City Comparisons of Shelter Costs in Canada: A Hedonic Approach*

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Introduction

Inter-city Indexes of retail price differentials (or spatial price indices) have been produced by Statistics Canada since 1955. Although these price indicators share certain commonalities with the better-known Consumer Price Index (CPI), they remain quite distinct in terms of their use and construction. Further, the level of detail of the spatial index program was incomplete, relative to the CPI. For instance, in a move to improve the coverage of the spatial indices, commodity categories such as restaurant meals, clothing and furniture were added in 1995. Even then, shelter-related costs remained excluded. The importance of this missing component is not to be underestimated. Economists have long known that shelter costs are the prime factor behind price level differences among geographical areas.

Measures that compare geographical differences in price levels satisfy a growing demand for this type of information. Differences in regional prices have implications for regional cost-of-living comparisons. Information on regional price

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differences is important not only to government and academia, but also to businesses and individuals contemplating relocation. By quantifying these differentials, this new source of information has potential applications for decision-making – such as for use in wage adjustments and as a deflator for regional income levels. This is a critical issue in the present socio-economic context.

The inclusion of shelter in the spatial index is vital because most of the variation in living costs in Canada is explained by differences in shelter costs.[1] However, shelter has presented measurement challenges for the spatial indices. Specifically, the heterogeneity of shelter has prevented a meaningful comparison of prices across regions.[2] This paper continues the inquiry by further developing the techniques employed previously and by focusing attention on one particular model used to calculate spatial price indices for shelter.[3] Furthermore, this paper introduces several novel contributions: a) rental equivalence methodology is for the first time applied on a combination of several unique Canadian data sets to be able to analyze rental prices spatially at a national level; b) the multi-stage design of the survey data is exploited within the context of hedonic modeling (i.e. neighbourhood effects are included); and c) primarily, a hedonic methodology has been combined with bilateral index number theory allowing for the development of shelter-cost indices. These results are also novel in that, for the first time in Canada, quality-adjusted price indices that account for locational variations across Canada can be used for comparative purposes.

A rental equivalence approach is used to measure the cost of shelter service for homeowners. To control for the heterogeneous nature of shelter among areas, a semi-log hedonic regression model is used to produce Laspeyres, Paasche, and Fisher-Törnqvist quality-adjusted price indices for the spatial comparison of rental prices among 16 Census Metropolitan Areas (CMAs) across Canada.

First, the methodology and assumptions used in the analysis are outlined. Then, the various data sources are briefly described. This is followed by an outline of the model and estimation techniques as well as the rational for these choices. The data analysis and the results of both the regression output and the indices are then presented. Concluding remarks make up the last section.

1. Furthermore, it is interesting to note that shelter is the principal component of family expenditure accounting for 27.9 % of average household expenditures in 1992. Due to the substantial differences in shelter cost price levels, variation in shelter costs can have a substantial effect on a consumer's budget allocation.
2. The heterogeneity of shelter refers to the variety and diversity of the commodity "shelter". Shelter is made up of a variety of quality characteristics, which is discussed in greater detail in the body of the paper. Not all shelter units contain the same characteristics and, as such, not all dwellings are equal or homogeneous.
3. Other techniques used previously are discussed in Prud'homme and Thivierge (1999).

Methodology

Rental Equivalence

The cost of shelter service includes both tenant and owned accommodation. A rent-based measure is the generally agreed upon method for measuring tenant accommodation; however, the approach to measure owned accommodation is more controversial. There are several approaches to measuring housing costs: money outlays, net purchase, rental equivalence, and user cost.

The money outlay approach calculates the cost as the sum of actual cash disbursements, inclusive or exclusive of equity payments that the homeowner must pay for the use of her home. The net purchase approach calculates the cost to the homeowner of purchasing her home outright, taking into consideration the costs associated with home maintenance.

This study focuses on the rental equivalence and user cost methods as the two most relevant approaches, because they are the most widely used by statistical agencies for measuring changes to the cost of shelter within the context of temporal price indexes. The rental equivalence approach reflects the value of the service that a shelter unit will generate for the homeowner. By contrast, a user cost approach focuses mainly on the opportunity cost of owning a dwelling unit. Both approaches represent a measure of the cost of the flow of services resulting from owning and living in a dwelling. These approaches are operationally different, but are conceptually equivalent.

A basic model of user cost should measure the opportunity cost of consuming a dwelling's flow of services. Costs such as, financing (or opportunity cost of money), depreciation, maintenance of the property (repairs and insurance), and changes in market value (home price appreciation), should all be considered when calculating the dollar value necessary to "bribe" the owner to give up their unit of shelter. Assuming owners utility maximize the user cost value is the amount of bribe that is necessary to make an owner indifferent between the bribe and their current dwelling. In housing markets where owner and tenant markets are not segmented, transaction costs are zero, no uncertainty exists, and markets are not distorted by individual or asset taxes, then the use of observed rental prices as proxies for flow of service from shelter use (rental equivalence) is equivalent to user costs in long-run equilibrium (Dougherty and Van Order 1982).

Rental equivalence uses observed market rents as approximations for cost of homeownership and, more generally, housing. This approach asks, "how much the homeowner would charge someone such as himself to rent his house" (Darrough 1983: 603). By observing actual market rental prices the potential rent can be estimated. This approach assumes that the cost of the shelter or housing service for homeowners may be approximated by using observed market rents. The rental equivalence approach is therefore the preferred approach for this study and is employed in the subsequent analysis.

The rental equivalence approach is preferred for several reasons. First, in practice and in the short- to medium-term user cost estimates and market rent do not move together. Generally, rental prices are relatively stable through time, whereas cost estimates have a tendency to be volatile. Second, defining and measuring the relevant variables required for deriving user cost estimates are often problematic. Darrough (1983) argues that user cost methods should not be considered unreliable in cases where variables are defined and measured appropriately. However, user cost estimates are typically sensitive to alternative assumptions surrounding variable choice and calculation. Thus, appropriate estimation of relevant variables that address how to deal with capital gains and differential tax treatments of assets and individuals are essential. Finally, it has been argued that the collection of housing prices by region is expensive, which makes the user cost approach more burdensome on given resources relative to the simpler task of collecting observed market rents. Although, the rental equivalence approach may not be the best approach, it is certainly the most feasible for deriving spatial estimates (Darrough 1983).

Hedonic Approach

The hedonic regression approach has a long and established tradition in empirical economics for measuring price-quality relationships. It is essentially based on a utilitarian philosophy that compares the price of commodities to measure the welfare and satisfaction consumers derive from the consumption of goods and services. With the hedonic approach, most goods and services are considered a composite commodity formed from a series of other goods and services, and these are usually referred to as attributes or quality characteristics. The contribution of each attribute to the value of the composite commodity can be derived through hedonic regression techniques. Thus, a hedonic regression for shelter can be used to measure the effects of specific dwelling quality characteristics on the rental price. Consequently, two rental units exchanged in the same market, the first having more desirable features than the second, will result in the first having a higher renter valuation, and thus, a higher rental price.[4]

The hedonic method recognizes the rental price of housing as being the price of a stream of goods and services that are bundled together to produce a composite commodity labelled "housing". The stream of goods and services are quality characteristics that make up the pure space. Although, the quality characteristics of housing are not sold separately, using the hedonic technique, an implicit price can be derived for each attribute that makes up the composite product. This follows from the assumption that implicit markets exist for these quality characteristics. Implicit prices are assumed to be supply determined or market generated and external to the household's consumption decision (price taking behaviour). The assumption of supply-determined prices is a valid one in cases of durable goods, such as housing, when supply is relatively stable (Muellbauer 1974). However, the approach of this study is demand oriented because it is the welfare of consumers that is being considered, and so the hedonic method used does not attempt to fully explain market phenomena.

4. More 'desirable' can be understood to be not the quality of the attribute but the quantity of the quality characteristic.

It follows from the assumptions stated above that the rental price can be decomposed into the rental units attributes' marginal prices. However, to achieve this result, it is also necessary to assume that the quality characteristics are homogeneous, and that the goods comprising the composite quality characteristics are also homogeneous. This assumption implies that the current state is the short run, and that any changes in characteristics and quality can only exist in the long run. Homogeneity is also important because it allows the good to take on an objective nature. Thus, the consumer's rental decision is between the collection of characteristics only and not between the qualities of specific attributes. This creates an opportunity to isolate the effect of quality change on prices (Lancaster 1966).

For example, the assumption of homogeneous characteristics in the case of bedrooms implies that all bedrooms are equal. There are no distinctions made by square footage, number of windows per room, closet size, or whether there is an en suite bath. Thus, the assumption being made is that consumers make their rental decision based strictly on the "collection" of quality characteristics and not on the "quality" of the quality characteristics. Continuing with the bedroom example, consumers make their decision based strictly on the number of bedrooms in the dwelling and not on the quality characteristics of each bedroom (i.e. the size of the bedroom, number of windows in the room, size of the room's closet, or direct access to a bathroom). In summary, all bedrooms are assumed to be equal within a dwelling, and across all dwellings and locations. In other words, a bedroom in Montréal is the same as a bedroom in Regina, and this holds for all attributes that comprise the good "shelter".

Data sources

Two main sources of data are used in the analysis: the Labour Force Survey (LFS) (August 1998 to December 1999) and the 1996 Census of Canada. The sample size is 14,434 households. The LFS rent questionnaire provides the physical characteristics of the dwellings and the Census provides the socio-economic characteristics of the neighbourhood in which the dwellings are located. Consequently, the primary unit of analysis for this investigation is the dwelling and the secondary unit is the neighbourhood or Enumeration Area (EA).[5] A novel exercise of postal code matching ensured that the rental units (their price and physical features) corresponded to the socio-economic features from the Census data. Combining both datasets, in order to expand the number of explanatory variables in a hedonic rent model, is a first for a study of this kind in Canada.

5. Information that is collected from the LFS, but that has been omitted from the analysis includes dwellings that are used for the dual purpose of home and business operations, and dwellings subsidized by government, employer, or relative.

Statistical Model

Economic theory does not suggest a functional form for hedonic models. Typically, researchers turn to the literature and goodness-of-fit criteria when choosing an appropriate functional form. Prud'homme and Thivierge (1999) reviewed several different models that could be used for the construction of spatial-shelter hedonic price indices. Specifically, separate regressions, dummy variable (pooled regression), and random coefficient models were all investigated with various functional forms such as linear, semi-log and log-linear models.

As for the type of model, a separate regression model was selected for the purpose of this study. The decision was based on Muellbauer (1974: 980) who argues that, "as far as possible, markets should be divided into segments based on commodity groupings which make it likely that their consumers have similar marginal rates of substitution (MRS) and these segments should be studied separately". He adds that this segmentation will result in less cross-sectional variation, but at the expense of more problems of multicollinearity. Hill and Mesler (2005) also add that a pooled regression approach does not satisfy the temporal fixity condition; in the context of hedonically computed spatial price comparisons, this means that if another city is added to the comparison, then the shadow prices (or coefficients) will be recalibrated and the relative position of the rental prices for the various cities will change. This is certainly not a desirable outcome in such an exercise. For the purpose of this study, the separate regression approach means that a regression is run for each segment, census metropolitan area, or location – as opposed to pooling all of the segments or locations together, controlling for area or segment, and running one regression. This paper assumes that consumers within a given location or segment have similar MRS and, as such, these areas are studied separately.[6]

The use of the separate regressions model approach could open the estimation

6. This paper uses the separate regressions approach for estimation. The decision follows from Muellbauer's (1974) investigation into hedonic techniques, where he suggests that there are grave problems with aggregation of locations or groups of consumers when marginal rates of substitution (MRS) are different. According to Muellbauer, the issue is two-fold. First, utility levels and tastes are often different as can be seen from Table 2 where the parameter estimates differ for the same characteristics across cities, and second, the implicit income distribution is also different across cities. Further, from Table 1, it can be seen that due to the wide discrepancy in the frequency or occurrence of certain quality characteristics across locations that consumers' MRS are likely to be dissimilar across cities. Thus, segmenting the locations into groups that are more likely to have similar MRS ensures that the model does not force relative prices to correspond to an aggregate or unique consumer's evaluation of relative quality characteristics. Therefore, various pooling specifications have been rejected on theoretical grounds and empirical evidence from Table 1, because under many of the pooling specifications the marginal prices and MRS are assumed to be fixed across locations (equivalent for all cities and not permitted to vary). See Miron (1995) for an example of fixed MRS across locations. Nonetheless, a pooled model where all variables of interest are interacted with locational dummy variables would produce a model that fits with the discussed theory, and results in a model with parameter estimates for each location consistent with the separate regressions approach. Since both the separate and pooled regressions produce consistently identical estimates and the bilateral indexes do not employ the errors in the estimation of the interarea price indices, the price indexes are identical under both model specifications.

in this study up to problems due to sampling variability; however, we posit our large sample size insulates the study from such problems. To investigate the extent of sampling variability two repeated estimation methods were used an out-of-sample and a bootstrap technique.

The out-of-sample method used 1000 replicated random out-of-sample simulations, in combination with a Hausman-like test that was used as a standardized comparison of model coefficients, to investigate the issue of sampling variability. Results indicate that sampling variability is on average not a significant problem (at the 95 % level of confidence). The tests were conducted by first holding in reserve, for the purpose of comparison, a randomly drawn sample representing 20 % of total observations for each city. Separate regressions for each city were run on both the 20 % and 80 % samples. Wald tests for testing the equality of coefficients across regressions for the 20 % to the 80 % sample coefficients were run for each city. These tests were also run with reserve samples of 15 %, 25 %, and 50 % and the results were similar.

The issue of sampling variability was further explored through a process of bootstrap sampling and estimation. It is assumed, as is usually the case, that the observed sample distribution is identical to the population distribution. Operationally, bootstrap sampling in this paper consists of drawing 1000 samples from our original sample with replacement; then separate regressions for each city on each of these 1000 samples were run in order to derive both estimates of bias for the coefficients and standard error estimates. The bias estimate is the difference between the average of the bootstrap coefficient estimates and the non-bootstrap coefficient estimate (or original estimate), as defined by Efron (1982). Standard errors are calculated by taking the coefficients generated by bootstrapping and applying a standard variance formula. The ratio of these two measures can be used to evaluate the sample variability. If the ratio obtained by dividing the coefficient's bias by the coefficient's standard error is greater than 25 % then according to Efron (1982) the bias due to sampling variability should be considered serious. The average ratio across all cities and parameters was 11.4 %, with only 6 % of the variables (15 of 256) recording a ratio over 25 %. Consequently, these results are taken as an indication that sampling variability is not a serious concern. In the end, even if the data manifested a high degree of sampling variability it would not necessarily affect the resulting price indexes, because only the estimates of standard error for the parameters would be affected due to their potential downward bias. This follows from Mooney and Duval (1993) who argue that a corrected unbiased estimator may have a larger mean square error than the biased estimate computed using the original observations, and so they suggest that it is a good practice to use the original estimate.

Based on the above discussion and following the work of Prud'homme and Thivierge (1999) this study is limited to separate hedonic regression models of rent. To further investigate the issue of model specification two tests to determine the appropriate specification that would generate the best functional form for the available data were also explored. The two tests used to investigate model functional form were the Box-Cox transformation and the MacKinnon, White and Davidson (1983) PE test. Both tests indicated that the semi-log specification was the most appropriate for the given data.

Hedonic studies by MacDonald (1986) and Salois (1987) also found that linear and semi-log specifications functional forms provided the best overall fit in the case of housing and rental units. The Cropper et al (1988) simulation study compared the consistent performance of a wide spectrum of models that faced measurement and omitted variable scenarios, and found that simpler functional forms such as linear, semi-log, double-log, and Box-Cox linear models considerably outperformed quadratic and Box-Cox quadratic specifications.

A specification should be chosen because of its inherent qualities. Most importantly, it should have *a priori* analytical usefulness and it should be an accurate descriptor of the underlying character of the data. A model specification should be rejected if the relationship between the dependent and independent variables suggests that a more appropriate specification is required.

A semi-log model specification is used to describe the relationship between rental prices and dwelling attributes. It is clear from the tests that the semi-log specification is the best descriptor of the data. The model's *a priori* analytical usefulness comes from three main points: it has performed well in goodness-of-fit tests in the literature (Moulton 1995); it has demonstrated an ease of use in routine production of indices (Prud'homme and Yu 1999); and its regression coefficients have an interpretable meaning. The explanatory coefficients (β) measure the constant proportional or relative change in the dependent variable (Y) for a given absolute change in the independent variable (X).

$$\beta = \frac{relative\ \Delta Y}{absolute\ \Delta X} \cong \frac{\frac{Y_k - Y_{k-1}}{Y_{k-1}}}{X_k - X_{k-1}} \tag{1}$$

Thus, the exogenous coefficients will vary proportionately with changes in the endogenous variable. The natural logarithm of rental price is regressed on the physical and socio-economic attributes by location. The separate regression semi-log model is described as:

$$Y_{vk} = \alpha_v + \sum_{j=1}^{J} \beta_{vj} X_{vjk} + \epsilon_{vk} \tag{2}$$

where Y_{vk} is the natural logarithm of monthly rent paid for the k^{th} dwelling in location v; a_v is the intercept of location v; b_{vj} is the coefficient vector for the j quality characteristics of the dwellings, and X_{vjk} is the matrix of all attributes (physical and socio-economic). The error term is represented by e_{vk} for the k^{th} dwelling in location v.

TABLE 1 Descriptive Statistics of Variables of Interest (with standard errors in parenthesis)

	St. John's	Halifax	Quebec City	Toronto	Winnipeg	Vancouver
Rent (dollars)	509.93	589.67	493.95	862.61	502.48	805.64
	(10.83)	(6.38)	(10.92)	(7.74)	(3.81)	(8.8)
<= 10 years*	0.170	0.197	0.133	0.057	0.028	0.126
	(0.025)	(0.014)	(0.012)	(0.005)	(0.004)	(0.009)
10 < age <= 20 years*	0.243	0.181	0.158	0.170	0.166	0.167
	(0.028)	(0.013)	(0.013)	(0.008)	(0.01)	(0.01)
20 < age <= 40 years*	0.337	0.413	0.405	0.532	0.525	0.482
	(0.031)	(0.017)	(0.017)	(0.01)	(0.013)	(0.013)
> 40 years*	0.250	0.209	0.304	0.240	0.280	0.226
	(0.028)	(0.014)	(0.016)	(0.009)	(0.012)	(0.011)
Detached Housing*	0.710	0.198	0.161	0.185	0.217	0.334
	(0.03)	(0.014)	(0.013)	(0.008)	(0.011)	(0.013)
Bedroom	2.062	1.725	1.750	1.712	1.597	1.715
	(0.053)	(0.031)	(0.028)	(0.018)	(0.022)	(0.027)
Luxuries*	0.090	0.262	0.050	0.179	0.401	0.345
	(0.019)	(0.015)	(0.008)	(0.008)	(0.013)	(0.013)
Utilities*	0.173	0.759	0.499	0.837	0.688	0.539
	(0.025)	(0.015)	(0.018)	(0.008)	(0.012)	(0.013)
Electricity*	0.122	0.219	0.380	0.679	0.433	0.166
	(0.021)	(0.014)	(0.017)	(0.01)	(0.013)	(0.01)
Fridge/Stove*	0.870	0.904	0.170	0.942	0.947	0.939
	(0.022)	(0.01)	(0.013)	(0.005)	(0.006)	(0.006)
Washer/Dryer*	0.095	0.081	0.016	0.143	0.239	0.257
	(0.019)	(0.01)	(0.004)	(0.007)	(0.011)	(0.012)
Parking*	0.813	0.817	0.746	0.641	0.635	0.569
	(0.026)	(0.014)	(0.015)	(0.01)	(0.013)	(0.013)
% of rented dwellings	42.267	67.678	65.294	69.643	65.805	58.775
	(1.447)	(0.944)	(0.91)	(0.577)	(0.775)	(0.675)
% with major repairs	6.047	6.282	5.786	9.272	8.320	7.845
	(0.336)	(0.181)	(0.16)	(0.141)	(0.194)	(0.149)
% post-secondary	55.535	60.698	46.511	52.401	47.602	60.835
	(0.966)	(0.592)	(0.594)	(0.321)	(0.392)	(0.357)
commuting distance	6.154	5.638	5.318	5.859	4.638	5.793
	(0.237)	(0.119)	(0.101)	(0.046)	(0.071)	(0.06)
% under low Y cut-off	17.199	23.584	28.457	28.089	29.246	22.391
	(0.822)	(0.6)	(0.604)	(0.365)	(0.535)	(0.335)
Number of Obs	235	819	793	2319	1424	1400

Note: * These statistics are frequencies and all others are averages.

Variables

The independent variables used for the hedonic regression are grouped into three broad categories: physical, socio-economic and spatial variables. Spatial divisions were handled through separate regressions conducted on each location. The dwelling attributes or exogenous variables are made up of physical quality characteristics and socio-economic attributes. See Table 1 for the descriptive statistics of the dependent and independent variables for select cities.

The physical quality characteristics are attributes that are unique to the individual dwelling. According to Statistics Canada (2000) a dwelling is defined, for the purpose of the Labour Force Survey, as "a set of living quarters that is structurally separate from the living quarters of other dwellings and has a private entrance outside the building or from a common hall or stairway inside the building". Physical characteristics define the nature of the dwelling and thus the flow of services the dwelling provides to the users. The socio-economic attributes are unique to the enumeration area (EA) or Census Tract (CT). Therefore, dwellings within the same enumeration area have identical socio-economic attributes. Socio-economic characteristics are calculated as the percentage of dwellings within the EA with the given attribute.

The physical characteristics used as independent variables in the regression are the type of dwelling (categorized as either detached housing or apartments), age of structure, number of bedrooms in the dwelling (ranging from bachelor apartments with no bedrooms to dwellings with 4 or more bedrooms), and a series of commodity dummy variables. The commodity dummy variables capture goods and services included with the rental price. They are heat, hot water, electricity, refrigerator, stove, washer, dryer, cable television, furniture, other major appliances, and parking. Composite commodity variables are created to limit the influence of multicollinearity.

The socio-economic variables are included in the model to avoid the variable proxy problem. Including neighbourhood information attempts to construct a model with a more complete specification. The independent neighbourhood variables used in the model are percentage of private dwellings rented in an enumeration area, percentage of private dwellings in need of major repairs, percentage of persons with post-secondary education, average commuting distance to work (km), and percentage of persons living under the low income cut-off (LICO).[7] LICOs are set at income levels that are differentiated by size of area of residence (or degree of urbanization) and by family size. The 1992 national Family Expenditure Survey data are used to arrive at benchmark levels of LICO for a given year and the CPI is subsequently used to refresh these levels annually. If 70 % or more of a family's income is spent on basic necessities such as food, shelter and clothing, then their circumstances are considered "straitened" and they were categorized as low income. The cut-off was an arbitrary number used to delineate family units into "low income" and "other" groups. Any family with income equal to or above the cut-off is considered in the "other" category (Statistics Canada 1997). By including the socio-economic characteristics, it was assumed that implicit markets exist for these regional and neighbourhood ambient quality characteristics.

7. Endogeneity is not an issue that is commonly addressed in the hedonic literature; none of the current literature referenced in this study address this issue. The potential for endogeneity exists if the variables, rental price and LICO, are jointly causal. The argument is that households falling below the LICO are more likely to gravitate to lower priced housing, and that lower rental prices lead to a higher proportion of households below the LICO. Endogeneity is due to the circular causality and the contemporaneous correlations between the errors and the regressors resulting in inconsistent estimates. Many researchers treat LICO as being exogenous even though a case can be made for its endogeneity. In the case of this study we diminish the statistical problem of endogeneity of LICO, by abating the link of causation, by using its lagged value so that it is not contemporaneous with the dependent variable. Thus, reverse causation is minimized. Any changes in the dependent variable (1999 rental prices) are less likely to affect the independent neighbourhood census variables (including the LICO variable) defined in 1996, because they are not contemporaneous.

Estimation and Indices

This study uses an index approach as the metric for measuring differences in rents paid across cities.[8] Hedonic indices, such as the ones computed in this study, respect the same rules and principles as conventional price indexes (temporal and spatial).[9] Therefore, hedonic indexes will obey the same properties as their conventional counterparts. Consequently, the paper computes three varieties of the most popular indexes in the literature when comparing hedonically quality-adjusted rental prices across cities: Laspeyres, Paasche, and Fisher-Törnqvist. All have their advantages and disadvantages and a lengthy discussion on this subject is beyond the scope of this paper. Suffice to say that the Laspeyres and the Paasche indexes are considered transitive, however a Laspeyres (hedonic) price index will tend to overestimate the true difference in rental prices while the Paasche (hedonic) price index will underestimate this difference. To remedy this important problem associated with the Laspeyres and Paasche indexes, Fisher-Törnqvist indexes are also computed. This index formula is deemed superlative but suffers from the absence of transitivity. In the end, the choice of formula is usually left to the user based on her preferences.

The calculation of hedonic indices is a two-step procedure. First, quality characteristic coefficients must be obtained from a regression of rental price on the quality characteristics. In the second step, the coefficient estimates are used to construct a Fisher-Törnqvist spatial price index. Before proceeding with the regressions, problems with model specification, multicollinearity, omitted variable basis, and non-spherical errors are addressed.

The first step in the estimation of quality-adjusted price indices is to generate quality characteristic coefficients; this is done using separate regressions for each index area (i.e. each urban centre). Further, a Feasible Generalized Least Squares (FGLS) two-stage estimator was used to correct for the variation in disturbances within the classes of attributes.

The second step in the production of inter-area indices is to apply the coefficients from the estimation to the construction of a Fisher-Törnqvist (*FT*) spatial price index, which is a geometric mean of the Laspeyres (*L*) and Paasche (*P*) price indices. Gillingham (1975) furthered the practice of constructing a geometric mean with semi-log hedonic quality-adjusted equations and Moulton (1995) extended the use of hedonic equations to inter-area indices. The Laspeyres index uses the reference area's mean value for characteristic j as the base ($\bar{X}_{jv_o}$) to weight the difference of the coefficients across areas:

8. An alternative approach to producing indexes would be to compute the quality-adjusted rent (or predicted rent) and express these values in monetary terms. However, presenting the results in index form has its advantages. For instance, there can be no confusion with regards to the base of comparison; the reference city or geographical area is, according to tradition, always equal to 100.

9. By conventional (or non hedonic) indexes, we mean indexes where the quantities and the prices are directly observed as opposed to hedonic price indexes where we have shadow prices and quantities of physical and non-physical characteristics.

$$P^{L}_{v_i v_o} = e^{\sum_j (\beta_{jv_i} - \beta_{jv_o})(\bar{X}_{jv_o})} \tag{3}$$

Note the reference area is represented by o and the comparison area by i. The Paasche index uses the area of comparison's mean value for characteristic j as the base ($\bar{X}_{jv_i}$):

$$P^{P}_{v_i v_o} = e^{\sum_j (\beta_{jv_i} - \beta_{jv_o})(\bar{X}_{jv_i})} \tag{4}$$

By geometrically averaging the two indices, a Fisher-Törnqvist index is produced:

$$P^{FT}_{v_i v_o} = \sqrt{P^{L}_{v_i v_o} P^{P}_{v_i v_o}} = \sqrt{e^{\sum_j (\beta_{jv_i} - \beta_{jv_o})(\bar{X}_{jv_o})} e^{\sum_j (\beta_{jv_i} - \beta_{jv_o})(\bar{X}_{jv_i})}} \tag{5}$$

$$P^{FT}_{v_i v_o} = (P^{L}_{v_i v_o} P^{P}_{v_i v_o})^{\frac{1}{2}} = e^{\frac{1}{2}\sum_j (\beta_{jv_i} - \beta_{jv_o})(\bar{X}_{jv_o} + \bar{X}_{jv_i})} \tag{6}$$

By using a geometric mean of the Laspeyres and Paasche indices, these indices' averages of characteristic j are used for the reference and comparison areas, respectively. The issue of non-transitivity of the Fisher-Törnqvist index still remains.

Data Analysis and Results

The overall fit of the model is generally good and consistent with previous cross-sectional studies. If the majority of variable coefficients have *a priori* correct signs and are of reasonable magnitude, then any deviation from the priors are assumed to be caused by omitted variables. Included variables could be acting as proxies if the model is mis-specified or does not include enough of the good's attributes to void the proxy relationships.

The discrete age variables were expected to have negative coefficients. Generally, as the age of a structure increases, the willingness to pay for the space decreases. It was expected that the dwelling type variable would have a positive sign as renters were expected to prefer a single detached housing style of living to apartment style living. The supporting argument is that if renters perceive neighbourhoods with single detached housing to have lower mortality rates, crime rates, mental illness, less juvenile delinquency, and less household overcrowding, then they may put a premium on detached housing, and the coefficient Detached Housing should have a positive sign.[10] The bedrooms and all commodity variables were expected to be positive because they add to the convenience of the dwelling. The majority of coefficients fell in line with the expectations of the authors. Those that did not were usually not significant (see to Table 2). Thus, the omitted variable issue is not considered to be a serious problem with the model specification.

There is an issue of the unlikely direction of estimates (unlikely positive or negative sign) and large standard errors for some of the coefficients. This may be due to the frequency or lack of frequency of a given variable for a particular city. When a variable appeared either highly infrequently as in the case of washers and dryers in Montreal, or frequently as in the case of stoves and refrigerators in Charlottetown, it is impossible to estimate the implicit price (coefficient) of the commodities accurately. As Moulton (1995) suggested, some markets do not adjust through the implicit price of a quality characteristic but through the quantities consumed. This result lends support to the use of regional averages for the quality characteristics in the calculation of the indices. If national averages were used, boundary conditions such as the examples mentioned above may be inappropriately characterized.

The percentage of private dwellings rented within an enumeration area and the percentage of persons with post-secondary education were expected to have positive signs. It was assumed that renters selectively choose to associate with persons who share similar values and motives. Thus, renters will pay a premium to be near other renters with similar levels of education and income. The percentage of private dwellings in need of major repairs, average commuting distance and low-income cut-off were all expected to have negative signs. Renters were expected not to prefer to live in dwellings that are in a state of disrepair, thus neighbourhoods with a high percentage of dwellings needing major repairs were expected to rent at a discount. It was also expected that as average commuting distances increased, the rent paid for the dwelling would decrease; thus, the savings from shorter commuting distances were expected to be incorporated as a premium in the total rental price. The LICO variable was expected to have a negative coefficient because income levels were expected to be positively correlated with the magnitude of rent paid. The variables for neighbourhood characteristics are usually significant; however, they are not always consistent with this study's *a priori* expectations regarding their sign (Table 2).

The use of the semi-log functional form gives the regression coefficients an interpretable meaning. The regression coefficients measure the relative change in rent paid for a given absolute change in an explanatory variable. For example, one

10. However, there are competing theories. The coefficient sign of the dwelling type variable may be expected to be negative if it is believed that high urban density has an effect on the renter's choice decision. For example, if renters are more concerned with reducing their role in the maintenance of the dwelling (gardening, snow removal, etc.), then they may put an implicit value on these forgone activities, which would be incorporated as a premium for an apartment dwelling. There are also possible social advantages that would lead to a premium for an apartment dwelling, which are linked to high density living such as: "unparalleled opportunity for gratification, overload of opportunity and stimulation and involuntary exposure to education, cosmopolitanism and innovative ideas" (Choldin 1978).

TABLE 2 Dependent Variable: Log(Rent Paid)

Variable	St. John's Coefficients	St. John's Std. Err.	Charlottetown Coefficients	Charlottetown Std. Err.	Halifax Coefficients	Halifax Std. Err.	Saint John Coefficients	Saint John Std. Err.
Intercept	5.609	0.146***	5.577	0.079***	5.640	0.071***	5.432	0.142***
10 < age <= 20 years	0.001	0.053	-0.094	0.017***	0.087	0.023***	-0.223	0.066***
20 < age <= 40 years	-0.024	0.051	-0.121	0.016***	0.039	0.015***	-0.211	0.061***
> 40 years	0.113	0.066*	-0.112	0.018***	0.028	0.025	-0.159	0.065***
Detached Housing	-0.088	0.046*	0.022	0.017	-0.063	0.027***	0.002	0.055
Bedroom	0.100	0.021***	0.194	0.008***	0.194	0.008***	0.151	0.014***
Luxuries	0.135	0.132	0.026	0.015*	0.187	0.016***	-0.035	0.121
Utilities	0.053	0.112	0.063	0.030**	0.054	0.017***	0.027	0.029
Electricity	0.010	0.114	0.064	0.017***	0.003	0.027	0.049	0.030
Fridge/Stove	0.022	0.065	0.049	0.057	0.088	0.049*	0.134	0.086
Washer/Dryer	0.042	0.072	0.096	0.033***	0.064	0.040	0.065	0.074
Parking	0.055	0.055	0.040	0.027	-0.096	0.016***	0.171	0.032***
% of rented dwellings	0.002	0.001***	0.001	0.000***	0.001	0.000***	0.005	0.000***
% with major repairs	0.001	0.004	-0.002	0.001	0.003	0.002**	-0.008	0.003***
% post-secondary	0.004	0.001***	0.003	0.001***	0.005	0.001***	0.001	0.001
commuting distance	0.007	0.007	-0.009	0.003***	-0.007	0.001***	0.003	0.004
% under low Y cut-off	-0.003	0.001*	0.001	0.001	-0.004	0.001***	-0.002	0.001***
Number of Obs.	235		611		819		337	
Adj-R-squ	**0.255**		**0.643**		**0.892**		**0.714**	

Note: 1. *** Statistically significant at the 99% confidence level; ** Statistically significant at the 95% confidence level; * Statistically significant at the 90% confidence level.

TABLE 2 Dependent Variable: Log(Rent Paid) (continued)

Variable	Fredericton Coefficients	Fredericton Std. Err.	Quebec City Coefficients	Quebec City Std. Err.	Montreal Coefficients	Montreal Std. Err.	Hull Coefficients	Hull Std. Err.
Intercept	5.679	0.147***	5.928	0.059***	5.732	0.040***	5.761	0.052***
10 < age <= 20 years	-0.028	0.064	-0.076	0.041*	-0.122	0.033***	-0.128	0.022***
20 < age <= 40 years	-0.084	0.060	-0.223	0.030***	-0.147	0.028***	-0.177	0.023***
> 40 years	-0.177	0.067***	-0.314	0.036***	-0.228	0.028***	-0.137	0.026***
Detached Housing	-0.066	0.046	-0.038	0.020*	0.023	0.018	0.029	0.019
Bedroom	0.174	0.018***	0.180	0.011***	0.135	0.005***	0.182	0.007***
Luxuries	0.168	0.046***	0.064	0.057	0.085	0.037**	0.028	0.023
Utilities	0.105	0.054*	0.115	0.021***	0.160	0.009***	0.025	0.026
Electricity	0.087	0.067	-0.018	0.021	-0.011	0.019	0.089	0.027***
Fridge/Stove	-0.233	0.071***	-0.112	0.024***	-0.088	0.011***	0.065	0.014***
Washer/Dryer	0.151	0.055***	0.031	0.049	0.106	0.089	0.065	0.048
Parking	0.096	0.063	-0.055	0.030*	-0.001	0.009	0.030	0.027
% of rented dwellings	0.006	0.001***	0.003	0.000***	0.003	0.000***	0.001	0.000***
% with major repairs	0.010	0.003***	-0.009	0.002***	-0.008	0.001***	-0.002	0.002
% post-secondary	0.006	0.001***	0.002	0.001***	0.005	0.000***	0.003	0.001***
commuting distance	-0.025	0.007***	-0.004	0.003	0.000	0.002	-0.010	0.004**
% under low Y cut-off	-0.010	0.002***	-0.004	0.001***	-0.003	0.000***	-0.002	0.001***
Number of Obs.	225		793		2496		536	
Adj-R-squ	**0.598**		**0.470**		**0.372**		**0.730**	

Note: 1. *** Statistically significant at the 99% confidence level; ** Statistically significant at the 95% confidence level; * Statistically significant at the 90% confidence level.

TABLE 2 Dependent Variable: Log(Rent Paid) (continued)

Variable	Ottawa		Toronto		Winnipeg		Regina	
	Coefficients	**Std. Err.**	**Coefficients**	**Std. Err.**	**Coefficients**	**Std. Err.**	**Coefficients**	**Std. Err.**
Intercept	6.031	0.060***	6.110	0.049***	6.211	0.077***	6.160	0.145***
10 < age <= 20 years	-0.200	0.039***	-0.015	0.027	0.037	0.066	-0.518	0.130***
20 < age <= 40 years	-0.224	0.033***	-0.086	0.027***	-0.086	0.066	-0.598	0.129***
> 40 years	-0.260	0.034***	-0.143	0.028***	-0.142	0.067**	-0.672	0.129***
Detached Housing	0.026	0.021	-0.020	0.018	-0.074	0.022***	-0.080	0.024***
Bedroom	0.183	0.008***	0.173	0.005***	0.112	0.007***	0.151	0.011***
Luxuries	0.107	0.023***	0.008	0.016	0.094	0.011***	0.008	0.016
Utilities	0.043	0.016***	-0.003	0.016	0.032	0.012***	0.034	0.021
Electricity	0.042	0.017**	0.041	0.012***	-0.021	0.013*	-0.017	0.038
Fridge/Stove	0.049	0.032	-0.037	0.031	-0.091	0.035***	0.056	0.056
Washer/Dryer	0.009	0.033	0.136	0.018***	0.090	0.017***	0.059	0.020***
Parking	0.060	0.014***	0.074	0.010***	0.061	0.013***	0.070	0.033***
% of rented dwellings	0.001	0.000***	0.001	0.000***	0.000	0.000**	0.000	0.000
% with major repairs	-0.001	0.001	-0.005	0.001***	-0.007	0.001***	-0.006	0.002***
% post-secondary	0.005	0.000***	0.005	0.000***	0.001	0.000***	0.004	0.001***
commuting distance	-0.007	0.002***	-0.004	0.002**	-0.018	0.002***	-0.001	0.003
% under low Y cut-off	-0.003	0.000***	0.001	0.000***	-0.003	0.000***	0.001	0.001*
Number of Obs.	770		2319		1424		511	
Adj-R-squ	**0.631**		**0.477**		**0.513**		**0.650**	

Note: 1. *** Statistically significant at the 99% confidence level; ** Statistically significant at the 95% confidence level; * Statistically significant at the 90% confidence level.

TABLE 2 Dependent Variable: Log(Rent Paid) (continued)

Variable	Calgary		Edmonton		Vancouver		Victoria	
	Coefficients	**Std. Err.**	**Coefficients**	**Std. Err.**	**Coefficients**	**Std. Err.**	**Coefficients**	**Std. Err.**
Intercept	5.788	0.195***	6.199	0.145***	5.644	0.055***	5.694	0.129***
10 < age <= 20 years	0.029	0.168	-0.296	0.128**	-0.174	0.030***	-0.073	0.103
20 < age <= 40 years	-0.133	0.168	-0.373	0.127***	-0.103	0.027***	-0.237	0.087***
> 40 years	-0.137	0.170	-0.483	0.130***	-0.207	0.028***	-0.090	0.088
Detached Housing	0.079	0.028***	0.103	0.023***	-0.009	0.022	0.063	0.033*
Bedroom	0.186	0.010***	0.142	0.009***	0.221	0.008***	0.208	0.014***
Luxuries	0.102	0.019***	0.062	0.019***	-0.073	0.010***	0.271	0.023***
Utilities	0.059	0.027**	0.059	0.021***	0.013	0.016	0.116	0.022***
Electricity	0.002	0.030	0.065	0.024***	-0.132	0.023***	-0.169	0.066***
Fridge/Stove	0.033	0.074	-0.036	0.060	0.151	0.017***	0.070	0.063
Washer/Dryer	0.078	0.022***	0.028	0.016	0.115	0.021***	-0.018	0.026
Parking	0.057	0.027**	-0.028	0.026	0.064	0.013***	-0.041	0.021**
% of rented dwellings	0.003	0.000***	0.001	0.000***	0.000	0.000	0.003	0.001***
% with major repairs	-0.002	0.002	0.002	0.001	0.000	0.001	-0.005	0.002***
% post-secondary	0.003	0.001***	0.001	0.000	0.012	0.001***	0.007	0.001***
commuting distance	-0.017	0.003***	0.005	0.002***	-0.021	0.002***	0.001	0.003
% under low Y cut-off	-0.002	0.001***	-0.003	0.000***	-0.002	0.001***	-0.005	0.001***
Number of Obs.	656		762		1400		540	
Adj-R-squ	**0.681**		**0.550**		**0.837**		**0.716**	

Note: 1. *** Statistically significant at the 99% confidence level; ** Statistically significant at the 95% confidence level; * Statistically significant at the 90% confidence level.

can easily measure the impact on rental price of an increase in the number of bedrooms in a dwelling, say, between Winnipeg and Vancouver. With every additional bedroom in Vancouver, the rental price increases by 22.1 %; whereas in Winnipeg, the rental price increases by only 11.2 %. These results highlight the differences in the willingness to pay for an additional bedroom in Vancouver relative to Winnipeg, and the premium placed on additional rooms across these urban centres. The coefficients of the remaining explanatory variables have a similar interpretation.

The Laspeyres, Paasche, and Fisher indices are reported for the CMA of Winnipeg as the base city (Winnipeg = 100). The Fisher index is the geometric mean of the Laspeyres and Paasche indices, and its value will always lie between the two. The magnitude of the Laspeyres and Paasche indices depends on the reference and comparison areas that are being compared and on the relativity of the average base characteristic. The indices compare favourably with the authors' expectations (Table 3). Ottawa, Toronto and Vancouver were expected to be relatively higher than the remaining urban centres.[11] Using the Fisher index, the four highest cost quality-adjusted urban areas for shelter are Toronto, Ottawa, Vancouver and Victoria. The lowest cost quality-adjusted cities are, in ascending order, Québec City, Saint John, Regina and Charlottetown.

Concluding Remarks

This study has produced price indices that can be used for making city comparisons of price "levels" for shelter. Previously, the use of spatial indices was limited because unlike their CPI cousin, the spatial indices at Statistics Canada did not include shelter costs – the most important component of family expenditure and often the most variable. Generally, geographic comparisons of living costs have always been problematic methodologically, but even more so in the particular case of shelter because of its heterogeneous nature.

To overcome the difficulties associated with making spatial comparisons of shelter, a new database was created, matching the rent questionnaire from the Labour Force Survey and the 1996 Census. The database contained detailed information on rental accommodations. The rental equivalence approach is combined with a semi-log separate hedonic quality-adjusted regression methodology to construct Laspeyres, Paasche and Fisher-Törnqvist indices. By focusing attention on one particular model used to calculate the experimental spatial price indices, a practical framework is investigated in detail. This methodology is technically and analytically straightforward to apply, and the results obtained are comparable to those of previous literature in the field.

The price indices that are generated are of such a reliable quality that city comparisons of shelter costs can now be made, and the construction of an "All-items" spatial price index is now possible. The expanded geographical price index series, inclusive of shelter, results in an "All-items" spatial index akin to its

11. The study's expectations were based on Prud'homme and Thivierge (1999).

TABLE 3 Spatial Shelter Price Indices by Census Metropolitan Area[1]

	LASPEYRES	PAASCHE	FISHER-TORNQVIST
St. John's	106.7	97.8	102.2
Charlottetown	96.4	95.6	96.0
Halifax	111.9	109.5	110.7
Saint John	84.6	92.9	88.6
Fredericton	105.9	115.9	110.8
Québec City	85.9	89.9	87.9
Montréal	101.3	100.2	100.8
Hull	103.0	98.2	100.6
Ottawa	131.6	142.8	137.1
Toronto	162.6	174.2	168.3
Winnipeg	**100.0**	**100.0**	**100.0**
Regina	92.2	93.6	92.9
Calgary	118.5	125.1	121.7
Edmonton	99.6	103.9	101.7
Vancouver	124.5	150.2	136.8
Victoria	121.3	135.8	128.4

Note: 1. Index Base Winnipeg = 100

CPI counterpart. The index will satisfy the growing demand for this type of information. The data would be useful, for example, in wage adjustments for relocating employees, and for deflating nominal incomes in studies of regional income disparities.

Bibliography

Allen, R.G.D. 1975. *Index Numbers in Theory and Practice*. Chicago: Aldine Publishing Company.

Amemiya, T. 1985. *Advanced Econometrics*. Massachusetts: Harvard University Press.

Carroll, R.J. and D. Ruppert. 1982a. "Robust Estimation in Heteroscedastic Linear Models." *Annals of Statistics*, 10(2): 429-441.

________. 1982b. "A Comparison Between Maximum Likelihood and Generalized Least Squares in a Heteroscedastic Linear Model." *Journal of the American Statistical Association*, 77(380): 878-882.

Choldin, H.M. 1978. "Urban Density and Pathology." *Annual Review of Sociology*, 4: 91-113.

Cropper, M.L., L.B. Deck and K.E. McConnell. 1988. "On the Choice of Functional Form for Hedonic Price Functions." *The Review of Economics and Statistics*, 70(4): 668-675.

Darrough, M.N. 1983. "The Treatment of Housing in a Cost-of-Living Index: Rental Equivalence and User Cost", in W.E. Diewert and C. Montmarquette (eds.). *Price Level Measurement: Proceedings from a conference sponsored by Statistics Canada*. Ottawa: Statistics Canada, pp. 599–618.

Deaton, A. and J. Muellbauer. 1980. *Economics and Consumer Behaviour*. Cambridge: Cambridge University Press.

Dougherty, A. and R. Van Order. 1982. "Inflation, Housing Costs, and the Consumer Price Index. American Economic Review, 72(1):154-164.

Efron, B. 1982. *The Jackknife, the Bootstrap and Other Resampling Plans*. Philadelphia, Pennsylvania: Society for Industrial and Applied Mathematics.

Gambino, J.G., M.P. Singh, J. Dufour, D. Kennedy and J. Lindeyer. 1998. *Methodology of the Canadian Labour Force Survey*. Catalogue No. 71-526-XPB. Ottawa: Statistics Canada, Household Survey Methods Division and Ministry of Industry.

Gillingham, R.F. 1975. "Place to Place Rent Comparisons Using Hedonic Quality Adjustment Techniques." *Annals of Economic and Social Measurement*, 4: 153-174.

Godfrey, L.G., M. McAleer and C.R. McKenzie. 1988. "Variable Addition and Lagrange Multiplier Tests for Linear and Logarithmic Regression Models." *The Review of Economics and Statistics*, 70(3): 492-503.

Hill, R.J. and D. Melser. 2005. "Constructing Panel Price Indexes using Hedonic Models: The Case of House Prices in Sydney." Working Paper, School of Economics, University of New South Wales.

Jobson, J.D. and W.A. Fuller. 1980. "Least Squares Estimation When the Covariance Matrix and Parameter Vector are Functionally Related." *Journal of the American Statistical Association*, 75(369): 176-181.

Koenker, R. and G. Bassett Jr. 1982. "Robust Tests for Heteroscedasticity Based on Regression Quantiles." *Econometrica*, 50(1): 43-62.

Lancaster, K.J. 1966. "A New Approach to Consumer Theory." *Journal of Political Economy*, 74: 132-157.

MacDonald, L. 1986. "Hedonic Models of Housing: An Examination with Reference to New Housing in the Ottawa Area.". Working paper. Ottawa: Statistics Canada, Prices Division.

MacKinnon, J.G., H. White and R. Davidson. 1983. "Tests for Model Specification in the Presence of Alternative Hypotheses." *Journal of Econometrics*, 21: 53-70.

Miron, J.R. 1995. "Place-to-Place Rent Comparisons among Canadian Cities." *Geographical Analysis*. 27(2): 116-136.

Mooney, C. Z. and R. D. Duval. 1993. *Bootstrapping: A Nonparametric Approach to Statistical Inference*. Newbury Park, CA: Saga Publications.

Moulton, B.R. 1995. "Interarea Indexes of the Cost of Shelter Using Hedonic Quality Adjustment Techniques." *Journal of Econometrics*, 68: 181-204.

Muellbauer, J. 1974. "Household Production Theory, Quality, and the 'Hedonic Technique'". *The American Economic Review*, 64(6): 977-994.

Prud'homme, M. and K. Yu. 1999. "Towards an Elementary Price Index for Internet Services". Working paper. Ottawa: Statistics Canada, Prices Division.

Prud'homme, M. and C. Thivierge. 1999. "Spatial Price Indexes for Rental Accommodation: Progress Report". Presented at the Annual Meeting of the Price Measurement Advisory Committee, May 17-18.

Royston, J.P. 1982. "An Extension of Shapiro and Wilk's W Test for Normality to Large Samples". *Applied Statistics*, 31(2): 115-124.

Salois, D. 1987. "Comparaison des loyers entre les villes : Résultats d'une étude sur la comparaison des loyers entre les centres urbains de Montréal, Ottawa, et Toronto pour les années 1979, 1980, et 1981". Working paper. Ottawa: Statistics Canada, Central Research Section.

Statistics Canada. 1992. *Guide to Labour Force Survey Data*. Ottawa: Ministry of Industry, Science and Technology. Catalogue No. 71-528.

_______. 1997. *1996 Census Dictionary*. Catalogue No. 92-351-XPE. Ottawa: Ministry of Industry.

_______. 1998. *Methodology of the Canadian Labour Force Survey*. Catalogue No. 71-526-XPB. Ottawa: Ministry of Industry..

_______. 2000. *Guide to Labour Force Survey*. Catalogue No. 71-543-GIE. Ottawa: Ministry of Industry.