Session Number: Parallel Session 8A
Time: Friday, August 27, PM

Paper Prepared for the 31st General Conference of
The International Association for Research in Income and Wealth

St. Gallen, Switzerland, August 22-28, 2010

Measuring Canadian Low Income Across Regions: Local Thresholds or Spatial Price Index Adjustments?

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July 14, 2010

Abstract

The Low Income Measure (LIM) is often criticized for its lack of regional variations in its thresholds. This study attempts to address several questions related to this criticism. In particular, we identify the effect of regional price variations on low income statistics by using the LIM line, both at the country level and across regions and groups of individuals. The study found that low-income trend at the national, provincial and city levels remained the same when costs of living were adjusted for by an expenditure-dependent price deflator or by an inter-city price index, while poverty ranking between regions (and cities) did change. When it is not feasible to construct spatial price index, localizing low income lines is probably a useful substitute as the low income statistics produced under local lines are quite similar as under spatial price adjustments. But the reference group of low income profile will be different under the local line than under the national line. A challenging question is at what geographic level one may construct a spatial price index or regional poverty line. We provide some criteria to help answer this question.

Executive Summary

The well-being of an individual does not depend only on his or her own income, but also on the costs of living he or she faces. The costs of living are closely related to the prices of goods and services a person faces and these can be very different across regions. This has implications for poverty and low income measurement and two choices or approaches appear reasonable to take regional price variations into consideration: we can either adjust an individual's income by the prices he or she faces, or we can construct poverty line based on regional income distributions. There are advantages and trade-offs to both techniques.

Using Canadian data, this study attempts to find out what would happen to low income statistics under these two approaches. The strategy under the first approach is to compare low income statistics under two different scenarios. In one scenario, we adjust income by a spatial price index, while in the other we do not. Under both scenarios, we keep the national low income thresholds constant. This enables us to identify the effects of price variations on low income indexes since the only difference between the two scenarios is whether income is adjusted by regional price variations or not.

We found that, at the aggregate level, low income statistics, both in terms of level and trend, did not change in any significant way after taking regional price differences into consideration. But between provinces, regions and cities, low income statistics changed significantly and generally, low income increase for cities/regions with higher costs of living and decrease for cities/regions with lower costs of living.

Our strategy under the second approach is to compare low income statistics under the national low line with those under local or regional low income lines. In this approach, the difference hinges on different the thresholds under the national and the local lines, and since the median of regional income distribution is closely related to local price level, this approach indirectly identify the effect of regional price variations on low income statistics.

It was found that at the aggregate level, the effect of localized thresholds on low income statistics is similar to that of spatial price adjustment. Again, the aggregate statistics conceals significant heterogeneities between regions and cities, and typically, low income statistics for cities with high cost of living would be increased under local low income line than under the national line. However, local low income lines have an advantage to help identify certain disadvantaged groups of individuals, notably, the elderly and individuals from families headed by recent immigrants.

Overall, our results suggest that it is useful to construct a spatial price index to adjust for regional price differences to help improve poverty and low income measurement. However, it should be noted that it is the aggregate price level, not prices for a single commodity or a group of goods and services that should be employed. When spatial price index is not feasible, a localized relative poverty line based on regional income

distribution may be used to produce similar poverty statistics. But it is important to note that local low income lines compare an individual with an average individual from the same region, not with an average Canadian. Hence, under local relative lines, a comparison of poverty in level between different regions does not make sense. We noticed, however, poverty and low income trend comparisons between regions are still valid under local lines.

1. Introduction

Prices vary over time, between countries and across different regions within a country. To compare income over time, researchers routinely adjust income by an inter-temporal price index such as the consumer price index (CPI). To compare income between countries, it is recommend to adjust country income by the purchasing power parity (PPP) index. If that is a sensible thing to do, then when price varies between regions of country such that, for the same amount of income, individuals living in an expensive area would be unable to acquire as much goods as those who live in inexpensive areas, it makes sense to take regional price variations into consideration in measuring poverty and low income within a country.

Indeed, local prices play an important role in many traditional poverty measures. The cost of basic need approach is a typical example. Under this approach, the basket of goods and services and their quantities are first chosen, the prices of these goods and services are then collected from each community and the costs of the basket are obtained for different communities. Poverty status of an individual is determined by comparing the local cost of the basket and his/her income. The Canadian Market Basket Measure (MBM) is a low income line created under this approach. But not all poverty and low income lines are created as such. In many developed countries, the relative low income line, defined as a certain percentage of the median or mean of the income distribution of a country, has become popular in the last few decades.

The typical Low Income Measure (LIM) is defined as a proportion of the median income. In Canada, half of the median income is used to determine a low-income threshold. Other countries have sometimes used 60% of the median income. The advantages of this measure are that it is simple, transparent and internationally comparable, and there are usually no extra costs to bear for creating this line. But it has often been criticized for its lack of regional variations: the threshold for deciding low income status of a given household is the same across different regions, even though price level can vary dramatically between regions. Since regional price variations affect the well-beings, it is legitimate to ask whether low income statistics under LIM and other similar lines are biased. If they are, what can be done and what are the best practices to deal with the issues. These are the objectives of this study.

To answer the above questions, it would be ideal if we can directly measure the welfare of individuals and to compare low income statistics produced by the LIM-type lines with observed welfare estimate. But this is not feasible because individual well-being is usually not observed. One may also be tempted to compare low income statistics under a line that takes regional price variations into consideration, such as the MBM line and those under a line that ignores regional price variations so as to identify the bias caused by the ignorance of regional price variations.

But this identification strategy would not work. Firstly, it implicitly assumes that low income statistics under the cost of basket approach are unbiased. But this premise is not

warranted since no poverty line may claim that it can precisely measure the minimum acceptable standard of living. Secondly and more generally, low income statistics produced under different lines are intrinsically not comparable because, on one hand, different lines measures low income from different perspectives. A relative line defines a person as being in low income by comparing this person with an average person while an absolute line compares a person's resources with the costs to purchase a given basket of goods and services. On the other hand, each line is subject to its own assumptions and arbitrary choices. For example, different lines may account for economies of scale in consumption differently. Therefore, the difference between low income statistics produced by two different lines cannot be attributed to a single factor such as the ignorance of regional price variations.

A feasible solution is to compare low income statistics under the same LIM-type line under two scenarios. One with income being adjusted by a spatial price index while the other without. The spatial price index measures price differences between different regions of a country, primarily focusing on consumer products. This is similar to the practices of several international organizations, such as the OECD and the World Bank which employ the purchasing power parity (PPP) index to adjust income of different countries.

An alternative solution is to create local or regional LIM lines and compare low income statistics produced by the current national LIM line and those under regional lines. The regional LIM lines can be created using the same assumptions and choices as those under national LIM. The only difference is that the national line is based on the income distribution of all households while the regional lines are based on the corresponding regional or local income distributions.

The maintained hypothesis behind regional LIM is that local income distribution depends on local or regional price level. Economic theory suggests that, at the equilibrium, the real wage of a worker must be equal to his or her marginal productivity. Since real wage is the ratio of nominal wage and the price the worker faces in local market, the labour income of a worker is a positive function of local price level. And since wage and salary is the major component of income for the vast majority of individuals, it is reasonable to infer that the local income distribution and hence regional LIM is strongly correlated with regional price level.[1]

But the difference in low income statistics under national LIM and local LIM lines cannot be uniquely attributed to regional price variations. Two other factors, local government taxes/transfers and labour productivities, also affect low income statistics under regional LIM lines.[2] Nevertheless, a comparison of low income statistics produced by national and regional LIM lines may provide us with a rough estimate of the effect of regional price

[1] The correlation is not perfect because some incomes, such as government transfers, are independent of regional prices. Others may be tied to national inflation rate only.

[2] Since taxes and transfers imposed by the central government are the same across regions, they affect low income statistics under local and national LIM lines in the same way.

variations because local taxes, transfers and productivity affect national LIM lines as well, albeit indirectly.

There are two other reasons why it is interesting to examine the local LIM lines. Firstly, in many countries, spatial price index is not available yet and for those where it is constructed, it is only available in large cities or several regions. This means that we have either to derive a spatial index number for the excluded areas, or we have to exclude them in low income estimation. When spatial price index is not available or it is available but incomplete, local LIM lines might be employed as an alternative method.

Let the total income of an individual living in region *r* be W_r+B_r, with W_r being labour income and B_r income from other sources, and let P_r be the price index. The local line approach in identifying the poor is to compare (W_r+B_r) with regional line L_r, which is strongly correlated with local price P_r. While the spatial price index adjustment approach compares $(W_r+B_r)/P_r$ with the national relative line L_n. This is the same as the comparison between (W_r+B_r) and L_n*P_r. As can be seen, the left hand sides of the equations are the same under the two approaches. The difference occurs on the right hand side: L_r vs. L_n*P_r. Under the price adjustment approach, local price directly affects the thresholds, while under the local line approach, regional price affects the thresholds through local income distribution. Hence, the levels of the low income statistics under the two approaches would be different. But since the right hand sides change in the same direction, we expect the trends in low income to be the same under the two approaches.

Secondly, measuring poverty or low income at regional level is also an important task for local governments as for the central government. In many countries, alleviating poverty is a shared responsibility between governments at both national and sub-national levels. This prompts one to ask whether the nation is the only "appropriate social reference group and physical unit for defining and then measuring the extent of poverty."[3]

In Canada, for example, low income lines have long been set at the national level. In addition to the LIM and MBM lines, Canada also produces the low income cut-offs (LICO). The LICO line is used to examine if a family spends significantly more of its income on food, shelter and clothing than an average family. All three lines use the nation, Canada, as the physical unit to measure low income. But in recent years, several provinces have implemented their own poverty reduction initiatives and created their provincial poverty thresholds.[4] It is thus time to examine local lines in Canada and other countries in which responsibility for poverty alleviation is shared between different levels of government. Hence, the construction of local low income lines does not only serve to reflect the effect of regional price variations, it also serves for local anti-poverty policy developments.

[3] Rainwater, Smeeding, and Coder (2001).

[4] The province of Newfoundland and Labrador is working to establish its own MBM line, the proposed low income thresholds in Quebec are 80% of the national MBM thresholds, but the anti-poverty legislation in Ontario adopted a version of the national LIM line.

The rest of the paper is organized as the following. In Section 2, we examine why price may vary across different geographic areas within a country and how regional price disparity may affect statistics on individual well-being. Section 3 examines the effect of regional price variation on low income statistics by comparing low income indexes. In Section 4, we examine low income statistics under the regional LIM lines. Discussions and conclusions are contained in Section 5.

2. Regional price disparity and low income statistics: a brief review

The law of one price suggests that in the long-run, the price of the same commodity should be the same across different geographic areas. But disequilibrium does occur, even in a perfectly competitive market, due to asymmetric information and economic or technical shocks, resulting different prices in different regions, at least temporarily.

Prices for many goods and services can also differ permanently between regions. Firstly, transportation costs make a difference. Many commodities are produced in one place and consumed in others. The distances from the production to consumption destinations vary, resulting different transportation and preservation costs. Consequently, retail prices paid by consumers living in different areas will different. Secondly, some commodities and most services are non-tradable, making arbitrage unprofitable, if not impossible. The prices of these goods and services are typically determined at local market. For example, housing is non-tradable and the prices for identical houses may vary significantly between large and small cities. Finally, political regimes may also make prices for the same goods and services different. In many countries, different levels of government have different authorities and policy aims. Some local governments impose sale tax, others do not. And among states that impose this tax, the tax rates may vary.

Regional price disparities have long been an issue in developing countries due to market segmentations. Data collected by the National Bureau of Statistics of China on 96 tradable goods show that in 1997, the average consumer price was four times higher in the most expensive province than in the least expensive province. In India, study by Deaton and Tarozzi (1999) suggests that price level varied from 90 to 111 across urban areas in 1994 (with the combined average for all urban areas in India being set to 100). Regional price disparities are expected to be weaker in developed countries in which market segmentations are not as strong. Nevertheless, regional price disparities also exist there. In German, for example, an estimated inter-regional price index indicates that in 2004, price level varied between 95 and 131, while in Canada, the inter-city price index of an all-item basket varied from 93 to 107 in 2007 between 11 cities (the combined average was set to 100 for these cities, see Table 1 in the next section).

Researchers have devoted significant effort to test if the law of one price holds within a country. This exercise stems from the extensive work to test the purchasing power parity (PPP) in the international context. Failing to reject the null hypothesis for international PPP, researchers feel that there is a better chance for PPP to hold within the borders of a nation, in which trade barriers and regulatory differences are thought to be less strong than between countries. But empirical evidences on intra-national PPP are mixed. Overall,

price divergences occur and the convergence process can be very slow. Studies based on data from the U.S. found aggregate price convergence between cities was not the norm or they converged very slowly. One study found that the convergence process took up to 9 years. While researches for Europe, Canada and Australia suggested aggregate prices converged somewhat faster (4 to 5 years) than those in the U.S.

Therefore, one can conclude that regional price disparities are a reality, in both developed and developing countries due to temporary and permanent factors. It seems logical then to account for regional price differences when measuring the economic well-being of individuals and this is particularly the case from the welfarist perspective. A key concept in welfare economics is the indirect compensation function $e(\boldsymbol{p}, v(\boldsymbol{q}, y))$. This function tells how much money a consumer would need at prices $\boldsymbol{p}$ to be as well off as one would be facing prices $\boldsymbol{q}$ and having income y. If the society can agrees on a particular v' such that whoever has a welfare level below v' shall be deemed as poor, then $e'(\boldsymbol{p}, v'(\boldsymbol{q}, y))$ would be the poverty line in which $\boldsymbol{p}$ can be viewed as the local or regional price faced by a particular person and $\boldsymbol{q}$ average prices across the nation.

Empirical work also shows that it is important to take regional price variations in measuring inequality and poverty. For example, Jolliffe (2006) suggest that adjusting cost of living differences completely reverse poverty ranking between metro and non-metro areas in the U.S. Work by Pendakur (2002), Muller (2005) and Hoffmeister (2009) indicate that inequality and poverty measures are also affected significantly by regional price variations.

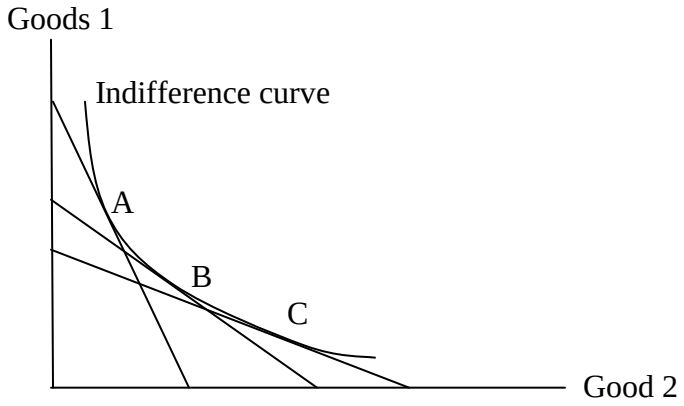
But two cases deserve further discussions. One is that the income and aggregate regional price are proportional, i.e., income and price of a region are both x% higher than the corresponding national averages. Since the consumer's optimal choices are homogenous of degree zero in price and income, individuals living in a region with higher price and equally higher income can attain the same level of well-being as individuals living in a region with lower income and equally lower price levels. If this is the case, price adjustment would not be necessary because the adjustment will not affect poverty statistics.

Another case is that in one region, prices for some commodities are high but low for others. This leads consumers to substitute the more expensive goods and services by the less expensive ones to achieve the same level of well-being. This can be easily seen from a two-goods model with different price regimes in Figure 1. The figure indicates that the same standard of living (or utility) can be attained with different quantities (A, B, and C) of the two goods in question.

Other than the above cases, the existence of regional price disparity implies that identical individuals with the same income but living in different regions would not be able to attain the same level of well-being. Furthermore, even those with higher income and living in an area with still higher prices may purchase fewer goods and services than those who have lower income but facing still lower prices. Consider two regions A and B in which the costs of purchasing the same bundle of goods and services are $100 and

$120, respectively. Since it is more expensive in region B, individuals living in that region would not be able to purchase as many goods and services as individuals living in the other when their incomes are equal. Furthermore, even if individuals living in region B have more income than those living in Region A, say $35,000 vs. $30,000, the lower cost in region A still enables its residents to purchase more goods and services than those from region B.

Figure 1. Consumer's choices when facing different prices



Nevertheless, the two cases demonstrate some important points in well-being measurements. The first suggests that it is real income, not nominal income that affects an individual's well-being. The second case indicates that the prices of a group of goods or services are not sufficient to affect the well-being of an individual because, given income, an individual can always substitute an expansive commodity by a cheap one to attain the same level of well-being and hence, to control for the effect of regional price disparities on well-being statistics, we need to adjust income by the aggregate regional price level, not by an index based on a single commodity such as housing price index or an index based on a subset of goods and services such as foods, shelter and clothing only.

3. The effects of regional price disparities on poverty statistics

In this section, we examine how regional price variations may affect low income statistics using the Canada's LIM line and data from Statistics Canada's Survey of Labour and Income Dynamics. The Canadian practice offers a reasonable opportunity for us to investigate the effect of regional price disparities on low income statistics as several spatial price indexes are directly available or can be easily derived. This will allow us to compare low income statistics with and without adjusting income by a spatial index while keeping the low income thresholds constant.

3.1 Regional price disparities in Canada: how large were they?

As mentioned before, Statistics Canada publishes several intra-city price indexes for 11 large cities across all of the ten provinces of the country. The 11 cities covered by the inter-city spatial price index are St. John's, the CMA OF Charlottetown and Summerside,

Halifax, Saint John, Montreal, Ottawa, Toronto, Winnipeg, Regina, Edmonton and Vancouver. We focus on the all-item index. The index measures the cost of an average basket of goods and services. It is based on the same data used for constructing the country's consumer price index (CPI), with about 600 consumer products being included in the basket, weighted by consumption patterns of residents living in those cities. Since the basket underneath the 11-city spatial price index is practically the same as that for the general CPI index and no consumer behaviour is taken into consideration in determining the content of the basket, we refer it to as a behaviour-free spatial price index.[5]

Table 1 contains the indexes for the period between 2000 and 2007. The combined average of the index in each year is 100 and hence, an index value of 109 means that the price level in that city is 9% higher than the combined city average, while a value of 92 indicates that the price level of a city is 8% lower than the combined average.

As can be seen from the table, aggregate price variations between Canadian cities are evident. Toronto, the largest city in the country, appears to be the most expensive one. It is followed by Vancouver and Ottawa. The former is the provincial capital of British Columbia while the latter is the capital of the country. While price level in Regina, the capital of the province of Manitoba, and Winnipeg, the capital of the province of Saskatchewan were relatively low. The difference ranged between 14% and 20% between the most and least expensive cities during the 2000 -- 2007 period.[6]

Table 1. The inter-city spatial price index (with combined 11-city average = 100)

City	2000	2001	2002	2003	2004	2005	2006	2007
St. John's	100	99	97	96	95	95	93	98
Charlottetown	95	95	94	93	93	94	94	94
Halifax	100	99	100	97	98	98	99	99
Saint John	95	93	94	92	93	93	92	96
Montreal	95	94	95	93	93	93	93	95
Ottawa	103	104	105	103	103	103	102	102
Toronto	109	110	110	110	110	110	109	107
Winnipeg	92	92	91	91	92	92	92	94
Regina	93	93	92	90	92	92	93	93
Edmonton	93	93	95	97	97	97	97	98
Vancouver	106	106	105	103	102	102	104	103

Source: Statistics Canada, CANSIM Table 326-0015.

[5] But we notice that the weights used to construct the index are based on expenditure patterns of the residents of the 11 cities.

[6] The Canadian province of Alberta also compiled its spatial price index across a number of cities in the province for the years 2001, 2003, 2005 and 2007, with the relative price of the provincial capital, Edmonton, set at 100. In 2005, the price difference between the most and least expensive cities was 21%.

An alternative spatial price index is developed by Krishna Pendakur in his study on consumption inequality in Canada.[7] In his work, Pendakur estimated a demand system of nine commodity groups (food from the stores, food from restaurant, rent, household operation, household furnishings and equipment, clothing, private transportation, public transportation and personal care) and used the parameters estimated to derive the spatial price indexes. The demand system was estimated for a sample of Canadian families using data from the 1969, 1978, 1982, 1992 and 1996 Family Expenditure Surveys and the 1997 Survey of Household Spending.[8] Since the price data were compiled for five regions of Canada: the Atlantic region (Newfoundland and Labrador, Nova Scotia, New Brunswick and Prince Edward Island), Quebec, Ontario, the Prairies (Saskatchewan, Manitoba, and Alberta), and British Columbia, the derived spatial price indexes are only available at these region/province levels.

Pendakur derived two versions of spatial price indexes. We focus on the more flexible one in which the deflator is assumed to depend on total expenditure. This is referred to as the "expenditure-dependent price deflator" by the author. We ignore the year 1969 due to the lack of income data. For years after 1997, we use annual provincial CPIs and the 1997 spatial deflators to derive the spatial price indexes for the three provinces. For the two regions, we first imputed the regional CPIs with provincial CPIs weighted by their population shares within the region. We then used their 1997 spatial indexes and imputed regional CPI to calculate their regional spatial price indexes for the period 1998 – 2007. Table 2 contains the spatial price index we derived using the result from the Pendakur study.

Table 2. Spatial price index based on Pendakur deflator

	1978	1982	1986	1992	1996	1997	1998	1999
Atlantic	99	96	97	95	96	96	96	96
Quebec	92	92	95	93	91	90	91	91
Ontario	103	103	107	109	109	109	110	110
Prairies	96	98	93	93	91	91	91	92
BC	110	112	108	110	113	113	113	112

	2000	2001	2002	2003	2004	2005	2006	2007
Atlantic	96	96	96	97	97	97	97	96
Quebec	91	91	90	90	90	90	90	89
Ontario	110	111	111	110	110	110	110	110
Prairies	92	92	93	93	93	93	94	96
BC	111	110	110	110	110	109	109	109

Sources: Authors' calculation based on Pendakur (2005) and CANSIM.

[7] Pendakur (2002). He also applied this method in studying consumption poverty in Canada. See Pendakur (2001).

[8] The study is based on data from residents lived in cities with 30,000 residents or more. Rural area was not covered.

The Pendakur spatial price index also reveals significant regional price variations. The provinces of Ontario and British Columbia were the most expensive, while the province of Quebec and the Prairies provinces (including Alberta, Saskatchewan and Manitoba) were the least expensive, and the Atlantic provinces (including Newfoundland and Labrador, Prince Edward Island, Nova Scotia and New Brunswick) fell in the middle. During the period examined, the regional/provincial price difference ranged from 15% to 23% between the most and the least expensive regions/provinces.

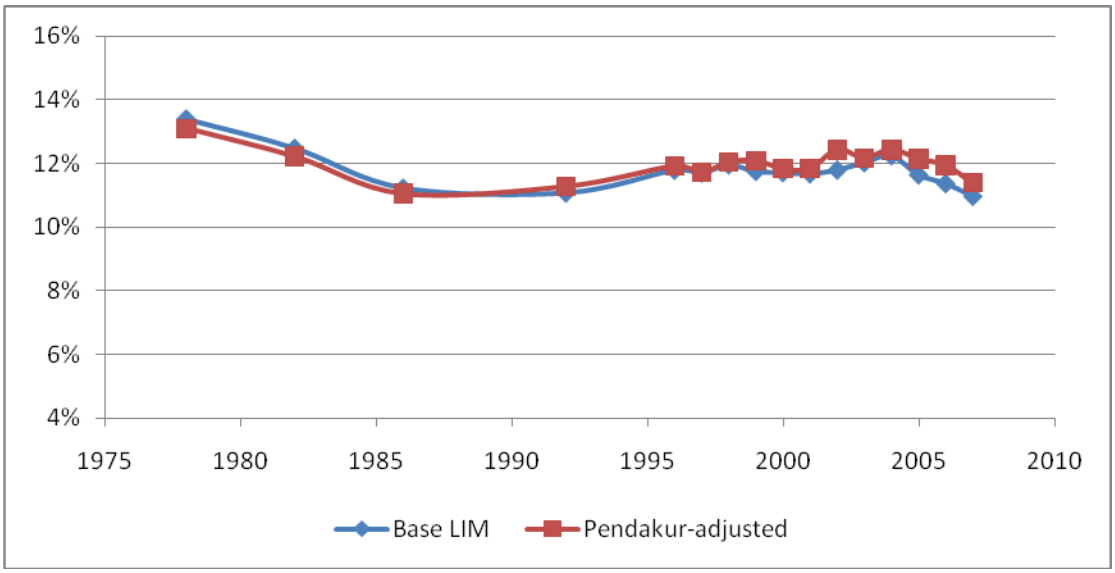
Notice that both the inter-city and the Pendakur spatial indexes focus on households of urban centers. The former focuses on the 11 largest cities of the country, while the later excludes areas with less than 30,000 residents due to the lack of data. If, as some studies indicated that, the average cost of living in rural areas is further below the average cost of living in cities, then the observed price differences from the inter-city index and the Pendakur index would be some lower bounds of the true regional price differences in Canada.[9]

3.2 The effect of price variation on low income statistics at the aggregate level

Figure 2 presents low income incidences at Canada level using the national LIM line.[10] The "Base LIM" case shows the annual incidence when income is not adjusted by regional price index. Here, the low income status of a person, no matter where he or she lives, is determined by comparing his/her unadjusted income with the national LIM thresholds. Low income incidence when income is adjusted by the Pendakur spatial price index is marked as the Pendakur-adjusted. In this case, a person's low income status is determined by comparing the national LIM line with his or her income adjusted by the price index of the region in which the person lived. Since only difference underlying the two sets of low income rates is whether income is adjusted by the Pendakur spatial price index, the gap between the two sets of low income rates is due to regional price variations.

Figure 2. Low income rates with or without spatial price adjustment: Canada

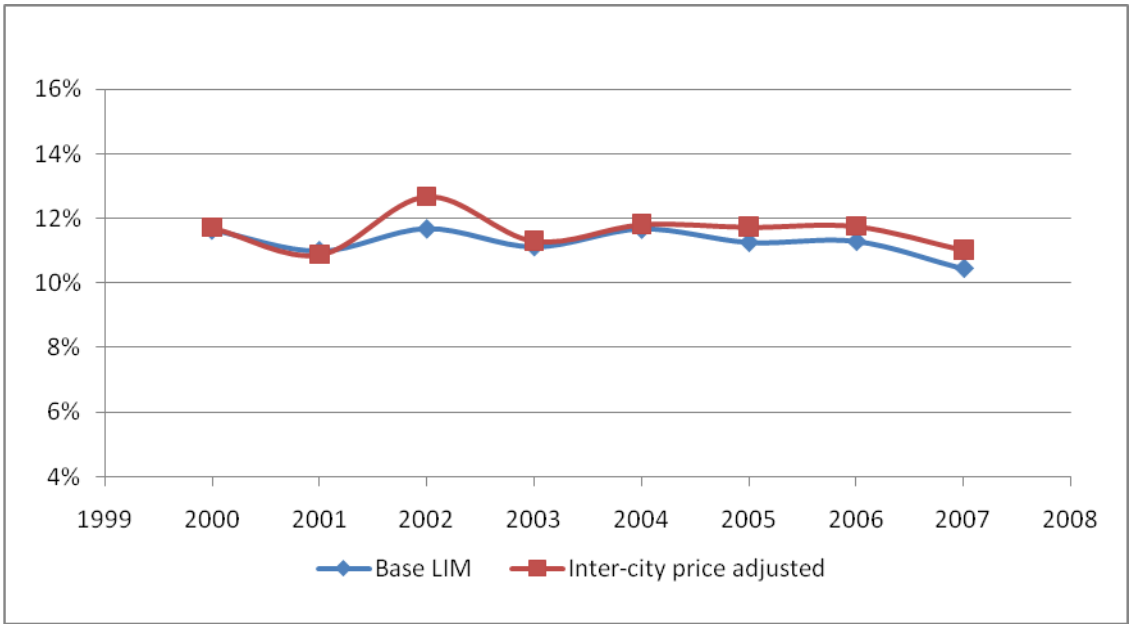
[9] The thresholds under the Canadian MBM basket may also be employed to construct a regional spatial price index. See Appendix table 1 for an example. But since its basket contains much fewer goods and services than those under the 11-city index or the Pendakur index, we choose not to pursue this approach.
[10] The after-income-tax and government transfer income concept of income is employed in this paper.



The figure suggests that, at the national level, regional price does not affect low income statistics. Firstly, price adjustment does not affect the low income trend. From the late 1970s to the late 1980s, low income incidence in Canada declined, whether income is adjusted by spatial price index or not. It increased slowly from the early 1990s to the early 2000s, and declined again thereafter under both scenarios. Secondly, price adjustment does not affect the level of low income statistics either. Before 1990, adjusting income by the Pendakur spatial price index would result slightly lower low income incidences than otherwise, while after 1990, the opposite occurred. Yet the effects were not statistically significant at the 95% level in both periods.

Figure 3 contains the estimated low income incidence across the 11 Canadian cities for which a spatial price index is available. The curve marked by "Base LIM" is the same as that in Figure 2, except now that the curve describes low income rate in the 11 cities. The "Inter-city price adjusted" curve shows what would be the low income rate for all residents of the 11 cities when their incomes are adjusted by the inter-city spatial price index of their respective cities.

Figure 3. Low income rates: income adjusted by the inter-city spatial price index



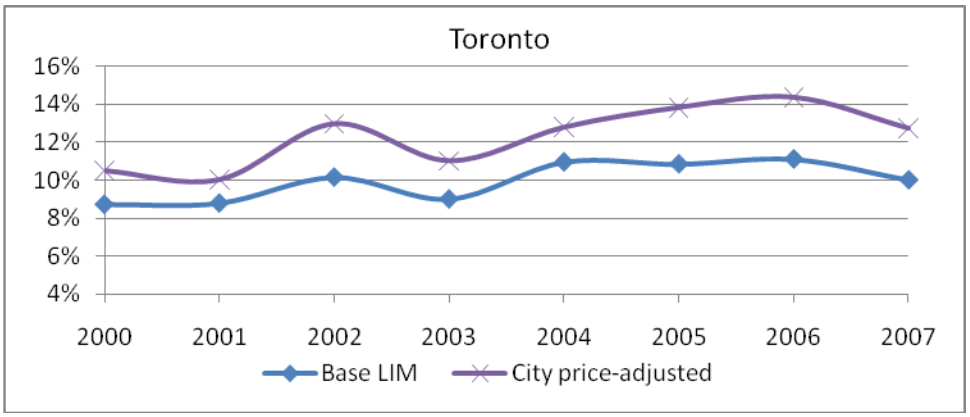
When income is adjusted by the inter-city spatial price index, low income statistics trend for individuals living in the 11 cities remained the same as the unadjusted case. However, the level in low income statistics generally increased. In other words, ignoring regional price variations could potentially lead to downward bias in low income rate within the cities in question. But the bias does not seem to be big, in the 8 years while the inter-city index was available, only in 2002 the bias was about one percentage point and it was significantly different from 0.[11]

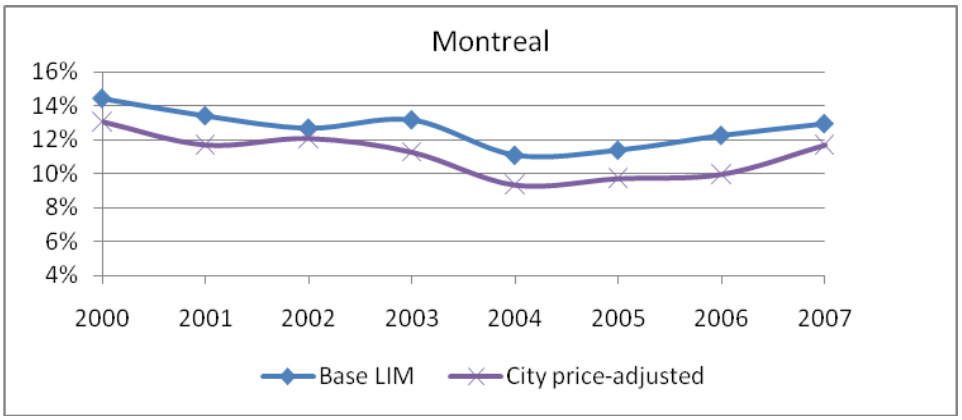
3.3 The effect of price variation on low income statistics: groups

The above low income statistics are largely limited to an aggregate level. What happens to different regions, provinces, cities and groups of individuals if income is adjusted by a spatial price index? Our estimation results show that the small differences between low income rates at the aggregate level concealed some important variations across provinces, regions and cities. Figure 4 illustrates this point for two major cities (Toronto and Montreal). In Toronto, the inter-city price index adjusted low income rates were higher than under the unadjusted case, and the differences were significantly different from 0 in at least some years and marginally significant from 0 during other years. But in Montreal (as well as in Charlottetown, Saint John and Winnipeg), price adjusted incidence was lower than the unadjusted incidence, although the difference was barely significantly at the 95% level. In the rest of the 11 cities, the differences were mixed, but not significantly different from 0.

Figure 4. Low income rates in Toronto and Montreal

[11] Our focus here is not to explain why it increased more in a particular year but to see if adjusting income will affect low income statistic. But reason behind this is probably that price increased faster in these cities than in the rest of the country between 2001 and 2002. For example, in Ontario, CPI increased by 2.0% in Toronto and Ottawa, while in the rest of the province, it increased by 1.5%.





In addition, adjusting income by the inter-city spatial price index appeared to increase the gap ratios and the severity indexes in Toronto, Vancouver and Ottawa, and decreased these indexes in Charlottetown, Saint John, Montreal, Winnipeg and Regina. But none of these differences were significant. The evidence seemed to suggest that spatial price adjustment using a general basket has little effect on low income statistics for all 11 cities together, but for cities with high costs of living, ignoring price differences may lead one to under estimate several low income statistics.

Furthermore, the ranking of cities in terms of their low income statistics may also change due to price adjustment. As an example, in 2000, Saint John, Montreal, and Halifax had the highest low income incidences among the 11 cities without price adjustment. But with price adjustment, Montreal was out of the bottom three list, while Vancour enters into the bottom list. But in 2007, Montreal, St John's and Saint John had the highest incidence before family incomes were adjusted by the inter-city indexes. While after the adjustment, Toronto and Vancouver became cities with highest incidence, only St John's remained on the top three list.

When different groups of individuals living in the cities were examined, the inter-city spatial price adjustment appeared to increase low income incidence some years for new immigrants and to a less extent, children under 18 years of age. However, the differences were barely significant. For other groups, such as elderly, unattached non-elderly individuals, individuals from lone parent families, from families headed by those with

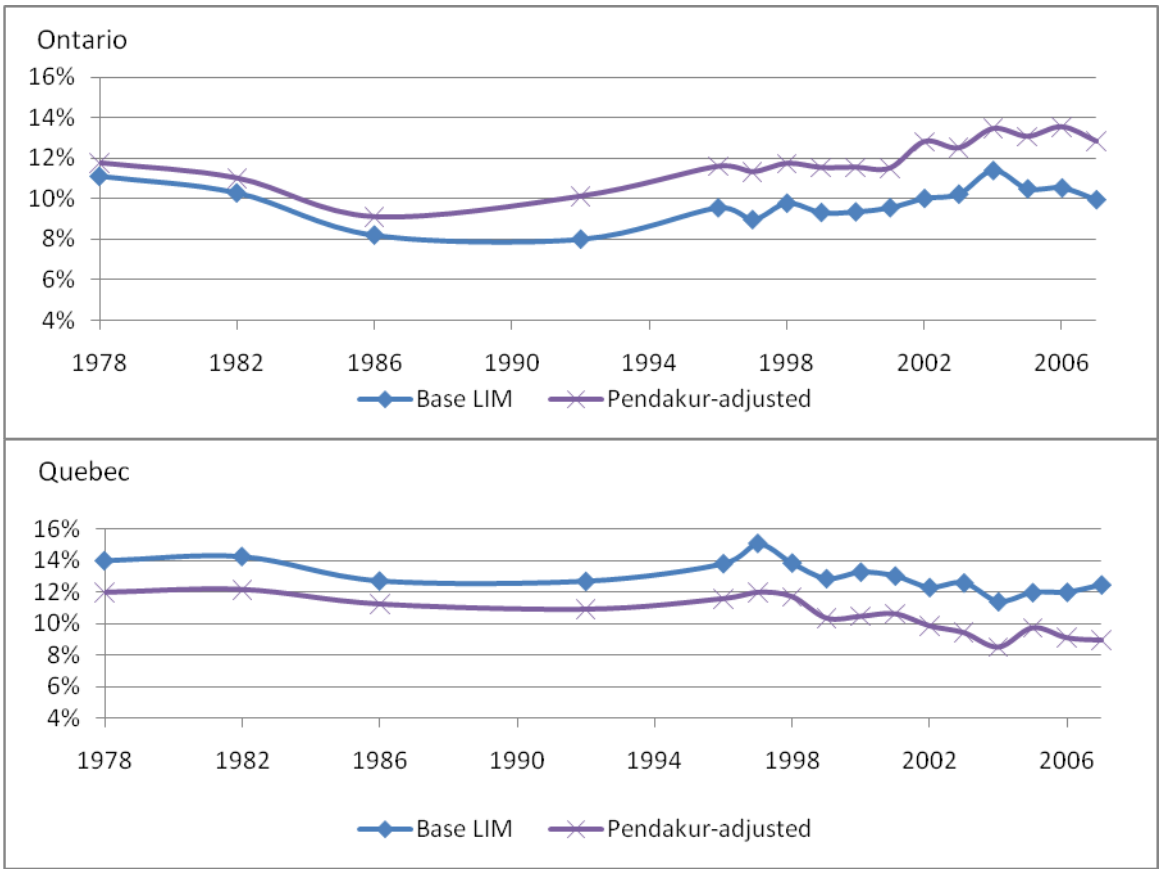
work limitation, price adjustment had no effect on low income incidence. Hence, spatial price difference does not appear as an important factor affecting low income status of disadvantaged groups of individuals living in the 11 cities.

When we apply the Pendakur index to adjust income, we found that take regional price variations into consideration may change the low income statistics for a province or region. For the Atlantic region, Quebec and the Prairies region, applying the spatial price deflator made low income statistics lower than otherwise, while for Ontario and British Columbia, applying the Pendakur deflators made low income statistics higher than otherwise. The differences in the incidences appeared to be significant at the 95% level quite often and even the differences in the low income gap ratios sometimes became significant particularly for BC and Quebec, and for Ontario in recent years. For example, in 1997, the 95% confidence interval estimate for the incidence in Quebec was [12.9%, 14.7%] before price adjustment, it became [10.8%, 12.4%] after. Because the two confidence intervals do not overlap, the effect of price adjustment on low income incidence was statistically significant. The effect of price adjustment was also significant on the gap ratio for Quebec in 1997: the 95% confidence interval estimates for the gap ratios were [3.4%, 4.1%] and [2.6%, 3.2%], respectively, before and after adjusting income by the spatial deflator.

An example is given in Figure 5. The figure contains low income rates for the provinces of Ontario and Quebec, with "Base LIM" describes low income rates for which income was not adjusted, and the "Pendakur-adjusted" curve shows low income rates when income was adjusted by the Pendakur spatial price index for the two provinces.

But our results can be problematic due to the fact that the Pendakur spatial index is based on data from cities with 30,000 or more residents and hence it may not be appropriate to use the deflators to adjust income of rural residents. For example, if the true cost of living in rural areas is lower than that in urban areas, the Pendakur index would over deflate income of rural residents and thus over estimate low income statistics among rural residents. Furthermore, when two provinces with different rural populations, low income statistics based on income adjusted by the Pendakur spatial index in the province with a large rural population would be over estimated. Thus the effect of the Pendakur spatial index on low income statistics should be verified further within urban areas.

Figure 5. Low income rates in Ontario and Quebec: effects of price difference



But when we focus on urban areas only, we obtain similar result as above. Before the mid 1990s, the incidences under the Base LIM were not significantly different from incidences based on the spatially adjusted income. However, the differences started to become significant after the late 1990s. We have also calculated the low income statistics for urban residents in each region or province, with and without adjusting their incomes by the spatial deflator. The previous result still holds: spatial price adjustment decreased low income statistics for regions in which costs of living commonly known to be low and increased for other regions in which costs of living were usually low.

Across groups of disadvantaged individuals, we found that applying the Pendakur deflators increased low income incidence for individuals from families headed by recent immigrants (lived in Canada for 10 years or less) in the period after the early 1990s. Before the end of 1980s, price adjustment did not seem to have any effect. There was also evidence that price adjustment increase low income incidence for individuals from families headed by those with work limitations, but the increase did not appear to be significantly different from 0. The effect was mixed for children. Before the end of 1980s, price adjustment appeared to decrease low income incidence, but in more recent years, price adjustment seemed to increase low income incidence for children.

4. Low income statistics under local LIM lines

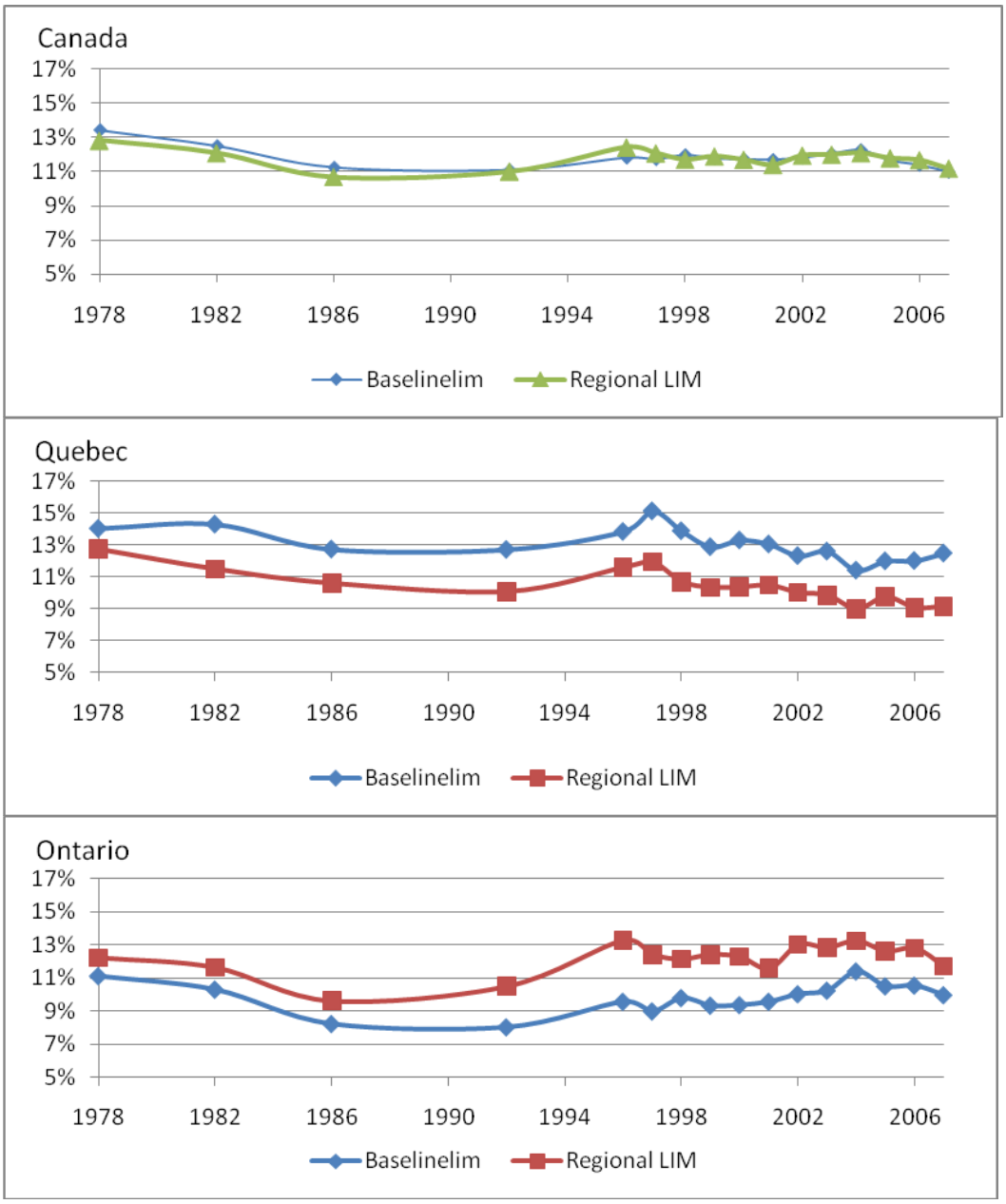
While adjusting income by certain spatial price indexes may help us to better understand regional disparities in low income, we need to keep in mind that the low income lines we employed so far are all national lines. With these lines, the standards being employed to determine if an individual is in low income are national standards. Questions arise towards this approach of low income measurement: is nation the only unit at which the measuring rods can be established? What happens if we adopt local thresholds based on local standard of living? Indeed, several provinces in Canada have started to build their own thresholds. It is thus useful to examine national low income statistics when low income is measured with sub-national thresholds.

A possible solution is to establish the local LIM thresholds. That is, from each locality, we estimate the median of its income distribution, and then calculate the thresholds as half of the median adjusted income, adjusted by the standard equivalence scale to account for scale economies in consumption for families with more than one person. An example is Heisz and Mcloed (2004) in which the authors examined low income statistics with CMA/CA specific LIM threshold. In order to compare with results in the previous section, we limit our self to the five regions and the 11 Canadian cities.

Of course, one needs to be careful in deciding which geographical level is chosen to establish the local line. We shall return to this later in the next section. In the current study, for comparison purpose, we choose areas that are corresponding to those available under the two spatial price indexes we employed in the previous section.

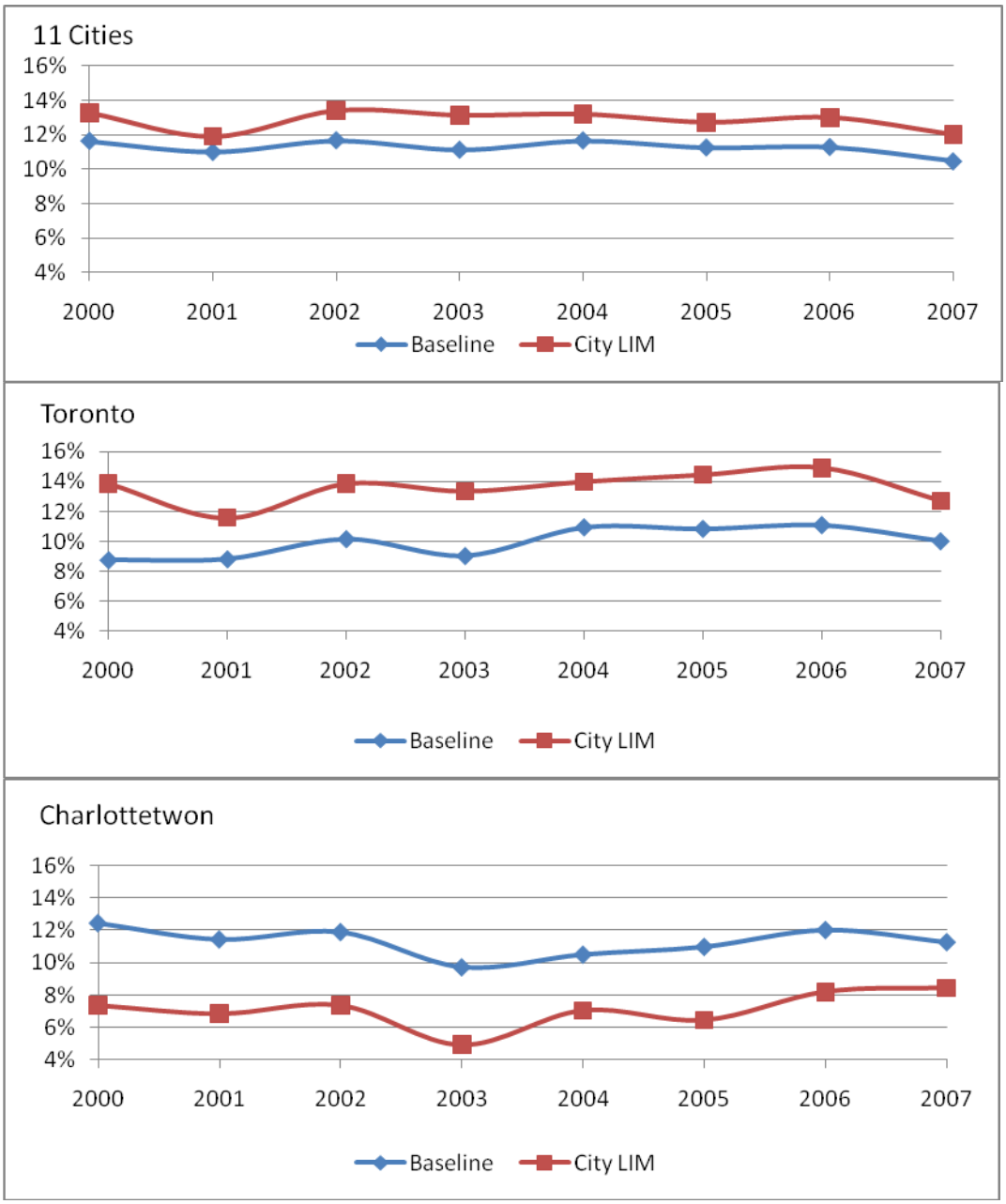
Our results show that, with regional level LIM thresholds, the aggregate low income statistics were similar to those under the national LIM thresholds. Figure 8 illustrates low income incidences under the national LIM and those under regional thresholds. The differences in the incidences under the two sets of LIM thresholds were not significant at 95%, even in years before the 1990s. But the similarities in aggregate low income statistics again concealed some systematic differences within certain regions. The lower panels of Figure 6 illustrated this point. In particular, for the Atlantic region and the province of Quebec, local LIM thresholds tended to lower low income statistics, while for the province of Ontario, the opposite occurred. Over the period examined (1978, 1982, 1986, 1992, 1996, 1997 – 2007), the changes were mostly significant, not only in terms of incidences, but also often in terms of the gap ratio. But the difference in the severity indexes did not appear to be significant. In the Prairies (not shown), however, the local LIM thresholds did not change the low income statistics in any obvious way, while in BC (not shown), local thresholds tended to increase low income statistics in the late 1990s, afterwards, no significant change had occurred.

Figure 6. Low income incidences under national and regional LIM thresholds



Corresponding to the previous section in which the effects of the inter-city spatial price indexes on low income statistics were examined, we also investigated the effects of city specific LIMs across the 11 Canadian cities. At the aggregate level (within the 11 cities), local LIM thresholds appeared to raise low income statistics. Figure 7 indicates that the incidence increased by 1 to 2 percentage points in the period of 2000 – 2007, and the differences in the incidence estimates were mostly significant at the 95% level. In addition, the estimated gap ratios were also significantly different sometimes at the aggregate level.

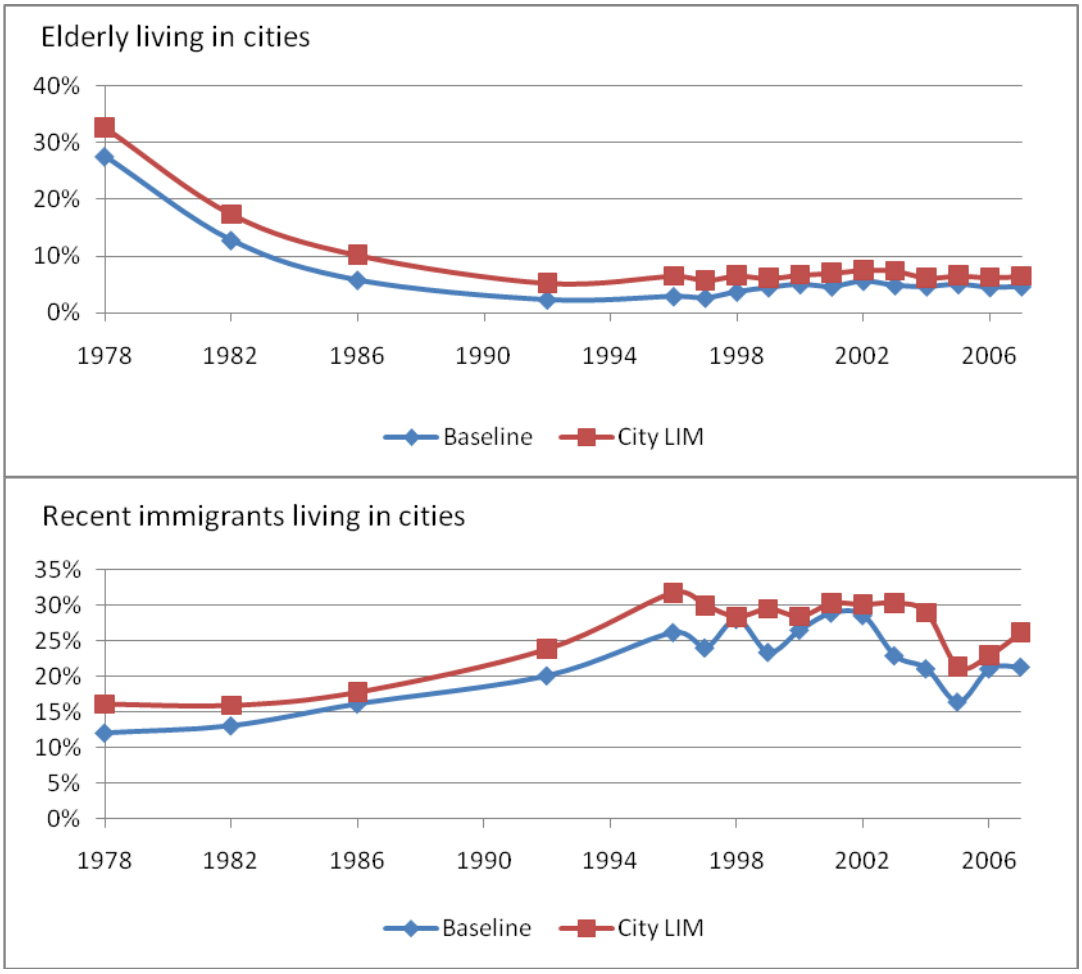
Figure 7. Low income incidence under city LIM-specific thresholds



But across the 11 cities, the effect of localized LIM thresholds was heterogeneous. Some examples are given in the lower portion of Figure 8. In several cities, notably in Toronto, Ottawa, Edmonton, Regina and in Vancouver after 2001, localized LIMs increased low income statistics. In other cities, including Charlottetown, St. John's, Saint John and Montreal, the effect of localizing the thresholds reduced the estimated low income statistics. And the changes were often significant, at least in terms of the incidences. Only in Halifax and Winnipeg, local thresholds had no effect on estimated low income statistics.

Furthermore, we found that localized LIM thresholds changed low income statistics for several disadvantaged groups of individuals in the 11 cities rather significantly in the 2000 – 2007 period. Firstly, local thresholds appeared to increase estimated low income incidence by about 2 percentage points for children and individuals from lone parent families. But the changes did not seem to be significant at the 95% confidence level for these two groups of individuals. Secondly, localized LIM thresholds increased low income incidences for the elderly (65 years or older) and persons from families headed by recent immigrants. These are presented in Figure 8. And the changes for these two groups sometimes were significant, particularly for persons from families headed by recent immigrants, whose income were relatively low and yet they tended to settle in large cities and/or provinces where costs of living were relatively high.[12]

Figure 8. Low income incidence for elderly and recent immigrants living in cities



The elderly living in cities mostly were relying on fixed income such as retirement pensions, OAS and other transfers, and since income in cities were generally higher than

[12] More than 60% of immigrants who arrived in Canada between 1996 and 2001 settled in Toronto and Vancouver.

in non-urban areas, which implies that localized LIM thresholds were likely to be higher than national LIM, it is not surprising to see that elderly individuals living in cities would incur higher low income rates under local LIM thresholds. Similarly, since recent immigrants mostly chose to live in large cities and their earnings were lower than fellow residents (Canadian born or immigrants lived in Canada for more than ten years), with local thresholds, they were facing higher measuring rod, and hence their low income rates would also be increased than under the national LIM thresholds.

5. Discussions

Numerous researches recommend geographic targeting of the poor as a way to allocate social spending and infrastructure investments. For a country as diverse as Canada, costs of living in different regions are different and the same amount of income may enable consumers to purchase different amounts of goods and services to maintain a give level of standard of living. This has implications for poverty and low income measurement. One possible choice is to adjust individual's income by regional price differences such that the adjusted income of an individual is compared with a national threshold. The other choice is to establish local low income line such that an individual's income is directly compared with the threshold of a locality in which the individual resides.

The current study examined the consequences of the two approaches and attempts to answer questions such as how different choices affect the national and regional low income estimates and low income statistics for different groups of individuals. The effect of the 11-city inter-city price indexes by Statistics Canada and the effect of five regional spatial price deflators by Pendakur (2002) were investigated. We found that, although they would not change the national estimates, they increased low income estimates for certain regions where costs of living were commonly known as high and decreased the estimates for other regions where costs of living were low.

The effects of localized low income lines were similar: the national low income statistics were not affected in any significant way with region specific low income lines, while low income statistics would be higher in regions where costs of living were high, and lower in which costs of living were low. But different from the effects of price adjustments, localized LIM line appears to increase low income statistics for several disadvantaged groups of individuals, notably the elderly and new immigrants, suggesting the elderly individuals and individuals from families headed by new immigrants have not shared the benefits economic growth as individuals from other groups.

These are preliminary results, but the use of a spatial price index, either through a basket measure that has more geographical breakdown or through local LIMs seem important. Localizing the low income line seems to identify certain disadvantaged groups of individuals that are not well identified through a national LIM. This is in part because when local LIM lines are employed, an individual is compared with an average person from his/her own region, not an average Canadian. For a number of policies, differences in trends may be as important as differences in levels and more work needs to be done particularly for seniors, where the income concept by itself may have some limitations.

The question of the level of aggregation for the construction of a spatial index or a regional line still remains. A decision could be made based on the geographical level at which decisions for poverty alleviation is made. Costs and operational constraints may also affect the level of disaggregation that is possible; it may not be feasible to collect price data from remote areas to calculate the local price index. And of course variation in the cost of livings among regions will drive the level of disaggregation required; for example, a country with large climatic difference between regions or with barriers for transportations that are quite different would result different consumption preferences or baskets of goods and services.

This study is based on available spatial price indexes and they are limited to either cities or to province level or above. These are not ideal spatial index to fully reflect regional price variations and more work is required. They can be employed to control for regional price variations in poverty measurement. But our results also suggest that regional LIMs at the provincial level may be used to complement the current suites of low-income measures. With regional lines, one can obtain similar low income statistics as with spatial price indexes. But they are easy to understand, the methodology is simple and their constructions do not involve additional cost.

Appendix table 1. Implicit spatial price index by MBM thresholds* (2007)

Newfoundland		PEI	
rural	103	rural	101
<30K	105	<30K	104
St. John's	101	Charlottetown	108
Nova Scotia		New Brunswick	
rural	106	rural	102
<30K	107	<30K	104
30K - 100K	99	Fredericton	105
Halifax	105	Saint John	96
Cape Breton	95	Moncton	99
Québec		Ontario	
rural	91	rural	100
<30K	92	<30K	100
30K - 100K	86	30K - 100K	93
100K - 500K	86	100K - 500K	98
Québec city	91	Ottawa	106
Montrèal	94	Hamilton/ Burlington	97
		Toronto	112
Manitoba		Saskatchewan	
rural	96	rural	95
<30K	100	<30K	99
Brandon	92	30K - 100K	90
Winnipeg	96	Saskatoon	96
		Regina	95
Alberta		British Columbia	
rural	103	rural	103
<30K	108	<30K	104
30K - 100K	104	30K - 100K	97
Edmonton	103	100K - 500K BC	109
Calgary	109	Vancouver	112

*. The indexes were obtained by dividing the MBM thresholds for each community by the simple average value of all thresholds. They are for illustration purpose only.

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