

Consumption Poverty in Canada, 1969 to 1998

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Dans cet article, je considère le taux de pauvreté comme la proportion d'individus dont la consommation — plutôt que le revenu — est au-dessous du seuil de pauvreté absolue. Le seuil de pauvreté absolue utilisé est basé sur les dépenses nécessaires pour atteindre un niveau minimum de bien-être matériel. Ce seuil ne varie pas avec le passage du temps alors que varient les valeurs sociales ainsi que le seuil de pauvreté relative. La consommation est utilisée parce que les niveaux de consommation sont choisis par des ménages ayant quelque connaissance des revenus passés et futurs, et la consommation peut donc être un meilleur indice de bien-être matériel que ne l'est le revenu. Ici, la consommation est ajustée pour tenir compte des variations dans les prix, auxquelles doivent faire face les différents ménages, ainsi que des variations dans les caractéristiques démographiques.

Les résultats de cette évaluation consommation / pauvreté sont divers. Comme c'était le cas lorsque l'évaluation de la pauvreté était faite selon le revenu, le taux de pauvreté établi d'après la consommation a décliné au cours des années 1970 et 80 — tous les bateaux montèrent avec la marée montante. Cependant, ce n'est plus la même histoire dans les années 90. Entre 1992 et 1998 le taux de pauvreté établi selon la consommation s'est accru de moitié. Les conséquences sur les enfants ont été encore pires. Parmi les enfants, ce taux de pauvreté a plus que doublé entre 1992 et 1998.

In this paper, I estimate the poverty rate as the proportion of individuals who have consumption — rather than income — lower than an absolute poverty line. The absolute poverty line used is based on the expenditure necessary to achieve a minimum level of material well-being. It does not change over time with changing social values as do relative poverty lines. Consumption is used because consumption levels are chosen by households with some knowledge of future and past incomes, and may thus be a better indicator of material well-being than income. Here, consumption is adjusted for differences in the prices faced by, and demographic characteristics of, different households.

The story told by consumption poverty measures is mixed. As with income poverty measures, the consumption poverty rate declined over the 1970s and 1980s — all boats rose in the rising tide. However, the 1990s tell a different story. The consumption poverty rate increased by more than half between 1992 and 1998. Outcomes for children were even worse. The rate of consumption poverty among children more than doubled between 1992 and 1998.

INTRODUCTION

Poverty measurement usually focuses on counting individuals who have a low income. In this paper, I count individuals who have low consumption rather than low income, with “low” defined by a minimal poverty line. Since poverty lines are often cast in terms of defining the minimum consumption necessary to reproduce oneself from period to period, it seems natural to use consumption rather than income as the metric of economic deprivation. Further, since annual consumption — total expenditure on flows of goods and services during a year — is chosen by individuals and households with knowledge of their past and future income prospects, it may provide a more accurate reflection of their level of material well-being than their annual income. Similarly, consumption poverty rates may reveal more about material deprivation in society than income poverty rates.

In this paper, I estimate the rate and depth of *absolute adjusted consumption poverty* in Canada over the period 1969 to 1998. *Consumption* is defined as annual expenditure flows on the following eight commodities: food purchased from stores, shelter,¹ clothing, personal care, public transportation, private transportation operation, household operation, and household furnishing and equipment.² Consumption is *adjusted* for differences in prices (over time and across area of residence in Canada) and for differences in household size and composition to get adjusted consumption. If adjusted consumption is below the poverty line, then the household is called “poor.”

This paper uses *absolute* poverty lines, rather than more commonly used relative poverty lines. Relative poverty lines depend on ever-evolving community norms and standards. Statistics Canada’s Low Income Cut-Offs (LICOs) and Low Income Measures (LIMs) are relative poverty lines because they rise as society gets richer. Absolute poverty lines usually attempt to hold constant the purchasing power of the poverty standard. Absolute poverty

lines may increase as prices rise, but do not increase with improvements in community standards or average income. Sarlo’s (1992, 1994) poverty lines and HRDC’s (1998) market basket measures are absolute poverty lines because they depend only on the prices of commodities.

The poverty line used in this paper is taken from Sarlo (1992, 1994). He estimates exactly the minimum amount of expenditure necessary to survive for one year for various types of households in various Canadian cities. This poverty line is absolute and is equal to \$8,082 per year for a single childless adult living in (Toronto) Ontario in 1992. This poverty line is minimal in the sense that it is at the low end of those used by researchers in this area; for example, it is approximately half as large as the LICO and LIM for this type of household.

In this paper, I report poverty rates and the depth of poverty in Canada over 1969 to 1998. The *poverty rate* is the proportion of Canadian individuals who have adjusted consumption below the absolute poverty line. The *depth* of poverty is the average proportional adjusted consumption shortfall of poor individuals compared to the poverty line.

In order to assess what difference it makes to use consumption rather than income, I also measure the poverty rate in Canada using net income (also adjusted for differences in prices and household size and composition). In addition, I explore differences in absolute adjusted consumption poverty rates and depth across age groups, size of area of residence, and region of residence. Finally, in order to assess the robustness of results, I provide estimates using alternative equivalence scales, price deflators and rent imputations, and estimates of consumption poverty using a relative rather than an absolute poverty line.

Four key results emerge from this research. First, income and consumption poverty measures give different pictures of poverty. That is, low income and low consumption are not the same. Depending on

the year, approximately one-half of individuals whose income is low have consumption that is not low. If consumption truly does measure economic well-being and deprivation better than income, then low income is a very noisy indicator of economic deprivation.

Second, estimated consumption poverty rates for Canada suggest a mix of good and bad news for the last three decades: poverty declined from 1969 to 1992, and then rose again from 1992 to 1998. The decrease in poverty during the 1970s and 1980s was very large — the rate of consumption poverty dropped from 11.4 percent in 1969 to 2 percent in 1992. This steady decline makes the increase in the 1990s all the more striking. The poverty rate rose to 2.8 percent in 1996 and to 3.4 percent in 1998. The increase is quite robust: it is seen in most regions and age groups.

Third, the depth of poverty has changed over time. The average consumption shortfall for the poor population declined from 12.5 percent in 1969 to 11 percent in 1998. Over the 1970s and 1980s, the depth of poverty was around 12 percent, but during the 1990s it was closer to 11 percent. This decline in the depth of poverty partially offset the increase in the rate of poverty in the 1990s. However, poverty intensity — approximately equal to the poverty rate multiplied by the depth of poverty — still increased by about three-quarters over the 1990s.

Fourth, some differences across age groups are evident. Among the elderly, the consumption poverty rate consistently declined over the 28 years from 1969 to 1997. The poverty rate among the elderly dropped from nearly 30 percent in 1969 to less than 3 percent in 1997. However, consumption poverty among the elderly rose between 1997 and 1998.

In contrast, child poverty declined greatly over the 1970s and 1980s, and then rose greatly in the 1990s. These results contrast somewhat with Picot and Myles (1996) finding that income poverty among children was quite stable during the 1980s.

Over the 1970s, child poverty declined by more than two-thirds, from 11.7 percent in 1969 to 3.5 percent in 1978. Over the 1980s, child poverty declined by another half, to 1.8 percent in 1992. However, the incidence of child poverty more than doubled over the 1990s: it increased to 4.2 percent in 1998. By 1998, all progress in the reduction of child poverty over the 1980s had been undone, and child poverty had returned to well above its 1978 level. These differences across age groups are particularly striking given the retrenchment of income support programs for the non-elderly, and the increasing share of public pensions among social expenditures, over the 1990s.

Since absolute poverty measures do not change with average living standards, we expect absolute poverty to decline over the long haul as a result of economic growth, which is what occurred over the period from 1969 to 1992. However, during the period of slow growth from 1992 to 1998, this trend reversed, especially for children.

WHY ABSOLUTE ADJUSTED CONSUMPTION POVERTY?

Absolute versus Relative Poverty

The majority of researchers who measure poverty use relative poverty lines (see, e.g., Osberg and Xu 2000) which evolve along with community standards over time and which may be very different in different countries and contexts. The standard line of reasoning is that whatever poverty line we set as researchers is embedded in our social context (see, e.g., Sen 1973, 1982). For example, although the World Bank (2000) uses a poverty line of one US dollar per day in its measurement of poverty in the developing world, it makes little sense to apply such a poverty standard in the developed world. Although approximately one billion people outside Canada live on less than this amount, almost nobody in Canada does.

On the other hand, although relative poverty measures are often preferred by academics, they do

not always coincide with popular conceptions of poverty. Amiel and Cowell (1999) found that in a multiple-choice questionnaire on poverty definitions, only 11 percent of respondents thought that “poverty is a situation where incomes are below a level which is relative to the income distribution (for example, 50 percent of the median income)” whereas 72 percent thought that “poverty is a situation where incomes are not enough for a supply of basic needs.”

To check how much difference it makes to use an absolute rather than a relative poverty line, I also present results on relative consumption poverty using a poverty line equal to 50 percent of the median adjusted consumption level.

An exchange of letters in *The Globe and Mail* newspaper exemplifies another issue that frustrates public discussion of poverty in Canada. On 8 August 2000, Anne Golden, president of the Greater Toronto United Way, wrote a commentary which presented some poverty statistics based on the Low Income Cut-Offs from the *Canadian Fact Book on Poverty* (CCSD 2000) including the fact that “in a single generation, the percentage of young Canadian families living in poverty has more than doubled from 22 percent to 46 percent.” John Baker responded two days later with “Anne Golden loses her credibility when she states that 46 percent of young families live in poverty ... One in two young families is an astonishing rate of poverty, which any reasonable observer realizes must be wrong. Therefore, it must be the definition of poverty that is misleading.”³

This exchange suggests that commonly used poverty lines may be higher than those that many people have in mind when they think about material deprivation. In this paper, I use a poverty line that is quite low compared to other poverty lines used by public agencies in Canada. The poverty line used in this paper of \$8,082 for a single adult living in Ontario in 1992 is just under half of the LICO and well under half the LIM. It is so low that a broad

spectrum of observers might agree that it represents real material deprivation.

I use a low poverty line in this paper not because I personally prefer them, but rather because I believe that the debate on poverty in Canada has been partially sidetracked by measurement issues. If a large fraction of the population believes that they should not be concerned with poverty because they do not believe that the available measures are informative, then they should be provided with measures that are informative to them, especially given that absolute and relative measures agree on what has happened in the 1990s. I note also that use of absolute poverty measures does not preclude the use of relative poverty or inequality measures alongside (e.g., Pendakur 1998, 2001, studies consumption inequality in Canada).

Consumption versus Income Poverty

When we think about poverty, it matters whether or not we are concerned with poor opportunities or poor outcomes. For example, if a person has the opportunity to consume the necessities of life but chooses not to, then they do not have poor opportunities but do have poor outcomes. There is substantial and unresolved debate among philosophers and welfare economists as to which is the correct approach (see, e.g., Sen 1999). In the case where we are concerned with poor outcomes, it may be sensible to use a material outcome like consumption rather than a measure of the opportunity set like money income. This is especially true if people are able to consume things that they do not have the income to purchase. Two important examples are monetary and in-kind gifts from friends and families and in-kind transfers from governments such as subsidized housing.

Consumption is different from income as a measure of deprivation in another way as well: under certain admittedly restrictive models of how savings and borrowing decisions are made, consumption is an indicator of lifetime wealth (see Pendakur 1998; Blundell and Preston 1998 for technical details). The idea is simple. If we can borrow and save as we see

fit and if we do not like fluctuations in our consumption, we will move money income around from period to period so as to minimize or even eliminate variation in consumption across time periods. In this case, consumption tells us something about lifetime wealth. People who perceive themselves as having low lifetime wealth will consume little even in the presence of a positive income surprise. People who perceive themselves as having high lifetime wealth will consume a lot even in the presence of a negative income surprise. In particular, one could have zero or negative income, but still have the consumption necessary to reproduce oneself in the presence of saving and borrowing. In this case, low income would not indicate deprivation. Alternatively, one could have moderately high income, but be servicing debt, anticipating debt or anticipating low income, and therefore consuming very little and living in a state of deprivation. In this case, income above the poverty line would not indicate the absence of deprivation. Thus, consumption may provide a more direct measure of individual economic deprivation than income.

Consider Figure 1 which maps out the possibilities for disposable income and consumption for a particular household (taking for granted that the issue of how low the poverty line should be is settled).

A household that has neither low income nor low consumption can definitely be considered non-poor.

This household has the means and chooses to consume enough. A household that has low income and low consumption can definitely be considered poor. Both the opportunity measure, income, and the outcome measure, consumption, show deprivation.

The mixed cases are slightly more complex. A household with low income but not low consumption merely reveals that it had resources other than current money income to draw on, so that household is not deprived.

A household with low consumption but not low income falls into one of two categories. On the one hand, the household may be saving due to anticipated income drops or servicing past debts, which means that the household is deprived in a long-term sense. On the other hand, the household might be spending its income on goods outside the bundle of eight commodities that comprise consumption for the purposes of this paper.⁴ For example, a household with disposable income just higher than the poverty line that spends a large proportion of its income on tobacco and alcohol — goods which are not included in the consumption measure — may show low consumption but not low income. Is this household materially deprived? Perhaps not. To assess whether or not this makes a difference to overall conclusions, I also present results for poverty rates which count the number of individuals who live in households with low income *and* low consumption.

FIGURE 1
Possibilities for Disposable Income and Consumption in Households

	<i>Low Net Income</i>	<i>Not Low Net Income</i>
Low Consumption	Deprived	Possibly deprived
Not Low Consumption	Not deprived	Not deprived

Adjusted versus Nominal Measures

I adjust nominal household consumption for differences in prices and household size and composition with price deflators and equivalence scales recovered from estimation of a consumer demand system (see Appendix 2 for technical details on this procedure).⁵ Basically, I estimate a model of how households allocate their expenditure across the eight commodity groups comprising the consumption basket given their total expenditure on these commodities, the prices of the commodities and the size and composition of the household. Then, I adjust household consumption in two steps. First, I divide household consumption by a “price deflator” to account for differences in the prices for commodities faced by households compared to a household in a base period and region. Second, I divide by an “equivalence scale” to account for differences in household size and composition compared to the reference household.⁶ In this paper, the base period and region is Ontario in 1992 and the reference household is a single childless adult. Thus, I adjust the set of actual household consumption levels so that adjusted consumption levels are all comparable to those of single childless adult residents of Ontario in 1992.

How does the estimation of a demand system help identify equivalence scales and price indices? For price indices, the basic principle is that for a small increase in a single price,⁷ the proportionate increase in expenditure needed to hold material well-being constant is equal to the expenditure share on that good multiplied by the proportionate price change. For example, if food comprises 20 percent of expenditure and the price of food rises by 5 percent, total expenditure must rise by 1 percent compared to the base price situation to buy the same bundle of commodities and hold well-being constant. Here, the price index equals 1.01 (one plus 1percent).

Intuitively, if we use this rule to get a price index for every household in the population, then we must allow this price index to depend on prices, total expenditure, and household size and composition, because these factors obviously affect expenditure

shares (see Banks, Blundell and Lewbel 1997; Pendakur 2001 for technical details).⁸ For example, expenditure shares on food are known to rise with the price of food, decline with total expenditure and rise with household size (see, e.g., Banks, Blundell and Lewbel 1997). This is because: (i) food does not have easy substitutes in consumption so that large price increases for food must be dealt with by spending more on food and less on other goods; (ii) food is a necessity, so that it comprises a greater share of expenditure for poor than rich households; and (iii) food is not easily shared, so that it comprises a greater share of expenditure for large than small households.

An equivalence scale gives the ratio of expenditure needs across household types. For example, if a couple with one child needs twice as much expenditure as a childless single adult to be equally well off, then we say that the equivalence scale for the couple with one child is equal to two. The identification of equivalence scales from information on how households allocate their expenditure across goods is more complex, and a little harder to believe (see Pendakur 1999*b*, 2001; Donaldson and Pendakur 1999 for details). Equivalence scales are consistent with household behaviour if and only if households that are equally well off respond identically to proportionate changes in total expenditure (see Blackorby and Donaldson 1993; Pendakur 1999*b*). Thus, we may identify equivalence scales by finding what differential in total expenditure across household sizes and types is associated with identical responses to proportionate changes in expenditure.⁹

To check for robustness, I also provide estimates of consumption poverty rates using an equivalence scale equal to the square root of household size, and using simpler price deflators, including the Consumer Price Index.

DATA

In this research, I set the absolute poverty line equal to Sarlo’s (1994) estimate of the minimum expenditure

on eight commodities necessary for an unattached single individual to survive for one year in Toronto in 1992. This absolute poverty line is \$8,082. Sarlo defines “survival” in a minimalist way: he asks what expenditure is required to allow an individual to get through a year while maintaining their health and a minimal level of happiness. Thus, Sarlo’s poverty line allows for toothbrushes, but not movie rentals. The eight commodities are: food from stores, (imputed) rent, clothing, personal care, public transportation, private transportation operation, household operation, and household furnishing and equipment. I use household expenditure on the above eight commodities as a measure of household consumption. Household consumption is adjusted with a price deflator and an equivalence scale to get adjusted consumption (see Appendix 1 for details).

Data on expenditures, demographics, and place of residence are drawn from the microdata files of the 1969, 1978, 1982, 1986, 1992, and 1996 Family Expenditure Surveys (FES) and the 1997 and 1998 Surveys of Household Spending (SHS), and from Browning and Thomas (1998b).¹⁰ The surveys were conducted by Statistics Canada and collected information on demographics, income, and expenditures from ten to fifteen thousand Canadian households in each survey year (Statistics Canada, various years). Households are grouped into one of five regions: Atlantic, Quebec, Ontario, Prairies, and British Columbia. Demographic information used includes the number of household members, the number of household members less than 15 years old and the number of household members aged 65 or more.¹¹ All data are weighted at the level of the household, so each individual in a household is assigned the household weight. Only full-year households consisting of a single individual or economic family are used in the analysis.¹²

Price data for all eight commodities except rented shelter are available by time period and region for 1969 to 1996 from Browning and Thomas (1998a). The prices for rented shelter are from the Canadian Mortgage and Housing Corporation (CMHC 1992).

Rental prices for four types of units are available for 68 cities and towns in Canada in October 1992. I aggregate these prices with population- and unit-type-weights to generate rental shelter prices for the five regions in 1992. These rental shelter price data for 1992 are extended to other periods using population-weighted provincial rented shelter price indices from CANSIM. Price indices for the other seven commodities are extended to 1998 similarly. Prices for the eight commodities are assumed to be fixed within regions, but vary across region and year. A list of all prices used in the estimation is given in Appendix 2.

For rental tenure households, the shelter consumption flow is known, but for owner-occupier households, the shelter consumption flow is not known, because for these households the flow of spending includes an investment component. Since many people, especially the elderly, own their accommodation, it is important to account for this. Further, since many rental tenure households live in subsidized or cooperatively owned housing, they may get a larger flow of consumption than their rental expenditures indicate. For both these reasons, I impute the value of shelter for all households.

As noted in Smeeding *et al.* (1993) and Katz (1983), imputed consumption flows may be based on either the *market value* of the good or the *opportunity cost* of the capital embodied in the good (see Diewert 1974; or Yates 1994). In the former case, the researcher assigns the market value of housing, conditional on dwelling characteristics, to the household as its flow of imputed rent. In the latter case, the researcher assigns the opportunity cost, or alternative capital market return, of the capital implicitly invested in housing to the household as its flow of imputed rent. Smeeding *et al.* (1993) impute consumption flows from owned accommodation based on the opportunity cost of home equity because they do not have data on the local cost of housing. In this paper, I lack information on home equity after 1996 and have information on local housing costs for the entire period, so I use the market value approach.

I estimate the market value of accommodation as the average rent for accommodation in the same year and region (35 region-years) with the same number of rooms (1 to 11+ rooms) in the same type of dwelling (detached, attached, or other). I then assign the imputed market value of accommodation to each household instead of actual shelter expenditure. To check for robustness, I also estimate consumption poverty using the opportunity cost approach for the period 1969 to 1996.

To estimate equivalence scales and price deflators, I use the Quadratic Almost Ideal (QAI) demand system, following Pendakur (2001); and Banks, Blundell and Lewbel (1997). This demand system is characterized by expenditure share equations which are quadratic in the logarithm of total expenditure. The exact forms for equivalence scales and price deflators dual to this demand system are given in Appendix 1.

Price deflators depend on total expenditure, prices, and demographic characteristics. To get a feel for the price deflators used in the adjustment, Table 1 gives the effective nominal poverty lines used in the paper. For example, the upper left cell of the table shows an effective nominal poverty line of \$1,810 for residents of the Atlantic in 1969. This means that a single childless adult in the Atlantic in

1969 whose total expenditure on the eight commodities was \$1,810 would be assigned an adjusted consumption of \$8,082 (exactly the poverty level).

The estimated equivalence scale, E , is equal to

$$(1) \quad E = (A + 0.91 * C)^{0.42},$$

or somewhat less than the square root of household size. To give the flavour of this equivalence scale, this results in an equivalence scale size of 1.34 for a childless couple, 1.56 for a couple with one child, 1.75 for a couple with two children, and 1.31 for a single parent with one child.¹³

RESULTS

Consumption versus Income Poverty

Table 2 shows the proportion of individuals in Canada whose household net income (from all sources) and household consumption — both adjusted for differences in prices by year and region of residence and for differences in household size and composition — fall below the absolute poverty line of \$8,082. I also show proportions of individuals whose adjusted net income is below \$8,345, a level chosen to give the same estimated poverty rate

TABLE 1
Effective Nominal Consumption Poverty Lines

Year	Atlantic \$	Quebec \$	Ontario \$	Prairies \$	British Columbia \$
1969	1,810	1,759	2,029	1,722	2,034
1978	3,529	3,195	3,776	3,408	3,963
1982	4,798	4,515	5,256	4,892	5,669
1986	5,788	5,544	6,441	5,481	6,482
1992	6,902	6,646	8,082	6,673	8,205
1996	7,494	6,968	8,734	7,021	9,047
1997	7,630	7,058	8,903	7,159	9,200
1998	7,702	7,126	8,987	7,259	9,289

TABLE 2
Consumption versus Income Poverty Rates, 1969 to 1997 (percentages)

Year	Number of Cases	Low Income	Low Income	Low Consumption	Low Consumption	Low Consumption	Not Low Consumption
		\$8,082 Cut-off	\$8,345 Cut-off	\$8,082 Cut-off	Low Income	Not Low Income	Low Income
1969	14,953	8.4	9.2	11.4	5.5	5.9	3.7
1978	8,671	3.1	3.4	3.9	1.3	2.7	2.1
1982	9,970	2.5	3.1	3.9	1.4	2.5	1.7
1986	9,544	2.2	2.9	2.7	1.0	1.7	1.9
1992	9,088	1.6	2.0	2.0	0.5	1.5	1.5
1996	9,745	2.5	2.9	2.8	0.9	1.9	2.0
1997	15,837	2.9	3.1	3.1	0.9	2.2	2.2
1998	13,407	2.6	3.0	3.4	1.0	2.3	1.9

in 1992 as the consumption poverty measure with a cut-off of \$8,082. This net income poverty measure is more interesting to compare with the consumption poverty measure because they may hold constant the level of well-being of the poverty threshold. The table also has three columns which show the proportions corresponding to various parts of Figure 1, using the net income poverty cut-off of \$8,345 and the consumption poverty cut-off of \$8082.¹⁴

Three key results emerge from Table 1. First, for poverty measured both by low net income and by low consumption, the poverty rate dropped drastically between 1969 and 1992, with the greatest part of this decline occurring between 1969 and 1978. Comparing the poverty rates in 1969 and 1992, we see that either measure shows the poverty rate to be less than one-fifth as large in 1992 as it was in 1969. This is consistent with a pattern of declining absolute income poverty over the 1980s reported by Sarlo (1994).

Notably, the large part of this decline in poverty occurred in the 1970s, when the federal government of Canada spearheaded efforts to redistribute resources toward the poor. During this period, the rate of consumption poverty dropped from 11.4 percent

in 1969 to 3.9 percent in 1978: a decline of approximately two-thirds over the decade. During the 1980s, the poverty rate rose (insignificantly) between 1978 and 1982 as the economy dropped into recession, and then began declining again, dropping from 3.9 percent in 1982 to 2 percent in 1992: a decrease of approximately one-half over the decade.

Second, looking at either low income or low consumption, the slow but steady erosion in poverty seen in the 1970s and 1980s was reversed in the 1990s. The consumption poverty rate increased from 2 percent in 1992 to 2.8 percent in 1996 and then to 3.4 percent in 1998. Thus, two decade's progress in the reduction of poverty was halted and reversed in the 1990s. Between 1992 and 1998 both income and consumption poverty measures rose by half or more.

Third, low income and low consumption are not the same. Comparing the income and consumption measures of poverty which use the same poverty cut-off, income poverty measures are about one-third lower than consumption poverty measures in each year. To the extent that low consumption better reflects economic deprivation, these net income poverty rates understate the degree of economic deprivation.

It is easy to correct the income poverty measure for this problem simply by using a higher poverty cut-off. The cut-off of \$8,345 is chosen so that the estimated net income poverty rate in 1992 is 2 percent: the same as the consumption poverty rate in 1992. Here, we see that the income measure gives a different picture of *changes* in poverty rates over time. The net income poverty rate fell by less than the consumption poverty rate over the 1970s and 1980s, and rose by less over the 1990s. Thus, even when corrected for the level difference in the poverty rate, the income poverty measure understates the changes over time in comparison with the consumption poverty measure.

The rightmost columns of the table show the proportion of the population falling into the various parts of Figure 1. In most years, about one-third of those with low consumption also had low income. These people had both poor opportunities and poor outcomes.

The second rightmost column shows the proportion of the population with low consumption but not low income. These individuals chose low consumption even though they appear to have had the money to support higher consumption. They may have chosen low consumption because they had or anticipated debt, or because they expected bad outcomes in the future and therefore saved. In this case, their material well-being was overstated by their income. Alternatively, they may have spent their resources on goods outside the bundle of eight commodities, for example, on tobacco or alcohol. In this case, it is hard to make a firm claim about their material well-being.

There are also many individuals who did not have low consumption but did have low income. This proportion is given in the rightmost column of Table 2. In most years, more than half of those with low income did not have low consumption. This is because people are able to draw consumption off of sources other than contemporaneous income. These sources include: money from family and friends, borrowed

money, saved money, and previously owned assets — notably housing. For these people, their material well-being was understated by their income.

I note that the more restrictive poverty measure which requires both low income and low consumption gives similar trends over time. The proportion of individuals who were deprived both in terms of net income and in terms of consumption dropped by a factor of ten from 5.5 percent in 1969 to 0.5 percent in 1992. It then doubled to 1 percent in 1998.

Regardless of which measure of poverty is used — net income, consumption, or both — poverty rates declined dramatically over the 1970s and 1980s, and then rose greatly over the 1990s. The rate of consumption poverty declined by about four-fifths during the early decades, a period characterized by activist redistribution policy. During the last decade, the rate of consumption poverty rose by more than one-half, a period during which federal and provincial commitment to redistribution was much weaker (see, e.g., Rice and Prince 2000).

Depth and Intensity of Poverty

Table 3 shows the rate, depth, and intensity of consumption poverty in Canada over 1969 to 1998. The Poverty Depth Ratio (PDR) is defined as the adjusted consumption shortfall of the poor taken as a ratio of the absolute poverty line of \$8,082. Poverty intensity is measured using the Sen-Shorrocks-Thon (SST) index of poverty intensity (see, e.g., Osberg and Xu 1998), and is equal to the poverty rate multiplied by poverty depth multiplied by a small adjustment for inequality *among* the poor. This adjustment is given by $1+G$ where G is the Gini coefficient for PDRs.¹⁵

Two key results emerge from Table 3. First, although the rate of consumption poverty declined greatly from 1969 to 1992, changes in the depth of poverty for the poor population over this period were less consistent. During the 1970s, the depth of poverty rose from 12.5 percent in 1969 to 13.1 percent in 1978, offsetting some of the decline in the poverty

TABLE 3
Rate, Depth and Intensity of Consumption Poverty

Year	Rate (%)	Depth (%)	PDR-Gini	Intensity
1969	11.4	12.5	1.92	273
1978	3.9	13.1	1.98	102
1982	3.9	12.2	1.97	95
1986	2.7	11.1	1.98	59
1992	2.0	10.8	1.99	42
1996	2.8	11.4	1.99	63
1997	3.1	10.4	1.98	63
1998	3.4	11.0	1.98	73

rate. In contrast, during the 1980s, both the scope and severity of consumption poverty declined. The depth of poverty declined from 13.1 percent in 1978 to 10.8 percent in 1992. Finally, during the 1990s, the depth of poverty did not change much: in 1996, the average poverty depth ratio was 11.4 percent and in 1998, it was 11 percent.

Second, since both the rate of poverty and the depth of poverty are important facets of social welfare, it is natural to aggregate these two indicators into a single metric of economic deprivation in so-

ciety. The SST index of poverty intensity is given in the rightmost column of Table 3. Poverty intensity fell by approximately two-thirds during the period 1969 to 1978, and then declined by more than half between 1978 and 1992. However, although the depth of poverty was lower in the 1990s than it was in the 1970s and 1980s, the increase in the poverty rate drove poverty intensity upwards in the 1990s. Between 1992 and 1998, the SST index of poverty intensity increased by almost three-quarters. The 1990s were not kind to the poor in Canada.

Poverty among Children and the Elderly

Table 4 shows the rate of poverty given by low net income and low consumption (both adjusted for price differences and differences in household composition), the depth of consumption poverty and the SST index of poverty intensity for children less than 16 years old¹⁶ and for the elderly aged 65 or more. The income poverty cut-off is \$8,345 and the consumption poverty cut-off is \$8,082.

The results for the elderly given in the rightmost columns of Table 4 are striking. The rate of consumption poverty (and of income poverty) continuously declined over the entire period from 1969 to 1997. The consumption poverty rate among the elderly was almost 30 percent in 1969, and dropped to

TABLE 4
Poverty Rates among Children and the Elderly (percentages)

Year	Children				Elderly			
	Income Rate	Consumption			Income Rate	Consumption		
Rate		Depth	Intensity	Rate		Depth	Intensity	
1969	7.9	11.7	12.1	271	30.0	29.9	14.0	777
1978	2.7	3.5	13.3	91	10.4	13.9	13.2	351
1982	2.7	4.0	12.6	99	6.7	9.6	13.2	244
1986	3.4	3.3	11.5	75	2.6	4.8	10.6	102
1992	1.6	1.8	11.7	42	2.3	3.8	9.5	72
1996	3.2	3.6	9.9	71	1.7	3.6	9.6	68
1997	3.2	4.3	9.5	82	1.7	2.5	12.1	61
1998	2.8	4.2	10.0	83	2.3	3.9	10.6	83

less than 3 percent by 1997. This stands in contrast to the falling then rising pattern found for the entire population. However, consumption poverty among the elderly rose substantially between 1997 and 1998.

The depth of poverty among the elderly also declined between the 1970s and the 1990s, which led to an even stronger decline in poverty intensity. The SST index of poverty intensity dropped by more than 92 percent between 1969 and 1997.

The results for children are quite different. As with consumption poverty measured on the entire population, poverty among children declined greatly over the period 1969 to 1992, and then increased over the period 1992 to 1998. However, the changes for child poverty were sharper. Over the 1970s, consumption poverty among children declined by almost two-thirds, from 11.7 percent in 1969 to 3.5 percent in 1978. Over the 1980s, child poverty declined by almost another half, to 1.8 percent in 1992. However, during the 1990s, the incidence of child poverty more than doubled. It doubled to 3.6 percent in 1996 and then increased to 4.2 percent in 1998. By 1998, all progress in the reduction of child poverty over the 1980s had been undone, and child poverty had risen back to well beyond its 1978 level.

Changes in the depth of poverty for children are also worth noting. Similar to what was found for the population as a whole, the depth of child poverty was on the whole higher in the 1970s and 1980s than it was in the 1990s. This decrease in the depth of child poverty in the 1990s countered the increase in the rate of child poverty in the 1990s. Thus, the SST index of poverty intensity approximately doubled between 1992 and 1998, which is a smaller increase than that observed for the child poverty rate.

The overall decline in consumption poverty found for the population as a whole over the period 1969 to 1992 is found for both children and the elderly. In contrast, the overall increase in consumption poverty found for the population as a whole between 1992 and 1998 is not found among the elderly, but is found to an even greater degree among children. In the 1990s, the trends in poverty rates for the population as a whole mask differing trends within age groups.

Regional Differences in Poverty Rates

Table 5 presents consumption poverty rates for three sizes of area of residence and for five regions of Canada from 1969 to 1998. The leftmost columns of Table 5 give consumption poverty rates in three different sizes of area of residence:¹⁷ (i) cities with

TABLE 5
Consumption Poverty Rates across City Size and Region (percentages)

Year	Size of Area of Residence			Region				
	100,000+	30,000-100,000	29,999-	Atlantic	Quebec	Ontario	Prairies	BC
1969	7.5	6.4	18.1	25.5	11.5	8.1	10.2	11.4
1978	3.2	3.1	5.1	8.5	3.1	3.3	3.2	5.2
1982	3.0	4.0	5.2	10.5	3.0	4.1	2.1	3.3
1986	2.3	3.7	3.2	4.8	3.0	2.3	1.5	3.4
1992	1.6	2.2	2.9	4.1	2.0	1.4	2.3	1.6
1996		2.7	2.9	6.4	2.3	2.4	2.1	3.5
1997		2.7	3.9	7.4	3.1	2.7	1.9	3.1
1998		3.3	3.3	6.1	2.8	3.7	2.0	3.0

100,000 or more residents, (ii) cities with 30,000 to 99,999 residents, and (iii) towns and villages with less than 30,000 residents (including rural households). After 1992, size of area of residence is only available for the more than/less than 30,000 distinction. In the early part of the period, the poverty rate is much higher among residents of small towns and villages than it is among city-dwellers, but in the later part of the period, the differences in poverty rates across size of area of residence become much smaller. Trends over time are similar to those found for the population as a whole. Regardless of the size of area of residence, the incidence of consumption poverty fell greatly between 1969 and 1992, and then rose between 1992 and 1998.

The rightmost five columns of Table 5 give consumption poverty rates in five regions of Canada. There is substantial variation in the level of poverty across regions. The Atlantic stands out as the highest poverty region in every year. Ontario was a comparatively low poverty region for most of the period, but stands out as the second highest poverty region in 1998. British Columbia has been a comparatively high poverty region throughout the period. The Prairie region has had comparatively low poverty throughout the period, and had the lowest poverty throughout the late 1990s.

The trends over time also varied somewhat across regions. In all regions, the rate of consumption poverty declined greatly over the 1970s. In most regions, poverty declined by about two-thirds. As the country entered recession in 1982, poverty rose or stayed constant in Ontario and east, but continued to decline in the west. Between 1982 and 1992, poverty fell in all regions except the Prairies.

The story for the 1990s varies somewhat across regions. In Ontario and east, consumption poverty rates rose fairly consistently over the 1990s, rising by about one-half in the Atlantic and in Quebec and more than doubling in Ontario. In the Prairies, the rate of consumption poverty declined over the 1990s, and in British Columbia, a large increase between 1992 and 1996 was followed by a decline in the rate of consumption poverty to 1998.

Robustness of Findings to Alternative Measurement Strategies

Table 6 shows consumption poverty rates using a variety of alternative measurement choices, reflecting a different rental imputation method, a relative instead of an absolute poverty line, a different equivalence scale, and different price deflators. The broad message from Table 6 is that these choices

TABLE 6
Consumption Poverty Rates with Alternative Measurement Strategies (percentages)

Year	Opp Cost Imputation		Relative Poverty Lines		Equivalence Scale= $\sqrt{\text{size}}$		
	r=1 yr yield	r=3% Median	50% Median	56% Median	QAI Deflator	TL Deflator	CPI Deflator
1969	22.6	24.1	1.0	2.4	21.9	25.0	23.5
1978	15.6	10.6	1.5	3.2	7.9	8.1	7.5
1982	14.9	12.7	1.3	3.2	7.4	7.7	9.1
1986	7.2	9.8	1.0	2.7	5.6	5.6	7.6
1992	14.1	8.8	0.7	2.0	4.7	5.1	9.2
1996	9.7	9.3	1.1	3.1	5.6	5.7	9.3
1997			0.9	2.7	6.1	6.1	10.1
1998	not available		1.1	3.0	6.4	6.5	10.1

make a big difference in the measured *level* of the consumption poverty rate, but not in the assessment of qualitative trends over time.

The leftmost column of Table 6 gives consumption poverty rates using the opportunity-cost method for the imputation of the consumption flow from owner-occupied shelter, rather than the market value method used above. The idea here is to make imputed rent equal to the opportunity value of capital sunk in owner-occupied housing. The column labelled “ $r=1$ yr yield” sets imputed rent for owner-occupiers equal to the Government of Canada one-year real bond yield multiplied by the estimated potential selling price of the house. This assumes that the expected appreciation of owned housing equals the current rate of inflation. For renters, imputed rent is equal to actual rent expenditures. The column labeled “ $r=3\%$ ” uses a fixed real interest rate of 3 percent instead of actual one-year bond yields. Since the estimated sale price of owned accommodation is only available to 1996, these results only cover 1969 to 1996.

Use of the opportunity-cost imputation makes a big difference to the level of poverty, which is similar in spirit to Pendakur’s (2001) finding that measured consumption inequality depends greatly on the imputation method. In particular, because opportunity-cost imputation by construction adds variance to the imputed consumption flow, it raises the estimated rate of consumption poverty.¹⁸ In the leftmost columns, we see that regardless of which interest rate is used to compute the imputed consumption flow from owned accommodation, the rate of consumption poverty fell from over 20 percent in 1969 to less than 10 percent by 1986, and then rose after that. Although use of the one-year yield versus the 3 percent fixed real interest rate leads to differing conclusions about the *timing* of the increase in consumption poverty, both show increased consumption poverty after 1986. It is worth noting that the increase in consumption poverty is smaller than that measured using the market-value imputation method.

The middle columns in Table 6 show estimated consumption poverty rates using relative poverty instead of absolute poverty lines. The relative poverty lines are similar in spirit to the LIMs produced by Statistics Canada, in which a household is defined as “poor” if its income is below half the median income for demographically similar households. The relative consumption poverty measures in Table 6 give proportions of the population that have adjusted consumption less than 50 percent of the median adjusted consumption and less than 56 percent of the median adjusted consumption in each year. The relative poverty measure based on 56 percent of the median uses that proportion because this results in an estimated relative consumption poverty rate of 2 percent in 1992, which is the same as the absolute consumption poverty rate reported for 1992 in Table 2. This allows easier comparison with previous tables.

The results for relative consumption poverty are somewhat different from the results for absolute consumption poverty, especially for the early part of the period. For both relative consumption poverty measures, poverty rates rose from 1969 to the 1980s and then dropped again to 1992, which is different from what is seen for absolute consumption poverty. In contrast, relative and absolute poverty measures agree on what has happened in the 1990s. Both relative poverty measures show increased consumption poverty between 1992 and 1998. In particular, poverty defined as 56 percent of the median shows relative consumption poverty increasing from 2 percent in 1992 to 3 percent in 1998, a proportionate increase of one-half.

The rightmost three columns of Table 6 show results for absolute consumption poverty with a more common equivalence scale and with more common price deflators. The equivalence scale used is the square root of household size, which is the same as that used in Pendakur (1998) and near the middle of the range of implicit scales surveyed by Buhmann *et al.* (1987). This equivalence scale is larger than that used in the earlier results. This means that the

adjusted consumption for couples and families is smaller in Table 6 than in earlier tables, which should raise the estimated level of the consumption poverty rate.

The three deflators used are the QAI, which is also used in earlier results, a Translog (TL) deflator, and the Consumer Price Index (CPI). The TL deflator is similar to the QAI deflator except that it is restricted so that the price deflator is independent of total expenditure. Price deflators used in the literature are almost always assumed to be independent of total expenditure. The CPI deflator is the Canada-wide all-items consumer price index from CANSIM (2000), and reflects an even stronger restriction on the price deflator — it is independent of region of residence.

These deflators represent testable restrictions on the consumer demand system. The hypothesis that the equivalence scale is equal to the square root of household size is rejected against the alternative that it is given by equation (1), and, not surprisingly, the joint hypothesis that the equivalence scale is the square root of household size and the price deflator is independent of total expenditure is rejected against the same alternative.¹⁹

The spirit of the results using the alternate equivalence scale and alternate price deflators is the same as that seen in Table 2. Consumption poverty rates fell from 1969 to 1992, with the bulk of the decline occurring between 1969 and 1978. Then, consumption poverty rates rose in the 1990s. Using the expenditure-dependent QAI price deflator and the square-root equivalence scale, consumption poverty increased from 4.7 percent in 1992 to 6.4 percent in 1998, an increase of almost one-half. Using the expenditure-independent TL price deflator and the square-root equivalence scale, the increase is from 5.1 percent in 1992 to 6.5 percent in 1998, a somewhat smaller increase. Using the CPI price deflator and the square-root equivalence scale, the lowest consumption poverty rate is recorded in 1986. The consumption poverty rate using this deflator rose

from 7.6 percent in 1986 to 10.1 percent in 1998, an increase of almost one-half. It is worth noting that using the CPI may overstate the degree of poverty because it applies the same price index to all residents of Canada, even those living in low-price regions such as Quebec and the Prairies.

CONCLUSIONS

Consumption — defined as expenditure on and imputed consumption flows from a large basket of goods — is chosen by households with knowledge of past and future liabilities, past and future income flows, and past and future needs. As such, annual consumption may reflect the material well-being of people more accurately than annual income. This paper estimates absolute consumption poverty rates by asking what proportion of the population of Canada over 1969 to 1998 had consumption (adjusted for differences in prices and demographics across households) less than a very minimal absolute poverty line of \$8,082 for a single childless adult in Ontario in 1992. Unlike relative poverty lines, such as Statistics Canada's Low-Income Measure, these absolute poverty lines are set at the same level of purchasing power throughout the three-decade period under study.

Several findings emerge from this research. First, income poverty measures and consumption poverty measures tell different stories. Approximately one-half of individuals whose income is low have consumption that is not low. To the extent that consumption is a better indicator of material well-being, income poverty is a very noisy indicator of material deprivation. Further, income and consumption poverty rates give different pictures of poverty trends over time. In particular, income poverty measures understate the decrease in poverty during the 1970s and 1980s and understate the increase in poverty during the 1990s.

Second, the time pattern in consumption poverty in Canada is not encouraging. Poverty declined

greatly from 1969 to 1992, and then rose from 1992 to 1998. The poverty rate for the population declined by more than four-fifths over the 1970s and 1980s, from 11.4 percent in 1969 to 2 percent in 1992. Unfortunately, this trend reversed in the 1990s, with poverty rising by more than one-half, to reach 3.4 percent in 1998.

Third, the incidence of poverty among different age groups has changed over time. Poverty among the elderly decreased drastically over the period, from almost 30 percent 1969 to less than 3 percent in 1997, and then rising somewhat to 1998. Child poverty declined by about two-thirds over the 1970s, from 11.7 percent in 1969 to 3.5 percent in 1978, and then by another half over the 1980s, to 1.8 percent in 1992. However, child poverty then rose sharply in the 1990s, doubling between 1992 and 1996, and then rising further to reach 4.2 percent in 1998. All the gains made in the reduction of child poverty during the 1980s were undone by the increase in child poverty in the 1990s.

NOTES

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¹The expenditure flow on shelter is imputed from data on household characteristics rather than observed directly, because of the prevalence of owned and subsidized accommodation in the data.

²Consumption defined in this way is a function of lifetime income among other things, not just a function of contemporaneous income.

³On 11 August, Russil Wvong's letter to the editor read "John Baker suggests that Anne Golden's figure must be based on a relative measure ... So what's the real rate?"

Krishna Pendakur ... recently did a study of consumption poverty in Canada based on absolute consumption ... Using this measure, the rate of child poverty dropped from ... 1969 to ... 1992; it then doubled [by] 1997, perhaps because of federal and provincial cutbacks." Mr. Wvong got his information from a version of this paper which had been hung on my Web site — an unexpected benefit to hanging the paper there.

⁴Some researchers have opted to include all expenditure in their consumption measure, rather than just a subset (e.g., Ravallion 1994). However, in order to adjust the consumption measure for changes in prices, commodity price data must be available for all commodities in the consumption basket. Thus, this paper, which adjusts for price differences over time and across region of residence, does not include all possible commodities in the consumption basket.

⁵Consumption adjusted in this way for price and demographic differences across households is referred to as an "extended money metric" in the microeconomic literature (see Donaldson 1992; or Pendakur 2001).

⁶In this paper, I discuss a price index that depends on household size and composition, prices, and total expenditure and an equivalence scale that depends only on household size and composition. This is equivalent to using a price index that depends on prices and total expenditure and an equivalence scale that depends on household size and composition and prices. See Pendakur (2001) for details.

⁷The intuition given here for a small price increase only works for a large price increase if preferences satisfy a condition called "homotheticity." Here, expenditure shares on goods must be independent of income. If expenditure shares depend on income, then the income effect of the price change must also be accounted for in the price index.

⁸Since poverty headcounts only use one level of well-being, it is not necessary to use an expenditure-dependent price deflator if the researcher is interested only in poverty headcounts. However, since this paper presents poverty depth measures for the poor population, expenditure-dependent price deflators are required. I re-did all the estimation with an expenditure-invariant (or homothetic) price deflator. This price deflator is the translog price deflator dual to the QAI model which is restricted to homotheticity. Use of an expenditure-

independent price deflator did not change any of the key results reported in the paper. Some of these results are reported below as part of the robustness testing.

⁹An example may be helpful. Food is a necessity, so its share of expenditure declines with total expenditure. Consider the effect of a 10-percent increase in expenditure for two types of households, a single childless adult and an adult couple with one child where the equivalence scale is equal to 2. If for poor singles the increase in expenditure results in one percentage point decline in the food share, then it must also result in a one percentage point decline in the food share for couples with twice as much total expenditure. Similarly, if for rich singles the increase in expenditure results in a one-half percentage point decline in the food share, then it must also result in a one-half percentage point decline for couples with twice as much total expenditure. If these responses are not identical across household types, then the equivalence scale cannot equal 2. The equivalence scale is identified as the scaling of total expenditure that equates these responses.

¹⁰The FAMEX and SHS collect similar data with the same sample frame, but differ in some important dimensions. I discuss differences that affect the estimation strategy in footnotes.

¹¹Whereas the 1969 to 1992 files topcode the number of children at 8 and the number of elderly at 4, the 1996 file topcodes the number of children at 4 and the number of elderly at 2. In the text and tables, I ignore this topcoding issue. However, re-estimation with topcodes set to 1996 values for all years changes neither the general results nor the results for seniors and children. This is primarily due to the fact that very few households have more than four children or two elderly persons.

¹²The SHS collects information on part-year households, but the FAMEX does not, so part-year households are dropped. The pre-1992 surveys treat the "spending unit" as the unit of analysis while the surveys conducted in 1992 and after treat the household as the unit of analysis. I create a consistent sample across these units of analysis by using only spending units and households comprised of a single economic family. (An economic family is defined as an unattached individual, or a group of people, related by blood, marriage or adoption, who live together in a household.) Poverty level and depth measures computed on a sample of all spending units and households exhibit similar features and time patterns as those in the text.

¹³By comparison, the equivalence scale implicit in the Low Income Measure for 1992 (Statistics Canada 2000) yields an equivalence scale size of 1.40 for a childless couple, 1.70 for a couple with one child, 2 for a couple with two children, and 1.40 for a single parent with one child.

¹⁴Poverty rates are related to Bernoulli distributions. The standard error for any poverty rate, P , computed off of N observations is given by the square root of $P(1-P)/N$. For example, the standard errors for the poverty rates reported in Table 1 are between 0.07 percent and 0.27 percent. The standard error of the 2-percent poverty rate reported for 1992 is 0.15 percent.

¹⁵Specifically, the SST index is equal to the poverty rate multiplied by the average poverty depth multiplied by one plus the Gini coefficient for individual poverty depths where the individual poverty depth is equal to the consumption shortfall of the individual relative to the poverty line or zero, whichever is greater. To make it easier to see the multiplication in the table, I do not normalize the SST index to a basis of [0,1].

¹⁶The 1996 to 1998 microdata files offer different age variables from other years. For years prior to 1996, Table 4 uses figures for children aged less than 16 years. For 1996 and 1997, it uses figures for children aged less than 15 years. For 1998, it uses figures for children aged less than 18 years. Since the figures reported are rates, this (hopefully) makes little difference.

¹⁷For the years 1969, 1978, 1982, and 1986, the size of area of residence is reported for all observations. In 1992, the size of area of residence is masked (not reported) for residents of Prince Edward Island (PEI). In 1996, it is masked for residents of PEI and Newfoundland (NF). In 1997 and 1998, it is masked for residents of PEI, NF, and Manitoba (MN). For the three leftmost columns of Table 5, masked observations are dropped. For the years 1969 to 1992, size of area of residence is reported for all three categories; for the years 1996 to 1998, the larger two categories are aggregated into a single category capturing residents of cities with 30,000 or more people.

¹⁸This imputation strategy adds variance because it uses the *actual* housing values and rents paid instead of the conditional expectation of rent (as in the market-value method). Adding variance raises estimated poverty rates because large negative errors, which are washed away in opportunity cost method, show up as poor households. In

addition, with real one-year bond yields varying over time, additional variance is introduced over time.

¹⁹All three models given in Table 6 restrict the equivalence scale to be equal to the square root of household size. The column using the QAI deflator imposes no further restrictions. The likelihood ratio test statistic of this restriction against the alternative used in Tables 2 through 5 is equal to 28, which exceeds the 1 percent critical value of 14. The column using the TL deflator imposes the restriction that the deflator is independent of total expenditure and demographic characteristics. The likelihood ratio test statistic of this restriction against the alternative used in Tables 2 through 6 is equal to 17,950, which exceeds the 1 percent critical value of 30. Model statistics are given in Appendix 1b.

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APPENDIX 1a

DEMAND SYSTEM ESTIMATION

I estimate demand systems in eight commodities on the subsample of families who rent their accommodation. The eight commodities are: (i) food purchased from stores; (ii) rent, including utilities; (iii) clothing; (iv) public transportation; (v) private transportation operation; (vi) household operation; (vii) personal care; and (viii) household furnishing and equipment. These expenditure categories comprise approximately three-quarters of net income for households in the sample.

The functional forms for the price deflator and the equivalence scale are determined by choice of a functional form for the expenditure function, $E(p, u, z)$, which gives the minimum expenditure for a household with characteristics z facing prices p to achieve a utility level u . For this paper, I use a modified version of the Quadratic Almost Ideal (QAI) model (see Pendakur 2001; or Banks, Blundell and Lewbel 1997) in which the expenditure function is given by

$$\ln E(p, u, z) = \ln a(p, z) + \frac{b(p)u}{1 + q(p)u}, \quad (1)$$

and the dual indirect utility function is given by

$$V(p, x, z) = \left(\left(\frac{\ln x - \ln a(p, z)}{b(p)} \right)^{-1} - q(p) \right)^{-1}. \quad (2)$$

Define the base price vector \bar{p} as that faced by residents of big cities in Ontario in 1992, require that $b(\bar{p})=1$ and $q(\bar{p})=0$.

Defining $E^R(p, u)$ as the expenditure function of a reference household type (in this case a single childless adult), the equivalence scale S which gives the ratio of expenditures across demographic types at base prices \bar{p} may be written as

$$\ln S(z) = \ln \frac{E(\bar{p}, u, z)}{E^R(\bar{p}, u)} = \ln a(\bar{p}, z) - \ln a(\bar{p}, z^R). \quad (3)$$

The price deflator D which gives the ratio of expenditures at prices p to expenditures at base prices \bar{p} for a household with characteristics z and utility level u is given by

$$\ln D(p, u, z) = \ln \frac{E(p, u, z)}{E(\bar{p}, u, z)} = \ln a(p, z) - \ln a(\bar{p}, z) + \frac{b(p)u}{1 + q(p)u} - u. \quad (4)$$

Substitution of $u=V(p, x, z)$ into D allows D to be written as a function of (p, x, z) .

The following parametric specifications for a , b and q are used. Compress the household characteristics vector z to be a scalar called composition adjusted household *SIZE* given by

$$z = A + a_0^{CHILDREN} C$$

where A is the number of adults, C is the number of children and a_0^{CHILDREN} is an estimated parameter reflecting the differential in cost between children and adults. Define a as a translog in prices and z as follows:

$$\ln a(p, z) = (a_0^R + a_0^z \ln z) + \sum_{k=1}^m (a_k^R + a_k^z \ln z) \ln p_k + \frac{1}{2} \sum_{k=1}^m \sum_{l=1}^m (a_{kl}^R + a_{kl}^z \ln z) \ln p_k \ln p_l. \quad (5)$$

Define b as a Cobb-Douglas function of prices,

$$b(p) = \prod_{k=1}^m p_k^{b_k}, \quad (6)$$

and q as a linear function of log prices,

$$q(p) = \sum_{k=1}^m q_k \ln p_k. \quad (7)$$

Note that, in an eight-share system, $m=8$. Homogeneity and symmetry require the following restrictions:

$$\sum_{k=1}^m a_k^R = 1; \sum_{k=1}^m a_k^z = 0; \sum_{l=1}^m a_{kl}^R = \sum_{l=1}^m a_{lk}^R = 0 \text{ for all } k; a_{kl}^R = a_{lk}^R \text{ for all } k, l; a_{kl}^z = a_{lk}^z \text{ for all } k, l; \text{ and } \sum_{k=1}^m b_k = \sum_{k=1}^m q_k = 0.$$

Note that $b(\bar{p})=1$ and $q(\bar{p})=0$.

The parameter a_0^R is chosen rather than estimated because it has a large effect on estimated price deflators and is difficult to identify (see Pendakur 2001; or Banks, Blundell and Lewbel 1997). I set $a_0^R=5.09023$, so that $u=0$ for a household with reference characteristics and average total expenditure in the base year.

Substituting (5) into (3) gives the equivalence scale at base prices:

$$S(z) = (A + a_0^{\text{CHILDREN}} C)^{a_0^z}. \quad (8)$$

Note that the exponent on z gives the elasticity of the equivalence scale — and therefore expenditures — with respect to composition adjusted household size.

Substituting (5), (6) and (7) into (4) gives the price deflator:

$$\ln D(p, u, z) = \sum_{k=1}^m (a_k^R + a_k^z \ln z) \ln p_k + \frac{1}{2} \sum_{k=1}^m \sum_{l=1}^m (a_{kl}^R + a_{kl}^z \ln z) \ln p_k \ln p_l \quad (9)$$

$$+ \frac{\left(\prod_{k=1}^m p_k^{b_k} \right) u}{1 + \left(\sum_{k=1}^m q_k \ln p_k \right) u} - u, \quad (10)$$

where $u=V(p,x,z)$.

Adjusted expenditure, y , is related to expenditure as follows:

$$y = \frac{x}{S(z) D(p, x, z)}.$$

Equivalence scales which depend on utility cannot in general be estimated from demand data because z -specific monotonic transformations of utility which leave demands unaffected may affect equivalence scales.¹ However, if the equivalence scale is assumed independent of utility, then Blackorby and Donaldson (1993) show that S can be estimated uniquely from demand data in the following sense: there is only one equivalence scale that is independent of u and is consistent with demand behaviour, and it can be estimated from the definition of S , which for the QAI is given by (8).²

Price deflators which depend on utility can in general be identified from demand data because z -specific monotonic transformations of utility which leave demands unaffected also leave price deflators unaffected.

Application of the logarithmic version of Roy's identity to (1) yields expenditure share equations that are quadratic in the natural logarithm of income:

$$w_j(p, x, z) = (a_k^R + a_k^z \ln z) + \sum_{k=1}^m (a_{jk}^R + a_{jk}^z \ln z) \ln p_j + b_j (\ln x - \ln a(p, z)) + \frac{q_j}{b(p)} (\ln x - \ln a(p, z))^2. \quad (11)$$

Adding an error term to the right-hand side produces an estimable demand system with all parameters uniquely identifiable. All demand estimation in this paper uses maximum likelihood estimation of demand systems of the form (11).

Parameter estimates follow. The eighth commodity group, personal care, is the left-out equation, and the symmetry conditions above ensure that the eighth parameter in any group is determined.

¹For an important class of exceptions to this rule, see Donaldson and Pendakur (1999). They show that equivalence scales which depend on utility and are iso-elastic in income are identifiable from demand behaviour.

²Blackorby and Donaldson (1993) require that expenditure share equations are not linear in the log of income for their result. The QAI model, which features expenditure share equations quadratic in the log of income, satisfies this condition.

APPENDIX 1b

DEMAND ESTIMATION RESULTS

Number of Observations = 21,873

<i>Parameter</i>	<i>Estimate</i>	<i>Std Error</i>	<i>t-statistic</i>	<i>P-value</i>
A0_Children	0.921176	0.028073	32.8139	[.000]
A0_Size	0.417111	0.019209	21.7138	[.000]
A_Rent_Reference	0.430381	1.69E-03	254.207	[.000]
A_PubT_Reference	0.046922	6.82E-04	68.7736	[.000]
A_PriT_Reference	0.109676	1.30E-03	84.0977	[.000]
A_Oper_Reference	0.078496	8.43E-04	93.1471	[.000]
A_Furn_Reference	0.051873	1.00E-03	51.8928	[.000]
A_Food_Reference	0.145614	1.36E-03	107.428	[.000]
A_Cloth_Reference	0.102335	1.04E-03	98.4168	[.000]
A_Rent_Size	-0.0979	2.63E-03	-37.2308	[.000]
A_PubT_Size	-6.39E-03	7.71E-04	-8.28652	[.000]
A_PriT_Size	0.019563	2.09E-03	9.36891	[.000]
A_Oper_Size	0.010944	9.59E-04	11.4173	[.000]
A_Furn_Size	4.78E-03	1.44E-03	3.3238	[.001]
A_Food_Size	0.060626	2.67E-03	22.6716	[.000]
A_Cloth_Size	7.13E-03	1.70E-03	4.1852	[.000]
B_Cloth_Reference	0.082415	1.72E-03	47.7958	[.000]
B_Food_Reference	-0.10635	2.23E-03	-47.5948	[.000]
B_Furn_Reference	0.065499	1.65E-03	39.5864	[.000]
B_Oper_Reference	1.03E-02	1.30E-03	7.93349	[.000]
B_PriT_Reference	0.05817	2.37E-03	24.5423	[.000]
B_PubT_Reference	9.01E-03	1.15E-03	7.86293	[.000]
B_Rent_Reference	-0.12463	3.16E-03	-39.4583	[.000]
Q_Cloth_Reference	0.028269	1.89E-03	14.9615	[.000]
Q_Food_Reference	0.014349	2.59E-03	5.5397	[.000]
Q_Furn_Reference	0.030343	1.78E-03	17.0775	[.000]
Q_Oper_Reference	0.014752	1.48E-03	9.95751	[.000]
Q_PriT_Reference	-0.03701	2.62E-03	-14.1098	[.000]
Q_PubT_Reference	5.33E-03	1.35E-03	3.96136	[.000]
Q_Rent_Reference	-0.0579	3.41E-03	-16.997	[.000]
A_Rent_Rent_Reference	0.081366	6.94E-03	11.7179	[.000]
A_Food_Rent_Reference	-0.0682	4.94E-03	-13.7932	[.000]
A_Rent_PubT_Reference	0.053562	2.55E-03	21.0075	[.000]
A_PubT_PubT_Reference	-0.01489	2.60E-03	-5.71631	[.000]
A_PriT_PubT_Reference	-1.61E-03	2.99E-03	-0.53763	[.591]
A_Oper_PubT_Reference	0.02055	3.70E-03	5.55738	[.000]
A_Furn_PubT_Reference	-0.01479	4.33E-03	-3.41919	[.001]
A_Food_PubT_Reference	-0.02882	3.63E-03	-7.93728	[.000]
A_Cloth_PubT_Reference	-0.0172	4.15E-03	-4.14447	[.000]
A_Rent_PriT_Reference	3.97E-03	4.55E-03	0.872654	[.383]
A_PriT_PriT_Reference	9.25E-03	6.33E-03	1.46043	[.144]
A_Oper_PriT_Reference	-0.02162	4.30E-03	-5.02539	[.000]
A_Furn_PriT_Reference	-0.01411	4.12E-03	-3.42418	[.001]
A_Food_PriT_Reference	0.017041	5.49E-03	3.10386	[.002]
A_Cloth_PriT_Reference	6.36E-03	4.49E-03	1.41746	[.156]
A_Rent_Oper_Reference	8.86E-04	3.17E-03	0.279251	[.780]
A_Oper_Oper_Reference	0.027559	0.013781	1.99979	[.046]
A_Food_Oper_Reference	0.035196	8.35E-03	4.21357	[.000]

... continued

APPENDIX 1b (CONTINUED)

<i>Parameter</i>	<i>Estimate</i>	<i>Std Error</i>	<i>t-statistic</i>	<i>P-value</i>
A_Rent_Furn_Reference	-0.03198	3.58E-03	-8.92793	[.000]
A_Oper_Furn_Reference	-0.03517	0.010527	-3.34133	[.001]
A_Furn_Furn_Reference	-0.05599	0.014208	-3.94118	[.000]
A_Food_Furn_Reference	0.045457	7.18E-03	6.3317	[.000]
A_Food_Food_Reference	6.28E-03	9.76E-03	0.642801	[.520]
A_Rent_Cloth_Reference	-0.03288	4.01E-03	-8.2041	[.000]
A_Oper_Cloth_Reference	3.15E-03	0.010608	0.297337	[.766]
A_Furn_Cloth_Reference	0.080618	0.013111	6.14907	[.000]
A_Food_Cloth_Reference	-0.02271	7.42E-03	-3.05846	[.002]
A_Cloth_Cloth_Reference	0.017486	0.014489	1.20683	[.227]
A_Rent_Rent_Size	0.049796	8.36E-03	5.95895	[.000]
A_Food_Rent_Size	0.010655	5.79E-03	1.84037	[.066]
A_Rent_PubT_Size	-1.15E-02	3.11E-03	-3.70215	[.000]
A_PubT_PubT_Size	6.49E-03	3.25E-03	1.99767	[.046]
A_PriT_PubT_Size	0.010342	3.71E-03	2.78805	[.005]
A_Oper_PubT_Size	0.013632	4.55E-03	2.99408	[.003]
A_Furn_PubT_Size	-0.01838	5.17E-03	-3.55208	[.000]
A_Food_PubT_Size	-0.02006	4.21E-03	-4.76178	[.000]
A_Cloth_PubT_Size	8.48E-03	5.03E-03	1.68541	[.092]
A_Rent_PriT_Size	-6.17E-04	5.46E-03	-0.11286	[.910]
A_PriT_PriT_Size	0.015819	7.68E-03	2.06008	[.039]
A_Oper_PriT_Size	-0.01833	5.36E-03	-3.42205	[.001]
A_Furn_PriT_Size	-2.05E-03	4.93E-03	-0.41643	[.677]
A_Food_PriT_Size	0.013116	6.38E-03	2.05626	[.040]
A_Cloth_PriT_Size	-1.07E-02	5.39E-03	-1.98735	[.047]
A_Rent_Oper_Size	6.81E-03	3.81E-03	1.79041	[.073]
A_Oper_Oper_Size	-1.97E-02	0.0172	-1.14698	[.251]
A_Food_Oper_Size	0.021831	0.010084	2.16492	[.030]
A_Rent_Furn_Size	-0.02109	4.20E-03	-5.01582	[.000]
A_Oper_Furn_Size	-0.0101	0.012828	-0.7875	[.431]
A_Furn_Furn_Size	-0.03042	0.016966	-1.79281	[.073]
A_Food_Furn_Size	0.027294	8.34E-03	3.27401	[.001]
A_Food_Food_Size	-0.05622	0.010642	-5.28325	[.000]
A_Rent_Cloth_Size	-0.027	4.72E-03	-5.72231	[.000]
A_Oper_Cloth_Size	-1.64E-03	0.01302	-0.1258	[.900]
A_Furn_Cloth_Size	0.027921	0.01592	1.75387	[.079]
A_Food_Cloth_Size	-3.80E-03	8.55E-03	-0.44479	[.656]
A_Cloth_Cloth_Size	0.023098	0.017604	1.31207	[.189]

Equation (weighted) R-Squares:

Rent:	0.605	PubT:	0.075	PriT:	0.208	Oper:	0.209
Furn:	0.057	Food:	0.534	Cloth:	0.369	Rent:	0.605

Model Summaries

Model Description	Parameters	LLF
QAI, estimated scale (estimates given above)	86	237,729
QAI, estimated scale, child effect equals 1	85	237,726
QAI, scale is square root of household size	85	237,715
QAI, scale is square root of household size, deflator independent of size	49	234,126
TL, deflator independent of total expenditure (scale not in model)	68	232,732
TL, deflator independent of size and total expenditure (scale not in model)	35	228,754

APPENDIX 2

PRICE DATA

		<i>Food</i>	<i>Shelter</i>	<i>Household Operation</i>	<i>Household Furnishing</i>	<i>Clothing</i>	<i>Private Transp.</i>	<i>Public Transp.</i>	<i>Pers. Care</i>
1969	Atlantic	22.4	22.5	23.9	37.3	32.4	18.2	15.6	27.6
1969	Quebec	20.9	20.9	23.4	34.9	32.0	23.1	21.4	28.1
1969	Ontario	21.2	28.5	22.6	33.9	31.2	18.2	20.0	27.0
1969	Prairies	20.9	21.9	20.3	33.6	30.7	16.7	16.5	25.7
1969	BC	22.2	28.0	23.9	36.6	32.6	19.3	15.9	29.7
1978	Atlantic	51.5	43.9	44.3	51.9	48.2	31.8	28.4	44.2
1978	Quebec	46.7	35.8	44.5	53.7	48.8	41.2	28.8	45.7
1978	Ontario	46.7	51.6	42.0	49.8	47.5	34.2	30.1	45.2
1978	Prairies	49.5	42.4	41.3	50.9	49.7	28.6	30.3	44.8
1978	BC	51.5	53.3	47.1	52.6	51.1	32.4	32.7	48.0
1982	Atlantic	72.6	53.7	74.2	77.4	65.7	54.7	50.8	63.7
1982	Quebec	72.0	45.3	71.2	71.8	66.9	75.0	56.5	64.2
1982	Ontario	71.7	62.3	74.1	73.8	67.9	62.7	55.8	67.9
1982	Prairies	71.9	56.5	63.9	72.8	72.2	53.0	56.5	64.7
1982	BC	75.6	68.9	73.3	75.4	72.9	68.0	57.0	69.9
1986	Atlantic	83.0	68.2	82.9	89.6	75.9	59.4	70.1	72.2
1986	Quebec	87.6	58.4	81.2	81.2	74.3	79.9	71.1	76.0
1986	Ontario	85.7	78.0	82.2	86.1	78.3	77.5	75.6	78.3
1986	Prairies	84.0	62.2	73.7	83.5	80.5	56.2	68.9	74.7
1986	BC	88.4	80.3	83.6	86.2	81.7	62.4	74.7	79.0
1992	Atlantic	98.2	80.4	95.3	103.2	96.5	74.8	87.6	89.6
1992	Quebec	97.8	72.0	94.8	100.1	99.7	89.6	95.2	99.1
1992	Ontario	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1992	Prairies	98.6	75.1	88.9	98.3	102.8	75.8	94.5	91.6
1992	BC	104.7	102.0	97.7	102.1	99.8	97.8	99.0	96.5
1996	Atlantic	109.7	84.1	107.2	104.0	101.3	87.2	118.5	98.5
1996	Quebec	102.8	75.5	102.0	99.6	97.9	90.7	114.0	103.7
1996	Ontario	105.4	108.1	108.2	100.5	105.3	110.9	124.4	98.8
1996	Prairies	104.0	79.0	94.6	96.5	105.2	78.0	108.0	96.9
1996	BC	114.3	109.9	104.1	100.6	103.4	131.4	115.1	98.5
1997	Atlantic	111.7	84.8	108.2	102.1	106.1	91.0	132.7	101.4
1997	Quebec	104.8	76.1	104.4	100.4	99.4	91.7	120.6	104.7
1997	Ontario	105.5	109.7	110.4	100.6	106.3	117.9	134.7	101.4
1997	Prairies	107.1	80.1	95.8	97.7	106.6	79.6	118.2	98.7
1997	BC	117.4	111.1	106.3	100.8	106.7	130.4	125.8	100.2
1998	Atlantic	114.0	85.3	110.7	101.2	106.7	88.9	141.0	103.1
1998	Quebec	107.2	76.5	107.0	100.5	101.0	88.9	125.3	107.1
1998	Ontario	106.8	111.1	110.2	101.9	106.8	115.2	140.5	102.9
1998	Prairies	107.5	81.7	98.9	98.2	107.8	78.0	126.0	100.1
1998	BC	119.0	111.9	111.9	102.0	109.0	125.3	134.2	102.1

Source: Price data are from Browning and Thomas (1998a, b); CANSIM (2000); and CMHC (1992).

