USER-COST APPROACH TO THE ESTIMATION

OF PRICE CHANGE FOR PRIVATE TRANSPORTATION

Experimental study in the spirit of the Cost-of-Living Index

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CONTENTS

KEY TERMS

Cost-of-Living approach (COL)

Fixed-Basket approach (FB)

Broad common denominators

Narrow common denominators

ABSTRACT

There is a well-known controversy between the Cost-of-Living approach to consumer price indices and the Fixed-Basket approach, sometimes called the Pure-Price-Change approach. Disputes between the partisans of the two approaches are often rather fruitless, as the differences seem to be insurmountable, especially when looked at from extreme, dogmatic positions.

In fact, the core of differences lies in the choice of the criterion that is supposed to make expenditures (values expressed in money units) comparable from the point of view of price levels. In the case of the Fixed-Basket approach, the physical identity of sets of products acquired by means of these expenditures constitutes such a criterion, while in the case of the Cost-of-Living approach, it is the equivalence of utility levels (or of standards of living) reached due to the expenditures. The Fixed-Basket approach is relatively easy to apply in practice and intelligible to most users. The Cost-of-Living approach, although impractical, at least in its orthodox version, seems to reflect better the way how consumers assess the comparative value of different products.

The author investigates the possibility of finding some intermediate ground between the two positions, which would be closer to the spirit of the Cost-of-Living Index than the traditional fixed-basket indices, yet be based on less esoteric assumptions and less questionable data than the orthodox Cost-of-Living approach. One of the compromise solutions is to keep constant the service rendered by the consumed products, and to calculate price-induced changes in the cost of such services. This is a variant of the user-cost approach to the estimation of price change. It seems to be quite consistent with the consumer perception, yet much less abstract than the estimates based on the notion of utility. The possibility to cover the entire range of products, either substitutes or complements, constitutes another advantage of this approach.

Private transportation was chosen to experiment with the approach because of its importance (it has almost the same weight in the Canadian CPI as the entire food and non-alcoholic beverages, purchased from both stores and restaurants) and because of problems with the estimation of its price movement. Indeed, it is much more difficult to measure price change for cars than for food, and the traditionally disjointed treatment of various sub-components of private transportation is likely to cause distortions.

The effect of price changes on the cost of private transportation is treated in the study in an integral way, and not as a fixed-weighted average of price indices for different sub-components. Empirical data about the cost of owning, maintaining and using automotive vehicles were provided by Runzheimer, a private company that specialises in the estimation of various business costs. These data cover the period from 1988 to present, and relate to 12 models of private cars produced by three major North-American manufacturers.

1. Controversy between the Cost-of-Living and Fixed-Basket approaches

1.1. The controversy between the Cost-of-Living (**COL**) and the Fixed-Basket (**FB**) approaches to consumer price indices sometimes bears resemblance to a religious war. The supporters of the former Church often blame their opponents for *ignorance of Saint Economic Scriptures* and are in turn being accused of *celebrating psychological voodoo messes.* Such mutual excommunications deter from recognising some legitimate concerns that are hidden behind the militant phraseology.

1.2. The attempt to reflect the consumers' perception about the relative value of products and to mimic their behaviour in the face of changing relative prices seems to constitute the very essence of the COL approach. This goal, even if it were utopian, looks appealing, at least when meant to provide some conceptual guidance to price statisticians who try to produce adequate income escalators. The principal credo of the FB partisans seems to be "You shall not release price indices that are based on foggy notions and unverifiable data". This commandment also sounds very appropriate, particularly for indices to which huge wealth transfers are tied, which is the case of most consumer price indices. In practice, neither of the two goals is realisable in a strict form. Curiously, the supporters of each of the approaches use in fact some help from the other approach, albeit often without recognising it openly.

1.3.. The FB partisans reject the COL approach as based on speculations, but they accept the principle and the practice of adjusting prices for product quality changes. However, the adjusted prices are no more "real market prices", but their transformations, derived using more or less arbitrary assumptions about the relative value of quality changes, whether explicit or implicit. Also, when these statisticians agree that *symmetric index formulae,* such as the Fisher formula, have some edge over the asymmetric ones, such as the Laspeyres and Paasche formulae, they actually reason in terms of the COL approach. An average of the Laspeyres and Paasche formulae is a better indicator of price change than either of them only if one tends to overestimate and the other one tends to underestimate the "actual" price change. Yet, to claim it, one needs some criterion hinting in which direction the actual magnitude is likely to be located and such a criterion cannot be deduced from price data alone.

1.4. On the other hand, the COL followers are not able to derive any consumer price index number *directly* from their basic conceptual premises. The notions of standard of living (or those of welfare, utility, or satisfaction, used interchangeably) are too abstract and too vague to become objects of rigorous statistical measurement and to be well understood and accepted by most users of consumer price indices. For this reason, all real-life COL approximations resort to some more practical procedures in the price data aggregation, most often using the FB approach at least at some stage.

1.5. Disputes between the two schools are rather fruitless when carried out from extreme, dogmatic positions. Recently, though, some more conciliatory attitudes seem to be slowly gaining momentum[1]. In fact, the FB and COL approaches have more in common than it appears at first glance. Both of them call for comparing consumer expenditures, either real or hypothetical, under different price regimes. The crux is to find a criterion which would make these expenditures comparable from the point of view of prices. For the COL school, they should provide the same standard of living (or utility), while for the FB school they should provide the same set of products[2]. Physical identity of products is a criterion which is relatively easy to apply in practice and intelligible to most users. Equivalence of utility, though an impractical criterion, seems to reflect how consumers assess the comparative value of different products, which is an important issue when indices are used for escalating incomes.

1.6. The purpose of this paper is to examine the possibility of finding some compromise solution between the two extremes, which would provide results closer to the spirit of the Cost-of-Living Index than the FB indices, yet would be based on less esoteric assumptions and less questionable data than the former. After a general discussion about the levels at which one can try to achieve comparability between more or less incomparable sets of products, a concrete solution is proposed with respect to the Private Transportation Component of the Canadian Consumer Price Index (CPI).

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[1] See for example the paper by Peter Hill "*Inflation, the Cost of Living and Domain of the Consumer Price Index*", presented at the Meeting of the Statistical Commission for Europe on November 3, 1999. Its draft version was distributed at the fifth meeting of the Ottawa Group held 25-27 August 1999 in Reykjavik.
[2] The term *products* is used here to designate both goods and services.

2. Narrow versus broad common denominators

2.1. The quantity, quality and mix of products that are being produced, sold, purchased or consumed, do change through time, which makes direct comparisons of observed prices unsuitable for the purpose of measuring price variation in the strict sense. Various assumptions and various approaches have been proposed to solve, overcome or bypass this seemingly insurmountable problem of comparing incomparables. It is useful to distinguish between two general categories of solutions used to make price comparisons possible for sets of various consumer goods and services. The approaches of the first category seek comparability at lower levels of product hierarchy, while the approaches of the second category consist in looking for common denominators at levels higher than individual products. Either category offers some advantages, but also entails some disadvantages.

2.2. Searching for low-level denominators is a prevalent practice in price index making, particularly in the CPI. One breaks down the consumption into classes and sub-classes of goods or services, and designates within each of them some representative products, whose prices are considered comparable through time or in space. Ideally, only prices of identical products should be directly compared, which would require extremely precise definitions of specific representative products. Yet, the more detailed is the description of products, the more problems arise with their representativity and with their price collection. Particular difficulties arise from frequent discontinuities of narrowly-defined products. They force price statisticians to replace the observed products and to apply explicit or implicit adjustments to their prices for quality changes, which is a very delicate procedure. In addition, what was decomposed has to be later aggregated, and this leads to more theoretical and practical problems.

2.3. Estimating price movement based on direct comparisons above the level of individual products is another option. Comparisons of average prices or unit values of larger groups of products constitute a very simple application of this approach. Since large groups of products generally endure longer on the market than individual products, one can avoid in this way the problems related to the treatment of discontinuities of finely defined representative products. This comes, though, at the cost of ignoring the effect of potential changes in the mix of groups.

2.4. The search for broad common denominators can be carried on farther, beyond the groups of products described by their physical attributes. Partisans of the COL approach to consumer price indices suggest utility (or welfare) as such a denominator. This is an umbrella concept able to cover any imaginable range of goods and services consumed in every combination and to treat their substitutions. Most importantly, it ties the consumer price index to the economic theory of consumer behaviour. There is no question in my mind that this very idea is appealing, particularly when a given index is supposed to serve mainly as an escalator of incomes. The use of utility in actual price index calculation encounters, however, serious practical problems because of its abstract nature. There is no objective way to measure utility (or any of the substitute denominators), especially at social levels. At best, it can only be approximated, and this by means of some, often questionable assumptions. In addition, it is difficult to explain a notion of such elusive nature to the public at large, which may be detrimental to the credibility of those consumer price indices that are supposedly based on this notion.

2.5. One can, however, search for other broad common denominators in the process of generating consumer price indices. One of them could be the service rendered by the consumed or used products. Service is a concept consistent with consumer perception, yet much more intelligible and easy to measure than utility or standard of living. Service rendered may be a common denominator to an entire range of products, either substitutes or complements. A letter, a facsimile and e-mail are the examples of the former because all of them serve the purpose of transmitting messages. In that context, their prices could be compared directly to each other, although with adjustments for differences in the speed and conditions of transmitting, which might be tricky. Car, gasoline and a parking spot, are the examples of complementary products, which are purchased with a single final purpose of transportation. Treating their cost as one entity offers many advantages over a disintegrated approach. W.D. Nordhous[3], for example, launched a similar idea by proposing that the consumption of electric current and the use of bulbs be treated together, in the category of price indices of light.

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[3] *Do real output and real wage measures capture reality? The history of lighting suggests not.* Cowles Foundation Discussion Paper N° 1078, Yale University 1994. See also "Price Index Numbers for Complementary Goods" by H. van Tuinen, B. de Boo and J. van Rijn, in *Proceedings of the Third Meeting of the International Working Group on Price Indices*, Voorburg, 1997, Discussion Paper N° 1078, Yale University 1994.

3.   Private Transportation component in the Canadian CPI

3.1.   The author chose the price index for private transportation to experiment with the new approach because of its importance in the CPI and because of the difficulties involved in its computation. The component has almost the same weight as the entire food and non-alcoholic beverages purchased in Canada from both stores and restaurants (17.1% versus 17.8% according to value of the 1996 basket, currently in use). The estimation of its price movement, however, is much more challenging than for food, especially with respect to the purchase of automotive vehicles, which account for over 6% of the basket value. Even the use of sophisticated hedonic methods to adjust car prices for quality changes often brings more disappointment than satisfaction. All this gives way to understandable criticism about the results, yet the critics' claims vary from a large overestimation to underestimation of actual increases in prices of cars by the official CPI series.

3.2.   According to the current methodology, the Price Index for Private Transportation (PIPT) is derived in a way that is equivalent to a weighted average of price indices[4] for the following basic commodity classes[5], shown hereafter with their weight expressed as percentage of the total 1996 basket value:

- purchase and leasing of automotive vehicles (7.1%),
- rental of automotive vehicles (0.1%),
- gasoline and other fuels (3.9%),
- parts and supplies (0.8%),
- maintenance and repair services (1.5%),
- insurance premiums (3.2%),
- registration fees (0.2%),
- driver's licences (0.1%),
- parking fees (0.2%),
- other automotive vehicle operating expenses (0.1%).

The implicit quantitative proportions between these sub-components, as those between most basic classes in the Canadian CPI, are based on household expenditures in the basket reference year and are kept constant during the lifetime of a given basket. Indices for the sub-components are derived from price data gathered for this purpose by commodity specialists and interviewers of Statistics Canada. These indices, like the vast majority of price indices generated by Prices Division, are deemed to measure "pure price movement".

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[4] The Canadian CPI is actually computed as a ratio of price-updated values, rather than as an average of sub-indices.
[5] Some sub-components are further divided to form more homogeneous micro-aggregates.

3.3. In the author's opinion, such disjointed treatment of sub-components may be detrimental to the cognitive capacity of the Index. All the sub-components are interrelated and constitute in fact just inputs to the transportation service. Yet, changes in their costs are treated in the CPI in isolation from each other, which is a potential source of serious errors. Suppose, for example, that a new model of cars costs more than the previous one, but requires less gasoline. It would be extremely difficult, if possible at all, to assess the effect of this feature through price adjustments for changes in car quality. On the other hand, nothing else in the PIPT can reflect the savings that consumers would achieve with the new car model. The use of gasoline would remain constant, at least until the life-end of the CPI basket, spoiling the assumption of constant quantity and quality. Many similar examples could be quoted.

3.4. An alternative approach would be to treat simultaneously the various aspects of changes in the cost of private transportation. At first glance, this endeavour looks impractical. Indeed, there seems to be no common yardstick to bring these cost elements together, short of searching for the Holy Grail of utility or welfare. A simpler solution could be envisaged, though, by recognising that all the expenses in question are being made to obtain transportation service. In other words, one could derive a comprehensive price index for private transportation by monitoring, through time, the cost of owning, maintaining and using automotive vehicles that provided similar transportation service. The question remained whether there are input data available for price indices based on this user-cost idea.

4. Data used in the study

4.1. Car manufacturers must almost certainly monitor various aspects of transportation costs for their cars, but they are unlikely to share the information. American and Canadian Automobile Associations publish some data on costs of owning, maintaining and using specific models of cars. Although more independent and readily available, these data are too sporadic and too incomplete to be used in a serious comparative study. Moreover, this is a second-hand information, the original data being compiled by Runzheimer International, a private company that specialises in estimating various business costs. Among others, the company produces consistent estimates of transportation costs, broken down by models of cars and geographic areas.

4.2.   Prices Division asked Runzheimer to provide historical series of cost estimates for selected car models, reflecting as much as possible typical Canadian conditions of car utilisation and maintenance. Unfortunately, due to limited resources, it became necessary to narrow the scope of requested series in terms of time coverage, number of car models reported and geographical references. Moreover, Runzheimer is only able to retrieve information from the existing databases, which have been set to serve mostly its business clients interested in the cost of hired transportation services. Prices Division was conscious that the selective nature of data might reduce the possibility of making conclusive comparisons with the corresponding CPI series. The hope was, however, that one will be at least able to examine the feasibility of developing in the future some alternative estimates of price changes for private transportation.

4.3.   The Runzheimer data relate to 12 car models, one for each of the three major North-American manufacturers (General Motors, Ford and Chrysler) in each of the four car categories by size (full-sized, intermediates, compacts and sub-compacts). The models have been selected to match those that appeared in the CPI car samples. Based on its databases and methodology, Runzheimer generated the mid-year costs for every one of the 12 selected models, from 1988 to 2000. This forced limitation of the time coverage is quite unfortunate, especially because the most substantial changes in the North-American car features took place before that period. The data were derived from the sub-set of employee-owned cars, i.e. excluding transportation services provided by professionals and enterprises. This category has been chosen as the best possible representation of transportation costs borne by individual car owners. Separate cost estimates were calculated for Toronto and Montréal, with specific scenarios of travel patterns, road surface, terrain and climate conditions.

4.4.   According to the standard Runzheimer classification, the cost information is divided into operating and fixed costs. The operating costs, which include fuel and oil, maintenance and tires, are annualised assuming 15,000 kilometres of driving per year, which makes it possible to combine them with fixed costs. The fixed costs include licence and registration fees, insurance premiums, depreciation and financing.

4.5. The data provided by Runzheimer correspond to the following specifications :

- fuel consumption is determined by records from large samples of passenger vehicles of a given model, driven in normal conditions (not in test conditions) in a given territory; fuel prices, for the kind recommended by manufacturers, are gathered through the company's own surveys; oil consumption is added separately ;

- maintenance covers normal and preventive expenses, as recommended by manufacturers to ensure sound and economical operation;

- the costs of tire rotation, repairs and replacement relate to the original equipment;

- insurance premiums are for drivers with a six-year "clear" driving record; it covers Third Party Liability of $1,000,000, comprehensive insurance with $100 deductible and collision insurance with $250 deductible, which corresponds to the current standard insurance specifications in the CPI ;

- depreciation estimates are based on the average annual decrease in value from the time the vehicle was new until it is assumed sold after 4 years, with 60,000 kilometres on the odometer; the values are established with respect to standard models of cars, with options whenever preponderantly used;

- financing includes interest charges, based on a 4-year loan with a 20% down payment.

5. Comparison between indices derived from the CPI and Runzheimer data

5.1. The Runzheimer cost data for individual car models have been averaged for every cost element to make the aggregate comparisons possible with the CPI index series for Private Transportation. First, equiweighted averages have been computed between models produced by the three major North-American manufacturers, but within each of the four size categories of cars. Next, general average costs have been calculated for all size categories of vehicles together, using fixed quantitative inter-category proportions as weights. The use of fixed proportions, derived from the numbers of new cars sold in Canada in the covered time period, ensures that trends in car sizes, if any, would not affect changes in the average user costs. Incidentally, the same rule of fixed inter-category weights is applied in the calculation of the CPI indices for car purchases and leases. All the Runzheimer's cost averages have been calculated separately for Toronto and Montréal, the cities for which CPI data are available.

5.2. Regrouping of certain cost elements was necessary to enable comparability between the Runzheimer and CPI data at some sub-total levels. For example, the licence and registration fees, as well as the insurance premiums, have been transferred from the original Runzheimer's category of fixed costs to the category of operating costs. For the same reason, the cost of tires has been combined with maintenance. It was impossible, however, to implement such a reconciliation with respect to every lower cost category. For example, the province of Québec introduced in 1992 a provincial no-fault car insurance system and augmented the annual payments for driver's licences. In the CPI calculation, these additional payments are being identified and combined with insurance premiums paid by car owners to commercial insurance companies. Runzheimer, though, treats them as a part of regular licence and registration fees. There is no way to impose a common treatment and, even less, to make changes in historical databases. This illustrates the compatibility problems between the Runzheimer and CPI data.

5.3. Finally, the Runzheimer and CPI data are compared to each other in the form of index numbers on a 1988 time base. Tables 1 and 2 in the Annex compares three of these index series, that is for Operating Costs, Fixed Costs and Total Costs, separately for Toronto and Montréal. Comparisons for certain more detailed categories are also available. The comparison between the Runzheimer and CPI series reveals several differences, a few of them quite notable and some unexpected.

5.4. Probably the most surprising outcome resulted from the comparison between the Runzheimer and CPI index series for total fixed costs. One could expect large discrepancies between them, as they have been based on fundamentally different approaches. The Runzheimer series is a user-cost series composed of depreciation and interest charges. The CPI series includes purchase, leasing and rental of cars. And, yet, the two index levels are remarkably close to each other in 2000, 12 years from the base time. For several other years, the two series diverge from each other, albeit not too much. As the detailed comparisons show, a drastic variation in interest rates is the major reason of these divergences.

5.5. With respect to operating costs, the Runzheimer and CPI series for Montréal exhibit quite large divergences, but not those for Toronto. A detailed examination shows that the Runzheimer cost indices for maintenance, repairs and parts

grew more than the corresponding CPI series, and this both in Toronto and Montréal. There are several explanations possible. For example, Runzheimer takes into account preventive maintenance, as prescribed by manufacturers for cars up to 4 years old. Such a maintenance may include labour and parts whose prices rose faster than prices of regular repairs to cars of older age, which are included in the CPI surveys. Differences between the Runzheimer and CPI maintenance series for Toronto are compensated by opposite differences for other cost elements, in particular for insurance and gasoline, for which the CPI series increased more than the Runzheimer ones.

5.6. In the year 2000, the differences between the two index series at the General Total level amount to less than 1% for Toronto but to more than 10% for Montréal. Such an irregular relationship suggests that the differences are more likely due to data collection problems than to conceptual or methodological problems. Further thorough investigation will be necessary to explain some other discrepancies

6. Some conclusions

6.1. This study, although experimental, may play some role in the future development of the CPI methodology and practices. The study attempts to explore new methodological and conceptual avenues, and this may encourage other adventurous workers to seek and test some less orthodox index solutions. Prices Division has a long tradition of producing parallel analytical index series, namely for owned accommodation. Such series contribute to a better understanding of the latent assumptions of specific approaches, shed light on their strengths and weaknesses and help in assessing what could be the index values under some extreme assumptions.

6.2. Another lesson of the study is that conclusions highly depend on quality and pertinence of input data. Runzheimer's data may have been sufficient to start the research, but they would not be adequate in the case of a more or less regular production of index series. It would be necessary in such a case to find or create data sources better corresponding to the purpose of the endeavour, customised if possible and cheaper, too.

ANNEX

Price indices for private transportation in Toronto according to the Runzheimer and CPI data
1988 = 100

1988 = 100 Year	Operating costs		Fixed costs		Total costs	
	Runzheimer	CPI	Runzheimer	CPI	Runzheimer	CPI
	Gasoline, other fuels; Maintenance, repairs, parts and tires; Licence, registration fees; Insurance		Depreciation and financing	Purchase, lease and rental of cars		
1988	100.0	100.0	100.0	100.0	100.0	100.0
1989	106.2	107.2	107.7	105.8	107.2	105.7
1990	118.5	119.1	120.8	106.7	119.9	111.6
1991	128.5	121.6	122.1	104.5	124.4	111.6
1992	117.1	120.5	114.1	109.2	115.2	113.5
1993	131.1	123.2	112.8	113.6	119.5	117.1
1994	129.6	129.6	115.5	120.3	120.7	123.7
1995	141.3	138.8	136.0	126.9	137.9	132.0
1996	140.7	145.8	128.1	132.4	132.7	138.2
1997	151.1	154.3	127.6	135.8	136.2	144.6
1998	144.6	150.9	129.0	136.5	134.7	142.8
1999	157.2	157.4	131.9	137.3	141.2	146.9
2000	178.4	171.2	138.9	137.0	153.4	154.7

Price indices for private transportation in Montréal according to the Runzheimer and CPI data
1988 = 100

Year	Operating costs		Fixed costs		Total costs	
	Runzheimer	CPI	Runzheimer	CPI	Runzheimer	CPI
	Gasoline, other fuels; Maintenance, repairs, parts and tires; Licence, registration fees; Insurance		Depreciation and financing	Purchase, lease and rental of cars		
1988	100.0	100.0	100.0	100.0	100.0	100.0
1989	113.8	103.0	106.9	105.2	109.7	103.6
1990	120.0	109.4	120.4	105.6	120.2	106.8
1991	132.7	116.4	121.1	102.6	125.8	108.3
1992	122.9	115.7	113.4	105.8	117.2	109.7
1993	123.5	113.7	110.5	111.0	115.7	111.6
1994	122.9	110.8	114.9	119.3	118.2	114.7
1995	134.2	112.8	135.0	125.3	134.7	118.9
1996	132.4	115.7	127.7	129.6	129.5	122.5
1997	141.3	116.9	126.0	132.4	132.1	124.4
1998	136.3	113.9	129.1	134.0	132.0	123.3
1999	144.7	119.7	131.9	136.0	137.0	127.6
2000	169.8	131.7	138.9	133.2	151.3	133.9