garage	(D)
DBLATTGAR :	Presence of a double attached garage	(D)
* INDPARK :	Number of indoor parking spaces	(M)
SHED :	Presence of a shed	(D)
EXCAVPOOL :	Presence of an excavated pool	(D)

Site Characteristics :

LOTSIZE :	Size of lot in square meters	(M)
CORNER :	The property is located on a corner lot	(D)
NOSEWER :	Absence of a water and sewer network	(D)

Fiscal Variable :

EFFTXRATE :	Effective tax rate of the property expressed as the ratio of total annual tax bill to the property's market value, in percentage terms.	(M)
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Locational Characteristics :

SILLERY :	The property is located in Sillery	(D)
STEOFY :	The property is located in Ste-Foy	(D)
CAPROUGE :	The property is located in Cap-Rouge	(D)
BEAUPORT :	The property is located in Beauport	(D)
VANIER :	The property is located in Vanier	(D)
STEMILE :	The property is located in St-Émile	(D)
LORETTE :	The property is located in Loretteville	(D)
CHARL :	The property is located in Charlesbourg	(D)
ANCLOR :	The property is located in Ancienne-Lorette	(D)
LACSTCH :	The property is located in Lac St-Charles	(D)
VALBEL :	The property is located in Val-Bélair	(D)
STAUG :	The property is located in St-Augustin	(D)

Neighborhood Characteristics :

INCDIFF :	Differential between the average income of households in the enumeration area of the property and that of the QUC	(M)
UNIVLVL :	Percentage of the population aged 15 years and over in the enumeration area of the property who have a university diploma	(M)
SINGPERS :	Percentage of households in the enumeration area made up of a single person	(M)
MONOPAR :	Percentage of households in the enumeration area made up of monoparental families	(M)
AGE65PL :	Percentage of the population in the enumeration area aged 65 years and over	(M)

Access and Proximity Variables :

QUEBCBD :	Distance-time in minutes from the property to Quebec CBD	(M)
BUSSERV :	Level of quality of the bus service in the area	(R)
PRIMSCHOOL :	Euclidian kilometric distance to the closest primary school, less 0.250 km.	(M)
PRIMSCHOOL5 :	The property is located at more than 1.5 km. of the closest primary school	(D)
SUPRASHOP :	Euclidian kilometric distance to the closest supra-regional shopping center	(M)
REGSHOP2 :	The property is located at more than 0.250 km. but at less than 0.5 km. from a regional shopping centre	(D)
NEIGHBSHOP :	Euclidian kilometric distance to the closest neighborhood shopping centre	(M)
NEIGHBSHOP4 :	The property is located at more than 1 km. but less than 1.5 km. from a neighborhood shopping center	(D)
PARK :	Euclidian kilometric distance to the closest park	(M)
PARK4 :	The property is located between 1 km. and 1.5 km. from the closest park	(D)
PARK5 :	The property is located at more than 1.5 km. from the closest park	(D)
POWRSTAT3 :	The property is located between 1 km. and 1.5 km. from a major Hydro-Quebec power station	(D)
POWRLINE1 :	The property is located at less than 500 m. from a major Hydro-Quebec power line	(D)
LRHR2 :	Euclidian kilometric distance to the closest LRH complex for retired persons including between 50 and 100 housing units	(M)

Temporal and Cyclical Adjustment Variables :

DAY :	Incremental value of each day that have gone by between January 1st 1986 and the property transaction date	(M)
WEEK :	Incremental value of each week that has elapsed between January 1st 1986 and the property transaction date	(M)
MONTH :	Incremental value of each month that has elapsed between January 1st 1986 and the the property transaction date	(M)
YEAR :	Incremental value of each year that has elapsed between January 1986 and the property transaction date	(M)
PERIOD2 :	The transaction was closed between September and November, which would indicate a decision to purchase made between the preceding months of June and August	(D)
PERIOD3 :	The transaction was closed between December and February, which would indicate a decision to purchase made between the preceding months of September and November	(D)

4. RESULTS ANALYSIS

The detailed results from the RÉSIVALU model are available on request (APPENDIX B of the original French document). All equations are considered, both in their linear and multiplicative form. Statistical tables are followed by plots of residuals and display the following information :

- the analysis of variance of residuals;
- the "F" test and its statistical significance threshold;
- the standard prediction error of the model, the average sale price of the sample and the corresponding coefficient of variation;
- the raw and adjusted R^2 of the equation;
- the regression coefficients for each of the explanatory variables;
- the standard error of regression coefficients, their t-test and corresponding probability;
- the tolerance number and the variance inflation factor (VIF) for each coefficient (Neter, Wasserman & Kutner, 1985).

Taking into account the considerable quantity of information contained in these tables, it is not possible to proceed with an individual analysis of each of the equations. Therefore, this report is limited to a global evaluation of the model results. In addition, findings are commented for two sub-markets defined on the grounds of property type, namely the bungalow and the condo segments: these two segments prove to be particularly interesting and generate excellent performances while contrasting by their nature and the number of explanatory variables used. Finally, the main regression coefficients obtained for municipal sub-markets are compared.

4.1 Explanatory and Predictive Performances of the Model - A Global Evaluation

A global picture of the performance of the different sub-models developed is now presented. TABLE 1 identifies the sub-market considered and displays the functional form of the equation, its particularities, the size of the sample and the number of

independent variables used, the sale price range, the average transaction price of sampled residences as well as the main indicators of statistical performance (adjusted R^2 , "F" test and standard prediction error).

Main research findings can be summarized as follows :

- Generally, the model proves to be very satisfactory both on explanatory and on predictive levels and the implicit prices of residential attributes deriving therefrom are stable as well as realistic; as for multicollinearity, it remains under control in spite of the great number of explanatory variables used.
- The explanatory performance of the model is, by and large, quite acceptable: for all 56 regression equations, the average adjusted R^2 reaches 0.8246 and its variability remains very low (5.0 percent).
- The situation is somewhat different with regard to the predictive performance: if the mean SEE amounts to 10.49 percent of average sale price - well within agreed parameters -, it shows substantial fluctuations from one sub-model to the other (31.8 percent). Thus, the SEE varies from a minimum of 6.02 percent in the case of the Loretteville sub-market to a maximum of 21.02 percent for the Quebec-Lowertown segment.
- No systematic relationship emerges between, on the one hand the predictive or explanatory performance of a sub-model and, on the other hand, the size of the sample or the number of explanatory variables considered in the equation. As an illustration, the best performances (adjusted R^2 of 0.90 and SEE of 6.0 percent) are achieved with the Loretteville sub-model, which includes only 144 observations and 13 explanatory variables.
- On the other hand it appears that in most cases, the predictive error is appreciably reduced by improving the homogeneity of the sample used, either by focusing on a specific residential type (e.g. bungalows, condos, semi-detached & row) or on a narrowly delineated geographic sector (e.g.: Loretteville, Ancienne-Lorette, St-Émile/Lac St-Charles or the Northern suburbs), or both (e.g. bungalows in Charlesbourg). The price range may also be reduced so as to eliminate the extreme observations that distort the relationship. However, such a procedure, while improving the predictive power of the model, often leads at the same time to a lower explanatory performance (e.g. lower price or upper price bungalows vs. the general equation) due to the loss in trend resulting therefrom. Thus, there is no necessary inverse relationship between the coefficient of determination and the predictive error.
- In all cases, poor predictive performances refer to highly heterogeneous sub-markets (general model-QUC, cottages, plex and Quebec Lowertown). In contrast, homogenous segments with a relatively narrow

price range (condos, bungalows - Charlesbourg, Loretteville, Ancienne-Lorette as well as St-Émile/Lac St-Charles) yield excellent performances, from both explanatory and predictive standpoints.

- Finally, better performances are also achieved with the lower and medium price range than with the upper price segment. Heteroscedasticity of residuals, a well-known problem in these types of models, is at stake here and is due to the fact that the residential attributes of the more luxury homes (*i.e.* around \$200 000 in our study) are more varied and therefore more difficult to pick up by the model than those which characterize more standard residences. The segmentation of markets, where possible, may reduce the scope of the problem; resorting to a geographical information system can also help identify the missing characteristics and consequently improve the model.

In summary, two analytical approaches are possible: while the *macro-spatial* one, involving a large size sample and a widely diversified sub-market (*e.g.* bungalows - QUC), will result in providing useful information - otherwise inaccessible - on implicit prices for a large number of housing attributes, the *micro-spatial* one focuses on a relatively narrow market segment and allows for a fair predictive performance to be achieved using only a restricted number of explanatory variables. As can be hypothesized, one will choose an approach that maximizes either the explanatory power or the predictive dimension depending on what the model is aimed at. The macro-spatial approach best fits the requirements of the real estate analyst whereas the professional appraiser, who operates according to rather constraining administrative and judicial parameters, will prefer the more operational second approach.

4.2 Results Analysis by Property Type

4.2.1 The Bungalow Sub-Market

The bungalow sub-market has already undergone an in-depth analysis in previous publications (Des Rosiers 1990; Des Rosiers 1991). Its basic features are summarized here due to the importance of this segment which itself numbers 45 percent of the global sample of this study. TABLE 2 that follows displays the main regression results obtained with the help of the general model covering the whole

QUC territory (linear and multiplicative forms), the low range and high range segments (linear form) as well as the Charlesbourg bungalow sub-market (linear form).

The global explanatory performance (adjusted R^2) of equations obtained with the help of the QUC sample goes from 0.85 in the case of the general model to 0.79 and 0.73 for the "upper price" and "low range" segments respectively. As for the standard error of estimate, it fluctuates between 8.1 percent and 10.7 percent of the average sale price, the predictive performance of segmented equations proving better than that of the general equation in spite of a weaker explanatory power. Although resorting to the strictly linear form gives good results, use of the multiplicative form generally seems to improve the predictive performance of the model (although it is not the case for the "low range" segment). It notably improves the flexibility of use of the model by generating adjustment factors that adapt to a larger price range.

Regression coefficients prove very stable and statistically highly significant. In support of this, we note that the implicit prices obtained for various residential attributes through the use of a multiplicative form are, once translated into monetary values on the basis of average property prices, very consistent with those derived from the linear form. In addition, the similarity between these and several coefficients of the bungalow sub-market in Charlesbourg (LIVAREA, FINBASMT, FIREPLACE, GARAGE, UNIVLVL) - a quite different market segment - makes up a conclusive test of the stability of the model and is an indication that the multicollinearity remains well controlled (VIFs are maintained for the most part between 1 and 3). As for the graphic distribution of residuals, it indicates a certain heteroscedasticity relative to upper price properties, but the problem remains within acceptable limits; as mentioned above, using the multiplicative form makes it possible to further reduce the predictive error.

Almost all of regression coefficients comply with the theoretical expectations and by their scope confirm the results of previous research as well as the opinions of professionals in the field. Thus, intuitive evaluation which the latter make of the market value of a pool, fireplace, garage or kitchen cupboards - to name only a few attributes - tend to show the reliability and the realism of our results. Besides, the use of dummy variables to measure the impact of aging on the value of residences is particularly interesting as it makes it possible to pick up quite accurately physical depreciation; in the three market segments where this approach is used, very consistent results are obtained. Thus, the general model tends to show that the annual depreciation of an average bungalow is established at 3.5 percent of its value in the very first years and

drops subsequently quite rapidly, reaching 0.25 percent per year after 25 years. Furthermore, according to the linear form, a 15 year old property would have lost 24 percent of its value against 26 percent with the multiplicative form.

The segmentation of the global sample also provides interesting information on how households may value residential attributes differently from one market segment to another. From the analysis of TABLE 2, it can be concluded that, generally speaking, the value of upper price properties is enhanced by the presence of "luxury" characteristics whereas in the lower price segment it is the sub-standard characteristics that affect downward the market value of properties. The "luminosity" factor for instance, speaks for itself : whereas an upper price property will see its value increase by 5.7 percent by an above normal luminosity, a below standard luminosity will reduce the value of a lower price residence by 3.9 percent approximately¹. Furthermore, it is interesting to note that the carport is attributed a higher nominal contribution in the low price segment (\$2 587) to that found in the upper price segment (\$920) whereas the opposite is true in the case of a garage. These results tend to confirm the validity of the conformity principle well known in appraisal and under which a characteristic is valued only to the extent it fits the neighborhood demand structure. The study also confirms that the relative yearly appreciation of upper price residences is substantially higher (7.4 percent) than that of low price properties (4.4 percent).

Finally, the last sub-market analyzed - bungalows in Charlesbourg - is also very instructive: in several respects it approaches the upper price segment and is characterized by the importance households grant to the possibility of renting the basement (\$8 131), to the presence of a pool (\$8 106), the area of the lot, the fiscal dimension as well as to factors of proximity (distance from primary school and parks, downtown accessibility, etc.). The corresponding equation performs quite well with an adjusted R^2 of more than 0.85 and a forecast error below 9 percent of average price.

¹ One could be surprised by the systematically negative sign that affects the SOLARIUM coefficient. The reason is that this characteristic generally refers to a room that is not insulated, not finished and structurally weaker than the rest of the residence - therefore not liveable - located at the back of the kitchen. The statistical analysis of our sample of bungalows reveals that the age of properties with a solarium is 26 years on average and 15 for those which do not have any. Furthermore, the former although more spacious, command a unit price (*i.e.* per square meter of liveable space) lower than the latter by 8.6%.

To conclude on this sub-market, it should be noted that the physical characteristics alone explain close to 50 percent of the fluctuations in the price of bungalows, with liveable area and age of the property being by far the most important determinants (Des Rosiers 1991 :249-51). Location and neighborhood variables are also major determinants of value, but their impact proves appreciably higher in the upper price segment. The reverse is true for access and proximity factors, the importance of access to downtown in the lower price segment probably reflecting a lower motorization rate. Finally, the fiscal dimension (EFFTXRATE) is also prominent : in spite of recent research suggesting that recourse to standard regression procedures yield an over-evaluation of the capitalization effect of fiscal differentials into the price of properties (Yinger et al. 1988), the current study generates internalization rates which comply with previous findings on the subject. This rate is established at 63 percent in the case of bungalows, based on a 3 percent discount rate applied to fiscal differentials.

4.2.2 The Condominium Sub-Market

TABLE 3 summarizes the main results obtained for the condominium segment using the linear and multiplicative forms of the model. Being both highly homogeneous and concentrated in space (the downtown Quebec - Pointe-Ste-Foy axis, between St-Louis and Ste-Foy roads), this sub-market produces excellent performances (adjusted R^2 close to 0.90 and SEE below 8.5 percent) with only 13 independent variables. In addition to factors that predominate in nearly all market segments (liveable area, apparent age, effective rate of taxation, rate of university graduates and distance to downtown), other exclusive attributes emerge as being particularly important to condominium valuation, namely a panoramic view (VIEW), the number of storeys in the unit (STOREY), the density of the building (HIGHDENS and MEDDENS) and the presence of an indoor parking (INDPARK). The negative sign and the high amplitude of the coefficient BUSSERV suggests furthermore that the presence close to the unit of a an efficient, high frequency bus service represents a nuisance for households belonging to this segment of the residential market: being highly motorized, these households derive no benefit from this service while having to suffer the negative externalities it generates. Finally, the annual appreciation of condos for the period considered is established at 8.3 percent, *i.e.* roughly the same as that found for the whole bungalow sub-market.

Although the two functional forms produce results which are quite similar on the whole, some differences may be noted. For comparison purposes, implicit prices derived from the linear form have been expressed as a proportion of average property value; in the case of the multiplicative form, similar information is directly provided via the adjustment factor. While discrepancies are particularly substantial in the case of the variables VIEW and STOREY- whose contributions the linear form tends to overemphasize - as well as for the variable QUEBCBD - where it is the opposite -, everywhere else the correspondence goes from good to excellent.

4.3 Comparative Analysis of Model Results by Municipality

We now turn to the comparative analysis of regression coefficients relative to the municipal sub-markets. Considering each sub-model was set up with concern for optimality, equations may differ with respect to the choice of explanatory variables, their codification and mathematical transformations performed; this greatly complicates the comparison of implicit prices. To alleviate this difficulty, the following analysis is limited to the only variables which are most highly significant (i.e. those which come out most often and whose marginal contribution to R^2 is higher than 0.5 percent); in addition, coefficients obtained with the help of a logarithmic transformation were eliminated from the analysis. In TABLE 4, 5 and 6, findings relative to 13 QUC sub-markets and to 15 major characteristics are displayed. The tables present, for each regression coefficient and for both linear and multiplicative forms, the mean, standard deviation, coefficient of variation, minimal and maximal values as well as the number of observations on which the comparison is based.

4.3.1 Linear Coefficients - Analysis of Absolute Implicit Prices

TABLE 4 displays the coefficients of the linear model. The objective is to measure, through the coefficient of variation, the relative stability in space of residential implicit prices. Obviously, the coefficients will differ from one equation to the other since market segmentation implies that household behavior is not identical in the various sub-markets of the QUC. However, too great a fluctuation of the coefficients would suggest that the model is unstable and consequently non-operational for predictive purposes. Yet, this study leads to the opposite conclusion: in fact, besides the coefficients affecting the COTTAGE and LOTSIZE variables, the stability of implicit prices is quite acceptable and their sign of great

consistency. This is an excellent indication of the validity of the RÉSIVALU model and more generally of the hedonic approach as well as proof that it is possible to keep multicollinearity under control.

Thus, with respect to property type, the marginal contribution of the bungalow type is systematically positive, whereas it is the opposite for a semi-detached house. As for the COTTAGE variable, whose coefficient may take a positive or negative sign depending on the context, its very high coefficient of variation reflects both the great diversity for this type of structure on the QUC territory and the sort of codification used for type-descriptive variables: indeed, according to the multi-category dummy codification, the value and sign of regression coefficients is always established in relation to the reference, or mute, category. In Charlesbourg for example, bungalows are used as the reference and the coefficient of the variable COTTAGE therefore takes on a negative value; in Loretteville and Cap-Rouge on the other hand, its coefficient is positive since the semi-detached type is used as the reference². From this it can be concluded that multi-category dichotomic variables are not the best indicators of the stability of the model; however, the analysis of the coefficients of type-descriptive variables makes it possible to classify the sampled properties by order of "desirability", the bungalow having precedence over the cottage which, in turn, overruns the semi-detached type.

By and large, the physical characteristics of the building (*i.e.* age, liveable area, number of bathrooms, presence of a fireplace, dishwasher, carport and pool) generate regression coefficients of great stability: their variability remains systematically below the 50 percent threshold and even falls below 20 percent in the case of the most determinant attributes of the model, namely age and liveable area. In the latter case, it is interesting to note that the average value of the coefficient for all thirteen segments

² It may be surprising to find that cottages are less valued by households than bungalows, which is the case in nearly all QUC municipalities with the exception of St-Augustin - where the premium granted to cottages relative to other types achieves \$9 700 - and in Cap-Rouge where cottages and bungalows are equally valued. This stems from the very definition of the "cottage" type which groups together properties of very varied styles whose common characteristic is to have more than one storey above ground. This category cannot therefore be solely associated with upper price English cottages such as those that are found in St-Augustin, Cap-Rouge and Sillery particularly. Thus the statistical analysis of the Quebec and Charlesbourg sub-samples reveals that if the average sale price of cottages is 45% higher than that of bungalows, the variability of sale price is considerably higher in the first case (42% approximately vs. 22% for the bungalows). Furthermore, the unit price of cottages remains appreciably lower than that of bungalows (the difference is 23% in Quebec and 19% in Charlesbourg).

of the market considered in the analysis (*i.e.* \$241/sq. meter) is almost identical to that which the QUC sub-market generates (*i.e.* \$247/sq. meter). Furthermore, the coefficient relative to the socio-economic dimension, represented here by the UNIVLVL variable, also shows great stability with a coefficient of variation of only 32 percent.

There are marked variations affecting the LOTSIZE coefficient in spite of the similarity existing between some market segments (*e.g.* Cap-Rouge, St-Augustin and the QUC in general, where the unit value of the lot is established at \$3.98, \$4.15 and \$3.86 per square meter); indeed, the spread between the unit value of land in Quebec (\$6.95/sq. meter) and in Sillery (\$62.70/sq. meter) seems difficult to justify. In the first case, the regression equation includes 35 explanatory variables, 8 of which pick up most of the influences neighborhood and access factors have on values. In contrast, the Sillery equation includes only 6 independent variables, all neighborhood features being captured through the LOTSIZE variable.

Finally, the relatively important fluctuations affecting the coefficients of the fiscal (EFFTXRATE) and temporal (YEAR) characteristics can be explained: in the first case, they simply confirm - as suggested by the literature - that households from various market segments unequally assess the impact of fiscal differentials on property values, depending namely on their level of information regarding that issue; in the second case, fluctuations are due to the fact that different locations command equally different appreciations, depending on urban centrality and neighborhood factors.

4.3.2 Linear Coefficients - Analysis of Relative Implicit Prices

While the analysis of the fluctuations of regression coefficients, expressed in dollars, already provides information on the stability of the model, the differences in the average price of properties from one sub-market to the other risks altering upwards or downwards the actual scope of these fluctuations. TABLE 5 corrects the situation by presenting a comparative analysis of the coefficients expressed as a percentage of the average sale price. While the conclusions from the preceding analysis apply here also, some coefficients of variation are appreciably reduced, particularly those relative to the variables BUNGALOW, EFFAGE, LOTSIZE, EFFTXRATE, UNIVLVL and YEAR. On the other hand, some attributes - namely the physical characteristics of the building - show larger implicit price fluctuations, but these nevertheless remain within reasonable limits.

4.3.3 Multiplicative Coefficients

Using the multiplicative form of the model generates regression coefficients which may be easily translated into adjustment factors via a mathematical transformation. Once applied to the "basic" market value (*i.e.* the intercept) of a property, these factors, which may be lower, equal or higher than one, show the *relative* marginal contribution of each residential attribute. As can be seen from TABLE 6, the average value of the resulting regression coefficients, their respective variability as well as the multiplicative adjustment factors deriving therefrom prove in all points to comply with the results of the preceding table, and tends once more to show the stability of the RÉSIVALU model. The only exceptions are the EXCAVPOOL variable whose relative contribution is lower with the use of a multiplicative form (7.8 percent vs. 9.7 percent) and the COTTAGE variable for which the variability is significantly increased (283 percent vs 221 percent).

In the light of these findings, it is possible to establish a reliable measure of the relative marginal contribution of the residential attributes by performing an arithmetic average of both regression coefficients displayed in TABLE 5 and multiplicative adjustment factors - or their complements to unity in the case of negative contributions - derived in TABLE 6. For example, a bathroom, fireplace, carport and pool respectively add 6.9 percent, 6.0 percent, 6.1 percent and 8.7 percent to the value of a home.

4.4 Statistical Approach and Traditional Methods: An Evaluation of Respective Performances

A comparative analysis of the respective performances of both statistical and traditional approaches in mass appraisal will end this study on the residential bundle structure in the Quebec region. To do this, the explanatory and predictive performances of each of the 24 linear equations of the RÉSIVALU model are confronted with the results obtained by regressing, for the same market segments, sale prices on the *normalized assessment value*³ of properties. Results are displayed in

³ The *normalization* process consists in levelling all appraisal values, within and among jurisdictions, to a similar proportion of the actual market value - ideally 100 percent -, using for that purpose samples of sales that are representative of each local market.

TABLE 7 and are self-explanatory: only in the segment relative to cottages and in the Quebec sub-market (more specifically in the Lowertown which is characterized by a particularly heterogeneous - even assorted - residential stock) do the traditional appraisal methods provide a better estimate of the market value of properties. In all other segments, the hedonic model proves more accurate. In a number of cases (bungalows, condos and most of the suburbs) the difference in performance between the two approaches appears substantial and amply justifies resorting to multivaried methods.

It is therefore easy to understand why the statistical approach and, more generally, computerized mass appraisal systems have gained in popularity throughout the U.S.A. over the last two decades. A recent publication (Massachusetts Department of Revenue, 1992) reports on the popularity and pecuniary advantages which derive from the use of such systems: CAMA (Computer Assisted Mass Appraisal) systems are now used in some 70 communities in the U.S.A. to appraise more than 333 000 properties totalling some \$57 billion (\$U.S.) in real estate value and generating approximately \$640 million in taxes. In addition, the net benefit the average community annually draws from resorting to a CAMA system, as opposed to the traditional approach, is estimated at \$2 millions. Surely, such savings are higher in large size jurisdictions, but an improvement in the efficiency of the appraisal process as well as a reduction of fiscal inequities are noted in all cases.

5. THE RESIDENTIAL BUNDLE STRUCTURE OF HOUSEHOLDS IN THE QUEBEC REGION : CONCLUDING COMMENTS

5.1 General Conclusion

The results exposed in this report indicate that the objective of the project - i.e. to establish with the help of the hedonic approach the marginal value of residential attributes for the various sub-markets in the region - was achieved. Main findings... :

- ...corroborate many results of previous studies concerning the relative importance of certain key variables;
- ...stress the strategic role played by the socio-economic, locational, fiscal and environmental features in the formation of residential values;
- ...establish the reliability of the statistical approach in determining implicit prices for the physical characteristics of a property (type, area, age, quality, luminosity, fireplace, garage, pool, etc.) as well as for exogenous attributes (level of education of residents in the sector, access to the center and proximity to services, effective taxation rate, negative externalities, etc.);
- ...highlight the differences existing between sub-markets with regard to the relative valuation by households of various residential attributes;
- ...and, finally, show empirically the comparative advantages, for mass appraisal purposes, of the statistical approach over traditional appraisal methods while indicating the elements of complementarity between the two.

5.2 Avenues to Explore

Subsequent to the elaboration of the RÉSIVALU model and the comparative analysis of the residential bundle structure of households in the Quebec region, other research avenues are now being explored, namely... :

- ...the update of the data bank on residential transactions for the period 1990-91 and the dynamic study of changes in residential preferences by households between 1986 and 1991;
- ...the extension of the hedonic approach to rental housing so as to alleviate methodological problems encountered when using the income approach;

- ...the integration of the RÉSIVALU model to a Geographic Information System (GIS) in order to improve model performance and applicability.

While research on these three areas is already well underway, preliminary results deriving from the RÉSIVALU GIS - still only at the prototype stage - have already been published (Des Rosiers & Thériault, 1991; Des Rosiers & Thériault, 1992) and highlight the huge potential such contemporary tools offer for urban and real estate analysis purposes.

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TABLE 1 - Synopsis of Regression Results

Equation No.	Identification of Sub-Market	Functional Form	Particularities	N (# of observ.)	K (Ind. var.)	Price Range	Average Price-(\$)	Adjusted R ²	F Test	SEE (%)
1L	CUQ-General	Linear	All types except duplexes, triplexes, condos and row (over 3 housing units) Logar. transfor. on APPAGE	4 354	39	20 000-200 000	66 921	0.8359	569.634	13.63
1M	"	Multiplicative	"	4 354	39	20 000-200 000	66 921	0.8423	597.066	12.99
2L1	Bungalows-General	Linear	APPAGE in continuous form	2 846	56	20 000-200 000	65 717	0.8488	286.23	10.71
2L2	"	Linear	APPAGE in dummy form	2 846	60	20 000-200 000	65 717	0.8514	272.736	10.61
2M	"	Multiplicative	Logar. transfor. on APPAGE	2 846	57	20 000-200 000	65 717	0.8569	299.922	10.53
3L1	Bungalows-Upper Price Range	Linear	APPAGE in a continuous	1 429	49	63 500-200 000	78 488	0.7844	107.014	9.52
3L2	"	Linear	APPAGE in dummy form	1 429	54	63 500-200 000	78 488	0.7916	101.447	9.36
3M	"	Multiplicative	APPAGE in dummy form	1 429	54	63 500-200 000	78 488	0.7890	99.741	8.33
4L1	Bungalows-Lower Price Range	Linear	APPAGE in continuous form	1 417	42	20 000-63 500	52 838	0.7272	90.852	8.06
4L2	"	Linear	APPAGE in dummy form	1 417	47	20 000-63 500	52.838	0.7273	81.346	8.06
4M	"	Multiplicative	APPAGE in continuous form	1 417	42	20 000-63 500	52 838	0.7386	96.276	9.64
5L1	Two-Storey Houses	Linear	All CUQ jurisdictions	737	30	20 000-200 000	81 544	0.8641	157.049	15.98
5M1	"	Multiplicative	"	737	30	20 000-200 000	81 544	0.8797	180.400	16.72
5L2	"	Linear	Sillery, Ste-Foy, Cap-Rouge, St-Augustin, Haute-Ville	275	19	20 000-200 000	103 376	0.8219	68.541	13.73
5M2	"	Multiplicative	"	275	19	20 000-200 000	103 376	0.8331	72.970	16.60
6L	Semi-Detached and Row	Linear		818	35	20 000-200 000	58 047	0.8411	124.527	9.79
6M	"	Multiplicative		818	35	20 000-200 000	58 047	0.8493	132.543	9.32
7L	Duplexes and Triplexes	Linear	Logar. transfor. on APPAGE	493	24	20 000-200 000	62 779	0.7834	75.134	16.65
7M	"	Multiplicative	"	493	24	20 000-200 000	62 779	0.7899	78.076	17.72
8L1	Condos	Linear	Logar. transfor. on APPAGE LIVAREA according to building density	360	13	20 000-140 000	62 531	0.8911	226.888	8.55
8L2	"	"	Logar. transfor. on APPAGE Logar. transfor. on LIVAREA	360	13	20 000-140 000	62 531	0.8944	235.003	8.41
8M	"	Multiplicative		360	13	20 000-140 000	62 531	0.8908	226.275	8.02
9L	Québec	Linear	Exclusion of Duplexes, Triplexes and condos LIVAREA according to sectors	707	35	20 000-200 000	59 870	0.8523	117.402	11.17
9M	"	Multiplicative	"	707	35	20 000-200 000	59 870	0.8279	98.062	11.78

TABLE 1 - (cont'd)

Equation No.	Identification of Sub-Market	Functional Form	Particularities	N (# of observ.)	K (Ind. var.)	Price Range	Average Price-(\$)	Adjusted R ²	F Test	SEE (%)
10L	Québec,-Basseville	Linear	All types except condos	132	16	6 000-72 000	40 172	0.8022	34.205	17.76
10M	"	Multiplicative	"	132	16	6 000-72 000	40 172	0.8428	44.896	21.02
11L	Vanier-Dubergier, Neufchatel-Les Saules	Linear	Exclusion of Duplexes, Triplexes and condos	299	16	43 000-80 000	57 394	0.7734	64.558	6.80
11M	"	Multiplicative	"	299	16	43 000-80 000	57 394	0.7782	66.362	6.82
12L	Ste-Foy	Linear	Exclusion of Duplexes, Triplexes and condos and row (over 3 units)	581	23	30 000-180 000	74 562	0.8427	136.122	10.36
12M	"	Multiplicative	"	581	23	30 000-180 000	74 562	0.8413	134.691	10.51
13L	Charlesbourg	Linear	Exclusion of Duplexes, Triplexes and condos and row (over 3 units)	876	27	20 000-200 000	67 079	0.8754	228.744	10.52
13M	"	Multiplicative	"	876	27	20 000-200 000	67 079	0.8882	258.427	9.66
14L	Bungalows-Charlesbourg	Linear	Bungalows only	620	21	20 000-150 000	66 588	0.8535	172.665	8.74
14M	"	Multiplicative	"	620	21	20 000-150 000	66 588	0.8608	183.318	8.99
15L	Beauport	Linear	Exclusion of Duplexes, Triplexes and condos and row (over 3 units)	649	24	30 000-135 000	63 394	0.7677	90.207	10.77
15M	"	Multiplicative	"	649	24	30 000-135 000	63 394	0.7829	98.349	10.88
16L	Loretteville	Linear	Exclusion of Duplexes, Triplexes and condos and row (over 3 units)	144	13	39 000-105 000	58 819	0.8975	97.288	6.02
16M	"	Multiplicative	"	144	13	39 000-105 000	58 819	0.8956	95.359	6.07
17L	Ancienne-Lorette	Linear	Exclusion of Duplexes, Triplexes and condos and row (over 3 units)	217	15	40 000-90 000	61 714	0.8274	70.014	7.06
17M	"	Multiplicative	"	217	15	40 000-90 000	61 714	0.8385	75.760	7.13
18L	Val Bélair	Linear	Exclusion of Duplexes, Triplexes and condos and row (over 3 units)	218	14	30 000-66 000	49 709	0.8000	63.007	6.03
18M1	"	Multiplicative	Prop. with EFFAGE < 15 years	218	14	30 000-66 000	49 709	0.8140	68.851	6.10

TABLE 1 - (cont'd)

Equation No.	Identification of Sub-Market	Functional Form	Particularities	N (# of observ.)	K (Ind. var.)	Price Range	Average Price-(\$)	Adjusted R ²	F Test	SEE (%)
19L1	Sillery	Linear	Bungalows and two-storey houses	108	6	66 000-225 000	130 832	0.8457	98.757	10.58
19M1	"	Multiplicative	Idem	108	6	66 000-225 000	130 832	0.8145	79.298	12.51
19L2	"	Linear	Bungalows and two-storey houses LOTSIZE according to 4 sectors	108	6	66 000-225 000	130 832	0.8455	66.074	10.59
19M2	"	Multiplicative	"	108	6	66 000-225 000	130 832	0.8129	52.638	12.57
20L1	Cap-Rouge	Linear	Exclusion of Duplexes, Triplexes and condos and row (over 3 units)	299	18	45 500-130 000	83 703	0.7951	65.250	9.99
20M1	"	Multiplicative	"	299	18	45 500 130 000	83 703	0.8041	68.961	10.04
20L2	"	Linear	Exclusion of Duplexes, Triplexes and condos and row (over 3 units) LOTSIZE according to 2 sectors	299	18	45 500-130 000	83 703	0.7936	64.666	10.03
20M2	"	Multiplicative	"	299	18	45 500-130 000	83 703	0.8007	67.494	10.12
21L	St-Augustin	Linear	Duplexes, Triplexes and condos and row	152	11	35 000-130 000	73 188	0.8090	59.129	11.33
21M	"	Multiplicative	"	152	11	35 000-130 000	73 188	0.8140	61.075	11.62
22L	St-Émile/ Lac St-Charles	Linear	Bungalows and two-storey houses EFFAGE in dummy form	160	17	33 000-78 000	55 64	0.8212	43.966	7.38
22M	"	Multiplicative	"	160	17	33 000-78 000	55 624	0.8284	46.145	7.74
23L	Northern Suburbs (Anc. Lorette, Loretteville, Val-Bélair St-Émile, Lac St-Charles	Linear	Bungalows	664	24	35 000-85 000	56 697	0.8013	112.408	7.72
23M	"	Multiplicative	"	664	24	35 000-85 000	56 697	0.7978	109.974	8.06
AVERAGE EXPLANATORY PERFORMANCE OF SUBMODELS : STANDARD DEVIATION :								0.8246		
								0.0411		
								(5.0%)		
AVERAGE ERROR OF ESTIMATE OF SUBMODELS :										10.49%

Table 2 : Comparative Analysis of Regression Coefficients-Bungalow Submarket

	Equ. 2L1: Bunga. CUQ Lin./APPAGE continuous	Equ. 2L2: Bunga. CUQ Lin./APPAGE dummy	Equ. 2M: Bungalows CUQ Multi/APPAGE continuous	
VARIABLE	Coefficient B ₁	Coefficient B ₁	Coefficient B ₁	Adjust. Fact.
INTERCEPT	73 708	74 759	9.3318	11.291
SILLERY	8 934	8 812	-0.0782	0.925
STEFYOY	-8 737	-8 310	-0.1421	0.868
CAPROUGE	-2.345	-2.369	-0.0534	0.948
BEAUPORT	-5 588	-5 886	-0.1189	0.888
VANIER	-7 553	-9 479	-0.1079	0.898
STEMILE	-14 419	-15 081	-0.2561	0.774
LORETTE	-4 943	-4 713	-0.0797	0.923
CHARL	-1 356	-1 455	-0.0432	0.958
ANCLOR	-3 064	-3 395	-0.0576	0.944
LACSTCH	-9 616	-9 483	-0.2130	0.808
VALBEL	-4 135	-4 269	-0.0987	0.906
STAUG	-15 611	-15 341	-0.2655	0.767
OLD	-2 771	—	-0.0381	0.963
APPAGE	Ln -6 599	—	Ln -0.1135	10 to 15 yrs = $\Delta^+ 4.5\%$
APPAGE1	—	-4 657	—	—
APPAGE2	—	-7 332	—	—
APPAGE3	—	-12 794	—	—
APPAGE4	—	-15 907	—	—
APPAGE5	—	-21 706	—	—
APPAGE6	—	-25 823	—	—
LIVAREA	320	319	Ln 0.4535	100to100 m2 = $\Delta^+ 4.4\%$
BATHROOM	2 833	2 867	Ln 0.0680	2nd bath = $\Delta^+ 4.8\%$
SUPQUAL	6 629	6 779	0.0704	1.073
INFQUAL	-3 965	-3 677	-0.1067	0.899
CLADDING	—	—	0.00005	1.000
BRICKS1	1 297	1 450	—	—
STONES1	3 026	3 413	—	—
ALUMVIN51	—	—	-0.0152	0.985
INFCEIL	—	—	-0.0806	0.923
INFLOOR	—	—	-0.0713	0.931
SUPLUMIN	8 140	8 124	0.0600	1.062
INFLUMIN	-1 810	-1 463	-0.0341	0.966
ELECTRIC	-2 225	-2 138	-0.0247	0.976
FINBASMT	2 108	2 350	0.0304	1.031
RENTBASMT	5 718	5 972	0.0955	1.100
FIREPLACE1	3 350	3 211	0.0427	1.044
FIREPLACE2	6 511	5 558	0.0713	1.074
KITCAB	2 262	1 730	0.0317	1.032
STAIR	3 074	3 646	—	—
DISHWASH	1 460	1 332	0.0213	1.022
OVEN	1 399	1 522	0.0174	1.018
VACUUM	1 873	2 288	—	—
LRGVERAND	2 207	1 829	0.0277	1.028
SOLARIUM	-1 991	-2 111	-0.0255	0.975
BASMTENTR	1 181	1 209	0.0131	1.013
CARPORT	1 311	1 680	0.0241	1.024
SGLDETGAR	3 235	3 367	0.0407	1.042
DBLDETGAR	4 879	4 879	0.0696	1.072
SGLATTGAR	2 883	2 772	0.0391	1.040
DBLATTGAR	4 720	5 802	0.0795	1.083
EXCAVPOOL	4 756	5 116	0.0650	1.067
SHED	1 036	780	0.0181	1.018
LOTSIZE	2.55	2.52	Ln 0.0977	600 to 700 m2 = $\Delta^+ 1.5\%$
CORNER	—	—	0.0200	1.1020
NOSEWER	-6 203	-6 051	-0.1336	0.875
EFFTXRATE	-13 848	-13 776	-0.2398	2.5% to 3.5% = $\Delta^+ 21.3\%$
INCDIFF	—	—	0.000002	\$25000 to \$35000 = $\Delta^+ 2.0\%$
AGE65PL	112	132	0.0024	20% to 30% = $\Delta^+ 2.4\%$
UNIVLVL	397	392	0.0036	20% to 30% = $\Delta^+ 3.7\%$
QUEBCBD	-193	-267	Ln -0.0675	5 to 10min. = $\Delta^+ 4.6\%$
PRIMSCHOOL	Ln -389	Ln -396	-0.0224	(d-d*) Δ^+ by 500m = $\Delta^+ 1.1\%$
PARK	-2 150	-1 952	-0.0348	(d-d*) Δ^+ by 500m. = $\Delta^+ 1.7\%$
NEIGHBSHOP	Ln -611	Ln -653	Ln -0.0094	(d-d*) Δ^+ from 25to75km = $\Delta^+ 1.0\%$
REGSHOP2	3 312	3 305	—	—
SUPRASHOP	Ln -2 081	Ln -2 203	Ln -0.027	(d-d*) Δ^+ from 1 to 1.5km = $\Delta^+ 1.1\%$
POWRSTAT3	1 873	2 077	0.0377	1.038
PERIOD2	—	—	-0.0153	0.985
PERIOD3	903	996	—	—
WEEK	106	110	0.0015	52 weeks = $\Delta^+ 8.1\%$
	adjusted R ² : 0.8488	adjusted R ² :0.8514	adjusted R ² :0.8569	
	SEE: 10.71%	SEE: 10.61%	SEE: 10.01%	

Table 2 : (cont'd)

VARIABLE	Equ. 3L2: Bungalows Upper Price Range Ln./APPAGE dummy	Equ. 4L2: Bungalows Lower Price Range Ln./APPAGE dummy	Equ. 14L: Bungalows Charlesbourg Multi/APPAGE continuous
	Coefficient B _i	Coefficient B _i	Coefficient B _i
INTERCEPT	81 691	64 932	52 536
SILLERY	—	—	—
STEFOY	-10 330	-1 767	—
CAPROUGE	—	—	—
BEAUPORT	-5 967	-2 246	—
VANIER	—	—	—
STEMILE	-12 201	-8 287	—
LORETTE	-3 922	(n.s.) 1 002	—
CHARL	-2 682	1 689	—
ANCLOR	-3 251	(n.s.) 535	—
LACSTCH	—	—	—
VALBEL	(n.s.) -2 695	-1 030	—
STAUG	-15 413	-4 540	—
OLD	—	—	—
APPAGE	—	—	Ln -8 659
APPAGE1	-5 867	(n.s.) -1 308	—
APPAGE2	-8 381	-3 592	—
APPAGE3	-12 745	-7 884	—
APPAGE4	-16 626	-9 966	—
APPAGE5	-21 124	-14 669	—
APPAGE6	-24 747	-18 386	—
LIVAREA	306	229	317
BATHROOM	3 010	1 892	4 138
BRICK51	(n.s.) 652	2 265	—
ALUMIN51	—	—	-2 593
INFLUMIN	(n.s.) 201	-2 913	—
ELECTRIC	(n.s.) 1 787	-2 391	—
FINBSMT	2 657	1 937	2 170
RENTBSMT	5 730	3 826	8 132
FIREPLACE	—	—	2 544
FIREPLACE1	3 075	(n.s.) 838	—
KITCAB	(n.s.) 959	(n.s.) 811	3 284
STAIR	4 183	3 434	—
DISHWASH	1 621	1 081	—
OVEN	1 808	(n.s.) -400	—
VACCUM	3 937	(n.s.) 199	—
VERANDA	—	—	2 761
LRGVERAND	1 975	1 771	—
SOLARIUM	-3 145	(n.s.) -1 002	—
BASMTENTR	1 622	(n.s.) 6	—
CARPORT	(n.s.) 920	2 587	—
GARAGE	—	—	5 138
SGLATTGAR	4 036	1 228	—
DBLATTGAR	5 478	(n.s.) 723	—
EXCAVPOOL	4 154	2 681	8 107
SHED	925	492	—
LOTSIZE	5.53	(n.s.) 0.49	Ln 7 008
EFFTXRATE	-15 372	-8 142	-18 851
AGE65PL	253	-106	—
MONOPAR	—	—	248
UNIVLVL	439	86	468
QUBCBD	-617	-215	-775
PRIMSCHOOL	Ln -614	Ln -260	—
PRIMESCHOOL5	—	—	-4 196
PARK	-1 820	-2 029	—
PARK4	—	—	-2 492
NEIGHBSHOP	Ln -761	Ln -783	—
REGSHOP2	Ln 8 329	-5 449	—
SUPRASHOP	Ln -1 328	Ln -2 198	—
LRHR2	—	—	-3 371
POWRSTAT3	(n.s.) 1 648	1 759	—
POWRLINE1	—	—	-1 748
PERIOD2	—	—	—
PERIOD3	1 849	(n.s.) 277	—
WEEK	108	44	—
MONTH	—	—	(n.s.) 53
	adjusted R ² : 0.7606	adjusted R ² : 0.6544	adjusted R ² : 0.8535
	SEE : 10.03%	SEE : 9.01%	SEE : 8.74%

(n.s.) = non significant

Ln = A logarithmic transformation has been performed on the variable

Table 3 : Comparative Analysis of Regression Coefficients- Condomnium SubMarket

Equ. 8L2 : Condos Hauteville
APPAGE and LIVAREAMultiplic./Ln on APPAGE and LIVAREA

VARIABLE	Coefficient B ₁	Adjustment Factor (in % of aver. sale price)
INTERCEPT	-95 936	—
LNAPPAGE	-3 688	from 5 to 10 yrs = Δ^- of 4.1%
LNLIVAREA	40 181	100 to 110 m ² = Δ^+ of 6.1%
VIEW	6 246	10.0%
STOREY	19 340	30.9%
HIGHDENS	19 734	31.6%
MEDDENS	8 829	14.1%
INDPARK	5 047	8.1%
EFFTXRATE	-11 638	Δ^+ of 1 % pt. = Δ^- of 18.6%
SINGLPERS	348	Δ^+ of 10% = Δ^+ of 5.6%
UNIVLVL	269	Δ^+ of 10% = Δ^+ of 4.3%
BUSSERV	-857	Δ^+ of 1 in the lvl of serv. = Δ^- 1.4%
QUEBCBD	-792	from 5 to 10 min. Δ^- of 6.3%
MONTH	419	12 months = Δ^+ 8.3%

Adjusted R2 : 0.8944
SEE : 8.41%

Equ. 8M : Condos Hauteville Lin./Ln on

VARIABLE	Coefficient B ₁	Adjustment Factor
INTERCEPT	8.4026	4 459
LNAPPAGE	-0.0618	From 5 to 10 yrs. = Δ^- of 3.8%
LNLIVAREA	0.6824	100 to 110 m ² = Δ^+ of 6.8%
VIEW	0.0379	1.039
STOREY	0.1475	1.159
HIGHDENS	0.2401	1.271
MEDDENS	0.1012	1.106
INDPARK	0.0954	1.100
EFFTXRATE	-0.1647	Δ^+ of 1 % pt. = Δ of -15.2%
SINGLPERS	0.0048	Δ^+ of 10% = Δ^+ of 4.9%
UNIVLVL	0.0035	Δ^+ of 10% = Δ^+ of 3.6%
BUSSERV	-0.0189	Δ^+ of 1 in the lvl of serv. = Δ^- of 1.9%
QUEBCBD	-0.017	from 5 to 10 min. = Δ^- of 9.9%
MONTH	0.0062	12 months = Δ^+ of 7.7%

Adjusted R2 : 0.8908
SEE : 8.02%

Table 4 : Comparative Analysis of Regression Coefficients by Municipality/Linear Model

VARIABLES	Québec	V-D-N-L (Queb. new neighb.)	Ste-Foy	Charles- bourg	Beauport	Lorette- ville	Ancienne Lorette	Val-Bélair	Sillery
COTTAGE	-3 912	---	---	-6 513	---	5 059	---	---	---
SEMIDET	-8 608	---	-11 237	-5 383	-4 927	---	-5 949	---	---
BUNGALOW	---	4 533	---	---	3 902	10 817	---	6 801	---
EFFAGE	---	---	---	---	---	-432	---	-348	---
APPAGE	-677	-750	-741	---	-955	---	-822	---	-972
LIVAREA	181	183	265	294	245	258	197	225	---
BATHRM	3 128	---	7 929	4 842	3 439	---	---	---	313
FIREPLACE	2 529	---	---	3 598	4 545	2 557	3 103	1 460	---
DISHWASH	1 695	1 566	---	1 633	---	---	2 415	2 120	---
CARPORT	3 215	3 324	---	---	---	---	2 616	---	---
EXCAVPOOL	6 257	---	5 399	7 819	5 075	---	---	---	---
LOTSIZE	6,95	---	---	---	7,75	2,53	6,02	---	62,70
EFFTXRATE	-10 039	-10 078	-20 922	-19 678	-10 051	-14 241	-17 277	-13 200	-52 871
UNIVLVL	358	---	475	588	372	217	---	239	---
YEAR	4 902	3 160	12 403	1 352	6 847	3 265	---	1 626	12 151
Average price	59 870	57 394	74 562	67 079	63 394	58 819	61 714	49 708	130 832

Table 4 (con'd)

VARIABLES	Cap-Rouge	St-Augustin	St-Émile/ Lac St-Ch.	QUC General	Mean	Standard Deviation	Variation Coefficient	Min.	Max	Nb. of cases
COTTAGE	17 400	9 729	---	---	4 353	8 786	201,87%	-6 513	17 400	5
SEMIDET	---	---	---	-9 859	-7 661	2 384	31,13%	-11 237	-4 927	6
BUNGALOW	18 199	---	6 528	---	8 463	4 883	57,70%	3 902	18 199	6
EFFAGE	---	---	---	---	-390	42	10,77%	-432	-348	2
APPAGE	-1 016	-612	---	---	-818	139	16,99%	-1 016	-612	8
LIVAREA	223	251	255	247	241	38	15,71%	181	313	13
BATHRM	4 481	---	---	6 095	4 986	1 634	32,77%	3 128	7 929	6
FIREPLACE	4 340	---	7 985	4 831	3 883	1 780	45,85%	1 460	7 985	9
DISHWASH	---	---	---	---	1 886	328	17,39%	1 566	2 415	5
CARPORT	---	---	4 749	---	3 476	783	22,52%	2 616	4 749	4
EXCAVPOOL	5 019	---	---	9 732	6 550	1 716	26,20%	5 019	9 732	6
LOTSIZE	3,98	4,15	---	3,86	12,24	19,14	156,35%	2,53	62,70	8
EFFTXRATE	-12 762	-16 694	-6 267	-14 041	-16 779	11 154	66,48%	-52 871	-6 267	13
UNIVLVL	---	---	---	442	384	121	31,55%	217	588	7
YEAR	4 407	5 528	6 550	5 499	5 641	3 401	60,29%	1 352	12 403	12
Average price	83 703	73 188	55 624	66 921	69 447	19 711	28,38%	49 708	130 832	13

Table 5 : Comparative Analysis of Regression Coefficients Expressed as a Percentage of Average Price/Linear Model

VARIABLES	Québec	V-D-N-L (Queb. new neigh.)	Ste-Foy	Charles- bourg	Beauport	Lorette- ville	Ancienne Lorette	Val-Bélair	Sillery
COTTAGE	-6,53%	---	---	-9,71%	---	8,60%	---	---	---
SEMIDET	-14,38%	---	-15,07%	-8,02%	-7,77%	---	-9,64%	---	---
BUNGALOW	---	7,90%	---	---	6,16%	18,39%	---	13,68%	---
EFFAGE	---	---	---	---	---	-0,73%	---	-0,70%	---
APPAGE	-1,13%	-1,31%	-0,99%	---	-1,51%	---	-1,33%	---	-0,74%
LIVAREA	0,30%	0,32%	0,36%	0,44%	0,39%	0,44%	0,32%	0,45%	0,24%
BATHRM	5,22%	---	10,63%	7,22%	5,42%	---	---	---	---
FIREPLACE	4,22%	---	---	5,36%	7,17%	4,35%	5,03%	2,94%	---
DISHWASH	2,83%	2,73%	---	2,43%	---	---	3,91%	4,26%	---
CARPORT	5,37%	5,79%	---	---	---	---	4,24%	---	---
EXCAVPOOL	10,45%	---	7,24%	11,66%	8,01%	---	---	---	---
LOTSIZE	0,01%	---	---	---	0,01%	0,00%	0,01%	---	0,05%
EFFTXRATE	-16,77%	-17,56%	-28,06%	-29,34%	-15,85%	-24,21%	-28,00%	-26,56%	-40,41%
UNIVLVL	0,60%	---	0,64%	0,88%	0,59%	0,37%	---	0,48%	---
YEAR	8,19%	5,51%	16,63%	2,02%	10,80%	5,55%	---	3,27%	9,29%
Average price	59 870	57 394	74 562	67 079	63 394	58 819	61 714	49 708	130 832

Table 5 (con'd)

VARIABLES	Cap-Rouge	St-Augustin	St-Émile/ Lac St-Ch.	QUC General	Mean	Standard Deviation	Variation Coefficient	Min.	Max	Nb. of cases
COTTAGE	20,79%	13,29%	---	---	5,29%	11,66%	220,55%	-9,71%	20,79%	5
SEMIDET	---	---	---	-14,73%	-11,60%	3,18%	27,45%	-15,07%	-7,77%	6
BUNGALOW	21,74%	---	11,74%	---	13,27%	5,48%	41,28%	6,16%	21,74%	6
EFFAGE	---	---	---	---	-0,72%	0,02%	2,40%	-0,73%	-0,70%	2
APPAGE	-1,21%	-0,84%	---	---	-1,13%	0,24%	21,52%	-1,51%	-0,74%	8
LIVAREA	0,27%	0,34%	0,46%	0,37%	0,36%	0,07%	19,10%	0,24%	0,46%	13
BATHRM	5,35%	---	---	9,11%	7,16%	2,08%	29,01%	5,22%	10,63%	6
FIREPLACE	5,18%	---	14,36%	7,22%	6,20%	3,15%	50,86%	2,94%	14,36%	9
DISHWASH	---	---	---	---	3,23%	0,72%	22,21%	2,43%	4,26%	5
CARPORT	---	---	8,54%	---	5,98%	1,58%	26,39%	4,24%	8,54%	4
EXCAVPOOL	6,00%	---	---	14,54%	9,65%	2,90%	30,06%	6,00%	14,54%	6
LOTSIZE	0,00%	0,01%	---	0,01%	0,01%	0,01%	106,74%	0,00%	0,05%	8
EFFTXRATE	-15,25%	-22,81%	-11,27%	-20,98%	-22,85%	7,49%	32,77%	-40,41%	-11,27%	13
UNIVLVL	---	---	---	0,66%	0,60%	0,15%	24,29%	0,37%	0,88%	7
YEAR	5,27%	7,55%	11,78%	8,22%	7,84%	3,83%	48,88%	2,02%	16,63%	12
Average price	83 703	73 188	55 624	66 921	69 447	19 711	28,38%	49 708	130 832	13

Table 6 : Comparative Analysis of Regression Coefficients by Municipality/Multiplicative Model

VARIABLES	Québec	V-D-N-L (Queb. new neighb.)	Ste-Foy	Charles- bourg	Beauport	Lorette- ville	Ancienne Lorette	Val-Bélair	Sillery
COTTAGE	-0,0956	---	---	-0,1055	---	0,0958	---	---	---
SEMIDET	-0,1552	---	-0,1518	-0,1011	-0,0766	---	-0,1056	---	---
BUNGALOW	---	0,0830	---	---	0,0792	0,1988	---	0,1446	---
EFFAGE	---	---	---	---	---	-0,0074	---	-0,0068	---
APPAGE	-0,0117	-0,0131	-0,0103	---	-0,0155	---	-0,0132	---	-0,0078
EFFAGE	0,0027	0,0030	0,0031	0,0037	0,0038	0,0041	0,0029	0,0046	0,0025
BATHRM	0,0619	---	0,0860	0,0064	0,0442	---	---	---	---
FIREPLACE	0,0372	---	---	0,0471	0,0625	0,0357	0,0431	0,0262	---
DISHWASH	0,0253	0,0269	---	0,0339	---	---	0,0352	0,0433	---
CARPORT	0,0584	0,0595	---	---	---	---	0,0438	---	---
EXCAVPOOL	0,0740	---	0,0352	0,0992	0,0694	---	---	---	---
LOTSIZE	0,0001	---	---	---	0,0001	0,00004	0,0001	---	0,005
EFFTXRATE	-0,2080	-0,1724	-0,2826	-0,3151	-0,1703	-0,2535	-0,2805	-0,2763	-0,4258
UNIVLVL	0,0060	---	0,070	0,0084	0,0061	0,0036	---	0,0039	----
DAY	0,0002	---	---	---	0,0003	---	---	---	---
WEEK	---	---	---	---	---	---	---	---	0,0019
MONTH	---	0,0048	0,0135	0,0002	---	0,0045	---	0,0025	---
YEAR	0,0757	0,0587	0,1746	0,0024	0,1194	0,0558	---	0,0302	0,1037
Average price	59 870	57 394	74 562	67 079	63 394	58 819	61 714	49 708	130 832

Table 6 (con'd)

VARIABLES	Cap-Rouge	St-Augustin	St-Émile/ Lac St-Ch.	QUC General	Mean	Standard Deviation	Variation Coefficient	Min.	Max	Adjust. factor	Nb. of cases
COTTAGE	0,1994	0,1219	---	---	0,0432	0,1223	283,01%	-0,1055	0,1994	1,0441	5
SEMIDET	---	---	---	-0,1459	-0,1227	0,0298	24,28%	-0,1552	-0,766	0,8845	6
BUNGALOW	0,2275	---	0,1321	---	0,1442	0,0548	38,02%	0,0792	0,2275	1,1551	6
EFFAGE	---	---	---	---	-0,0071	0,0003	4,23%	-0,0074	-0,0068	0,9929	2
APPAGE	-0,0127	-0,0090	---	---	-0,0117	0,0023	20,13%	-0,0155	-0,0078	0,9884	8
LIVAREA	0,0026	0,0031	0,0049	0,0030	0,0034	0,0007	21,86%	0,0025	0,0049	1,0034	13
BATHRM	0,0498	---	---	0,0740	0,0637	0,0141	22,08%	0,0442	0,0860	1,0658	6
FIREPLACE	0,0575	---	0,1320	0,0711	0,0569	0,0297	52,17%	0,0262	0,1320	1,0586	9
DISHWASH	---	---	---	---	0,0329	0,0065	19,60%	0,0253	0,0433	1,0335	5
CARPORT	---	---	0,0799	---	0,0604	0,0129	21,28%	0,0438	0,0799	1,0623	4
EXCAVPOOL	0,0600	---	---	0,1111	0,0748	0,0249	33,33%	0,0352	0,1111	1,0777	6
LOTSIZE	0,0001	0,0001	---	0,0001	0,0001	0,0001	110,60%	0,00004	0,0005	1,0001	8
EFFTXRATE	-0,1540	-0,2414	-0,1184	-0,2267	-0,2404	0,0774	32,21%	-0,4258	-0,1184	0,7863	13
UNIVLVL	---	---	---	0,0061	0,0059	0,0016	26,41%	0,0036	0,0084	1,0059	7
DAY	---	0,0002	---	---	0,0002	0,0000	20,20%	0,0002	0,0003	1,0002	3
WEEK	---	---	0,0021	---	0,00020	0,0001	5,00%	0,0019	0,0021	1,0020	2
MONTH	0,0045	---	---	0,0063	0,00052	0,0038	74,16%	0,0002	0,0135	1,0052	7
YEAR	0,0554	0,0757	0,1144	0,0783	0,0787	0,0432	54,92%	0,0024	0,1746	1,0819	12
Average price	83 703	73 188	55 624	66 921	69 447	19 711	28,38%	49 708	130 832		13

Table 7 : RÉSIVALU Model vs. Traditional Approach - Comparative Analysis

Iden. Code of Equation	Segment considered	RÉSIVALU Model		Sales Price = f (normalised evaluation)			
		Adjusted R square	SEE %	Adjusted R square	SEE%	Coeff. B ₀	Coeff. B _i
1L	QUC-General	.8359	13.63	.8280	13.96	3 233	1.0129
* 2L1	QUC-Bungalows	.8488	10.61	.7655	13.33	5 916	0.9750
**3L1	Bungalows-Upper Price	.7844	9.52	.6809	11.58	17 400	0.8555
** 4L1	Bungalows-Lower Price Segment	.7272	8.06	.4280	11.67	22 561	0.5916
5L1	QUC-Cottages	.8641	15.98	.8699	15.64	2 786	1.0444
5L2	Cottages-Upper Price	.8219	13.73	.8145	14.01	6 328	1.0236
6L	QUC-Semi-Detached & Row	.8411	9.79	.8180	10.47	9 604	0.8472
7L	QUC-Plex	.7834	16.65	.7693	17.18	5 205	0.9648
* 8L1	Condos, Upper-Town	.8911	8.55	.8461	10.16	864	0.9692
9L	Québec	.8523	11.17	.8604	10.86	2 914	0.9214
10L	Québec, Lower-Town	.8022	17.76	.8792	13.88	-3 009	1.0225
**11L	Québec, New Neighborhoods	.7734	6.80	.6683	8.23	13 833	0.7434
* 12L	Ste-Foy	.8427	10.36	.7965	11.79	5 805	0.9527
* 13L	Charlesbourg	.8754	10.52	.8014	13.28	3 899	1.0345
** 14L	Charlesbourg-Bungalows	.8335	8.74	.7073	12.35	8 637	0.9582
* 15L	Beauport	.7677	10.77	.6849	12.54	14 584	0.8755
** 16L	Loretteville	.8975	6.02	.7268	9.83	12 385	0.8544
** 17L	Ancienne-Lorette	.8274	7.06	.6839	9.56	10 723	0.8990
** 18L	Val-Bélair	.8000	6.03	.4233	10.24	15 116	0.7219
** 19L	Sillery	.8457	10.58	.6870	15.07	26 288	0.9030
** 20L	Cap-Rouge	.7951	9.99	.6436	13.18	3 621	0.0015
21L	St-Augustin	.8090	11.33	.7911	11.85	5 641	0.9893
** 22L	St-Émile/Lac St-Charles	.8212	7.38	.6843	9.80	12 552	0.8400
** 23L	North Surburb	.8013	7.72	.6263	10.59	12 372	0.8367
Average		0.8234	10.36	.7285	12.13		