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ARE EQUIVALENCE SCALES THE SAME FOR THE UNITED STATES AND CANADA?

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This research uses microdata from the 1986 Statistics Canada Family Expenditure Survey and from the 1986–88 U.S. Consumer Expenditure Survey to estimate equivalence scales using a methodology which is very similar to that employed by Statistics Canada for the estimation of Low-Income Cutoffs. Employing identical sample selection criteria and identically specified models, we find that equivalence scales for the two countries are not, in general, statistically different when estimated in the same way. The larger issue is then whether the two countries should choose the same methodology for the estimation of equivalence scales.

Researchers interested in public policy, particularly those who focus on international comparisons, have become increasingly aware of the importance of choice of equivalence scale in determining conclusions reached. Buhmann, *et al.*, (1987) report the sensitivity of cross-country estimates of poverty and inequality to choice of equivalence scale. Burkhauser, *et al.* (1991) discuss the importance of the equivalence scale when studying the impact of divorce/separation on the economic well-being of men versus women and children in the United States and Germany.

Given the sensitivity of policy analysis to the equivalence scale employed, and given that country-specific equivalence scales can vary substantially, it is often difficult for a researcher to decide whether to use the same scale for all countries studied or to use each country's own scale. Hanratty and Blank (1991) choose to compare poverty in Canada and the U.S. using the *same* poverty lines, and implicitly, the same equivalence scales for both countries.[1] Burkhauser, *et al.*, on the other hand, while noting the divergence between the U.S. and German scales, decide that it is best to use the German scale to analyze German data and the U.S. scale to analyze U.S. data. Their rationale is that each country's equivalence scale reflects circumstances unique to that country. However, it is also possible that scales differ mainly as a result of differences in the way they are derived.

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[1]For example, they convert the U.S. poverty line into Canadian dollars using OECD purchasing power parities.

This paper asks whether we will obtain the same equivalence scale for Canada and the U.S. if we employ the same estimation procedure for both countries. Specifically, we use a methodology which is as close as possible, given the limitations involved in estimating the same model for two different countries, to that actually employed by Statistics Canada for the estimation of the Canadian Low-Income-Cutoffs (LICOs). We choose to study the United States and Canada, two reasonably similar countries which yet are sufficiently different to make it possible that the relative income needs of households of different sizes in the two countries might differ. For example, without medical insurance, extra household members presumably increase income needs. Thus, since a large number of households in the United States do not have any medical insurance while there is universally available medicare in Canada, we might predict that additional members add more to income needs in the U.S. than in Canada.

Section 1 of the paper outlines the Engel methodology employed to estimate equivalence scales. Section 2 discusses the data, emphasizing the efforts made to use identical sample selection rules for the two countries. Section 3 presents estimation results and calculated equivalence scales. Section 4 examines the sensitivity of poverty measurement to estimated scales using data from the Luxembourg Income Study. Section 5 concludes.

1. The Engel Methodology

An extensive literature on the estimation of equivalence scales has developed over the years. (For relatively recent examples, see Blackorby and Donaldson, 1989; Blundell, Pashardes and Weber 1989, 1984; Deaton, *et al.*, 1989; Johnson and Garner, 1993; Jorgenson and Slesnick, 1987; Lewbel, 1989*a* and 1989*b*; Nelson, 1992; Phipps, 1990; Ray, 1986.) Unfortunately, no consensus has emerged about how best to estimate equivalence scales (or even if it is possible to estimate equivalence scales—see Nicholson, 1976; Pollak and Wales, 1979; Blundell and Lewbel, 1991). Yet, scales are essential to the design, implementation and evaluation of almost all tax and transfer policies—scales, at least implicitly, are in use every day.

For this paper, we have decided to address the question "Are equivalence scales the same for Canada and the U.S.?" using an "Engel" methodology very similar to that currently in use for the calculation of the Canadian Low-Income Cutoffs (see Wolfson and Evans, 1990). Thus, we are not entering the debate about the "best" procedure for estimating equivalence scales. Rather, we are taking the rather pragmatic approach of investigating one particular option for the estimation of scales which is currently in use by a major statistical agency. Following the Statistics Canada methodology as closely as possible thus dictates certain choices about, for example, functional form and model specification.[2]

[2]Given that we want to follow Statistics Canada methodology, we do not experiment, for example, with functional forms other than that currently employed in the estimation of the LICOs. Nor do we distinguish between children and adults in the estimation of equivalence scales. Again, this decision is dictated by current practice. Finally, we choose to employ the Engel methodology rather than a more sophisticated utility-based demand analysis for the same reason. (See Johnson and Garner, 1993 or Phipps, 1990 for examples of this alternative style of research.) Given the possibility that price regimes differ significantly across the two countries, an interesting extension of the current project might be to estimate equivalence scales for Canada and the U.S. employing a demand-system approach.

Engel observed the empirical regularity that, other things equal, poorer households devote a larger share of their total budget to food than richer households and that, again other things equal, larger households devote a larger share of their total budget to food than smaller households. Engel thus proposed that the proportion of the budget devoted to food could serve as an indicator of material well-being; that households spending the same proportion of total expenditure on food have the same standard of living (see, for example, Deaton and Muellbauer, 1980 for a discussion of the Engel methodology).

While Engel pointed out that the share of income devoted to food increases as either family size increases or income decreases, this is also true for other necessity items. A simple generalization of the Engel methodology is thus to assume that families devoting the same share of the budget to "necessities" are equally well-off materially (see Watts, 1968). A comparison of the incomes at which families of different size spend the same share on necessities then establishes relative income needs.

In this research, we consider three different necessity bundles. The first, in conformity with the original Engel methodology and with earlier work in the U.S. (Wirtz and Burdetsky, 1968) consists solely of food purchased for home consumption. The second follows the definition of necessities chosen by Statistics Canada which includes expenditures on food for home consumption, clothing and shelter. Finally, we add health care expenditures to the Statistics Canada necessity bundle. We judge health care to be an important necessity item and one which is provided very differently in Canada and the U.S.

In each case, expenditures on necessities are assumed to vary with household income, number of household members,[3] region of residence and level of urbanization.[3] These are the explanatory variables included in the Engel curves estimated by Statistics Canada, with minor modifications to allow Canada/U.S. comparability. Finally, we choose the log-log functional form preferred for the Statistics Canada low-income cutoff estimates:

$$(1) \qquad \ln E = a + b \ln Y + \sum_{i=1}^{6} c_i \, \text{Nhous}_i + d_i \, \text{Region}_i + f_i \, \text{City}_i + e,$$

where E represents expenditures on necessities; Y represents household income; Nhous_i, $i = 1, \ldots, 6$ is a set of categorical variables indicating the number of household members;[4] Region_i, $i = 1, 2, 3$ is a set of categorical variables to indicate region of residence; City_i, $i = 1, 2, 3$ is a set of categorical variables to indicate population in the household's area of residence; $a, b, c_i, i = 1, \ldots, 6, d_i, i = 1, 2, 3, f_i, i = 1, 2, 3$ are parameters to be estimated; e is a random error term.[5]

[3]The Statistics Canada LICOs do not distinguish between adults and children.

[4]The excluded category is a one-person household. The largest household-size category is "7 or more persons."

[5]We include region of residence and level of urbanization as control variables in the Engel equations, but do not use these variables in the construction of scales. Statistics Canada does calculate scales by level of urbanization, though this practice may be discontinued (see Wolfson and Evans, 1990). To include scaling by level of urbanization would be extremely difficult for purposes of Canada/U.S. comparisons since this variable is less directly comparable than number of household members, given the vastly different populations of the two countries.

Once parameter estimates have been obtained, equivalence scales can be calculated using the following methodology. The Engel curve, (1) above, can be re-written as:

$$\ln (E/Y) + (1-b) \ln Y = a + c \sum_{i=1}^{6} c_i \, \text{Nhous}_i + \sum_{i=1}^{3} d_i \, \text{Region}_i + \sum_{i=1}^{3} f_i \, \text{City}_i$$

or

$$(2)\quad Y = \exp\left[\left(a + \sum_{i=1}^{6} c_i \, \text{Nhous}_i + \sum_{i=1}^{3} d_i \, \text{Region} + \sum_{i=1}^{3} f_i \, \text{City}_i - \ln (E/Y)\right) \Big/ (1-b)\right].$$

To calculate equivalence scales, we calculate the ratio of the incomes at which households of different sizes devote the same share of income—say, 30 percent—to necessities (i.e. are "equally well-off" by the Engel assumption), by evaluating equation (2) for each household size.[6]

2. Data

Data employed for the estimation of the Canadian Engel curves are from the public-use version of the 1986 Statistics Canada *Family Expenditure Survey*, FAMEX (Statistics Canada, 1986). Data for the estimation of the U.S. Engel curves are from the Bureau of Labor Statistics (BLS) internal files (data are not top coded) of the 1986 Quarter Two through 1988 Quarter One U.S. *Consumer Expenditure Survey Interview*, CEX (USDL, 1988). The reference period for the U.S. data, chosen to match the Canadian survey period as closely as possible, is January 1986 through February 1988.

Given the Engel methodology employed and the double-log functional form chosen, consumer units reporting negative incomes, or after-tax incomes less than the sum of expenditures on necessity items were exluded from both data sets. (See the Appendix for a more detailed description of these data.)

For this study, expenditures consist of the transaction costs, including customs, excise and sales taxes, of goods and services acquired during the interview period.[7] The full cost of each purchase is recorded even though full payment may not have been made at the date of purchase, the exception for our list of commodities is for owned homes (see below).

Expenditure categories considered are defined as follows:

Food consists of food and nonalcoholic beverages purchased from stores, including that purchased for preparation by the consumer unit on trips. This category does not include alcoholic beverages or food purchased from restaurants.

Clothing includes apparel, footwear, accessories, jewelery, watches, shoe repair and other shoe services, repair and alterations to apparel, and materials for

[6]This calculation reduces to the following formula: Scale = exp $[c/(1-b)]$, where c is the coefficient on the appropriate household-size category and b is the coefficient on log of income. In taking the ratio of (2) evaluated for households of different sizes, all control variables in the numerator cancel out with the exception of those describing family size. Thus, the equivalence scale calculation is independent of the control variables.

[7]Expenditures are for the personal consumption of the spending or consumer unit only and therefore do not include expenditures for gifts and contributions, security or income taxes.

sewing. This category does not include expenditures for dry-cleaning or storage.

Housing includes expenditures for both shelter and utilities. Thus, for homeowners, "housing" includes mortgage interest payments (but not reductions in principal or equity), homeowners' insurance premiums, expenditures for maintenance and repairs, replacement costs, property taxes, and condominium fees, where appropriate, as well as expenditures on utilities (water, fuel, electricity, cable, telephone, etc.). For renters, "housing" includes rent, tenant's insurance premiums, tenant's expenditures on maintenance or repairs as well as expenditures on utilities.

Health care includes insurance premiums for medical and dental care, direct out-of-pocket medical expenditures (e.g. for supplies, physician care, hospitals, care in nursing and convalescent homes, eyeglasses, contact lenses, prescription drugs, rental of medical equipment, nursing services and therapeutic treatments). For the U.S. this value can be negative since reimbursements and payments often do not take place during the same time period.

Both income before taxes are deducted and income after are included in separate estimations of the model. Income includes all the income of all the members of the spending units from wages and salaries, self-employment, investments, government transfer (e.g. unemployment and workers' compensation, public assistance), and other miscellaneous income including that from pensions. Income is defined similarly for each of the countries with two exceptions. First, in Canada income includes family allowance, not paid in the U.S., and child tax credits. And second, in the U.S. the cash value of food stamps is included in the official definition of income, but is deducted for this study. However, we were unable to make an adjustment to food expenditures to deduct those made with food stamps. We defined taxes for Canada to include income taxes paid on 1986 income and income received before 1986, tax refunds and provincial tax credits, other personal taxes, unemployment insurance premiums, and required government pension contributions. Taxes for the U.S. included federal, state and local income taxes, tax refunds and overpayment on Social Security, personal property taxes, other personal taxes paid, including Social Security taxes for the self-employed paid in the survey year to cover any underpayment or under withholding of taxes in the year prior to the survey, and deductions for railroad retirement and Social Security.

Since household composition varies over the course of a year (babies are born, adults marry or separate, students leave for university), defining the "number of household members" is difficult. For this analysis, we have chosen to study only those households who do not experience a change in composition during the period under study. For such households, size is thus unambiguous. However, we would like to point out that this is not in the end the most desirable solution given the large number of households excluded (8.9 percent of the Canadian sample experienced a change in composition during 1986; 13.2 percent of the U.S. sample experienced a change in composition during the study period). We experimented with estimating Engel curves using all observations (i.e. including those households which experienced a change in composition) but including a dummy variable equal to one for those households which did not experience a change. Results (available on request) indicated that treatment of household

composition can influence parameter estimates and thus that this issue should be addressed in a more detailed way in future research.

For each country, four categorical variables are used to describe "region of residence." For Canada, these regions are Atlantic (Newfoundland, Nova Scotia, Prince Edward Island and New Brunswick), Quebec, Ontario and West (Manitoba, Saskatchewan, Alberta and B.C.). For the U.S. these regions are South, West, Midwest, and Northeast. Clearly, these regions are in no way comparable. However, they constitute the most reasonable divisions of the two countries into four regions for which prices may vary.

Level of urbanization is also described by four categorical variables for each country. However, given the vastly different total populations of Canada and the U.S., these variables have been designed to indicate roughly similar *relative* levels of urbanization. For Canada, "Big City" denotes an urban area with a total population greater then 100,000; "Medium City" denotes an urban area with a total population between 30,000 and 99,999; "Small City" is an urban area with a total population less than 30,000; and "Rural" includes both farm and non-farm households. For the U.S., "Big City" denotes an urban area with a total population greater than 1.2 million; "Medium City" denotes a medium metropolitan statistical area (MSA); and "Small City" is a small MSA or urban non-metropolitan area. As for Canada, "Rural" includes both farm and non-farm households. The population cutoff between "Medium City" and "Small City" differs by region. For the Northeast, the cutoff is a total population of 500,000; for the Midwest it is 360,000; for the South it is 450,000; and for the West it is 330,000.

Table 1 presents full sample (unweighted) means and standard deviations for expenditure, income and demographic variables. Canadian expenditures and incomes are presented in both 1986 Canadian dollars and in 1986 U.S. dollars to facilitate comparisons.[8] For this table, U.S. expenditure and income data were converted to 1986 U.S. dollars using monthly unseasonally adjusted U.S. *City Average All Items Consumer Price Indexes* (CPI) for the urban population (CPI data are not produced for rural areas) (USDL, 1992). Twelve month averages, matching the reference period of expenditures and income, were computed for the conversion. For the Engel analysis, expenditure and income data were not adjusted to constant 1986 dollars.

Households in Canada spent more on food and clothing in 1986 than did consumer units in the U.S. during their survey period, but less on shelter and health care. However, U.S. consumer units spent more overall for the three and four item necessity bundles, and their incomes were slightly higher. Consumer units in each of the countries spent about 45 percent of total expenditures on the three commodity bundle items and 51 percent on the four bundle items. (These results are not reported in the included tables.) The average number of household members in Canada was 2.55 and for the U.S., 2.71. A larger percentage of consumer units reside in Western Canada (0.37) than in other regions; for the U.S., more live in the Southern states (0.29). "Big City" characterizes the

[8]Canadian dollars are converted to U.S. dollars using the OECD measure of purchasing power parity—$1 U.S. = $1.2519 Cdn.

TABLE 1

VARIABLE MEANS AND STANDARD DEVIATIONS

	Canadian Means		U.S. Means
	($=1986 Cdn.)	($=1986 U.S.)	($=1986 U.S.)
Expenditures on food	$3,631.80	$2,901.09	$2,435.03
	(2,049.50)		(1,407.67)
Expenditures on clothing	$1,995.40	$1,593.93	$1,025.67
	(1,987.80)		(1,259.68)
Expenditures on shelter	$5,308.20	$4,240.20	$5,484.74
	(3,098.90)		(3,899.33)
Expenditures on health care	$610.93	$488.01	$1,090.40
	(656.74)		(1,121.12)
Expenditures on food, clothing, and shelter	$10,935.00	$8,734.90	$8,945.45
	(5,394.60)		(5,406.54)
Expenditures on food, clothing, shelter, and health care	$11,546.00	$9,222.97	$10,035.85
	(5,664.50)		(5,742.22)
Income before tax	$34,461.00	$27,527.52	$30,134.32
	(22,818.00)		(24,222.79)
Income after tax	$28,307.00	$22,611.69	$27,496.84
	(16,887.00)		(21,074.25)
1 person	0.250		0.261
	(0.433)		(0.439)
2 persons	0.307		0.307
	(0.461)		(0.461)
3 persons	0.159		0.167
	(0.365)		(0.373)
4 persons	0.179		0.153
	(0.384)		(0.360)
5 persons	0.074		0.079
	(0.263)		(0.270)
6 persons	0.022		0.021
	(0.146)		(0.143)
7 persons or more	0.008		0.012
	(0.092)		(0.110)
Dummy = 1 if residence in Atlantic Canada or Northeast U.S.	0.201		0.194
	(0.401)		(0.395)
Dummy = 1 if residence in Quebec or southern U.S.	0.200		0.293
	(0.400)		(0.455)
Dummy = 1 if residence on Ontario or midwestern U.S.	0.232		0.272
	(0.422)		(0.445)
Dummy = 1 if residence in western Canada or western U.S.	0.367		0.241
	(0.482)		(0.428)
Dummy = 1 if residence in rural area	0.116		0.136
	(0.321)		(0.343)
Dummy = 1 if residence in Small City	0.078		0.205
	(0.269)		(0.404)
Dummy = 1 if residence in Medium City	0.161		0.121
	(0.368)		(0.326)
Dummy = 1 if residence in Big City	0.644		0.538
	(0.479)		(0.499)
Number of Observations	9,214		3,449

Note: Unweighted data. Sample restricted to spending units with no change in family size over 12 months and those with income after tax greater than the sum of expenditures on food, clothing, shelter, and health care.

TABLE 2A

CANADIAN PARAMETER ESTIMATES. INCOME AFTER TAX

	Log of Expenditure on Food	Log of Expenditure on Food, Shelter & Clothing	Log of Expenditure on Food, Shelter, Clothing & Health Care
Log of income after tax	0.245	0.457	0.473
	(24.151)	(76.753)	(82.234)
2 persons	0.541	0.176	0.173
	(37.045)	(20.518)	(20.866)
3 persons	0.775	0.036	0.298
	(43.398)	(29.209)	(29.352)
4 persons	0.956	0.141	0.396
	(52.730)	(38.589)	(38.440)
5 persons	1.089	0.479	0.462
	(47.109)	(35.252)	(35.210)
6 persons	1.205	0.521	0.506
	(32.952)	(24.253)	(24.355)
7 persons or more	1.382	0.626	0.599
	(24.779)	(19.098)	(18.930)
Medium City	−0.011	−0.037	−0.031
	(−0.753)	(−4.535)	(−3.941)
Small City	0.040	−0.072	−0.062
	(2.105)	(−6.499)	(−5.769)
Rural Area	−0.013	−0.193	−0.175
	(−0.816)	(−20.251)	(−19.049)
Western Canada	−0.028	−0.025	−0.022
	(−2.123)	(−3.248)	(−2.875)
Quebec	0.096	0.034	0.033
	(6.287)	(3.750)	(3.766)
Atlantic Canada	0.018	−0.031	−0.036
	(1.147)	(−3.336)	(18.930)
Constant	4.959	4.394	4.287
	(50.276)	(75.888)	(76.575)
Number of Observations	9,211	9,214	9,214
Adjusted R^2	0.517	0.682	0.701

Note: *t*-statistics in parentheses. Unweighted data. Sample restricted to spending units with no change in family size over 12 months and those with income after tax greater than the sum of expenditures on food, clothing, shelter, and health care.

population and urbanization area of the larger percentage of consumer units living in Canada (0.64) and in the U.S. (0.55).

3. ESTIMATION RESULTS AND CALCULATED EQUIVALENCE SCALES

Tables 2A and 2B present OLS Engel curve parameter estimates for Canada and the U.S., respectively. In a significant deviation from Statistics Canada methodology, we have chosen income after tax as our measure of income. Since government provision of services is more extensive in Canada than in the U.S. (particularly in terms of health care) and, correspondingly, levels of taxation are higher, it is more reasonable to compare after-tax income needs of households across the two countries. However, we did estimate scales using income before tax and found that this choice made little difference to results.[9]

[9]When we constructed confidence bands of plus or minus one standard error around the point estimates of the before-tax and after-tax Canadian equivalence scales, these bands always overlapped. Thus, the two sets of scales were not statistically different, even when we used a very narrow confidence band. The before-tax equivalence scale results are available on request from the authors.

TABLE 2B

U.S. PARAMETER ESTIMATES USING INCOME AFTER TAX

	Log of Expenditure on Food	Log of Expenditure on Food, Shelter & Clothing	Log of Expenditure on Food, Shelter, Clothing & Health Care
Log of income after tax	0.244	0.500	0.483
	(19.940)	(52.858)	(53.348)
2 persons	0.504	0.109	0.153
	(23.814)	(6.692)	(9.809)
3 persons	0.717	0.248	0.250
	(28.547)	(12.771)	(13.461)
4 persons	0.897	0.344	0.334
	(34.275)	(17.005)	(17.282)
5 persons	1.035	0.414	0.400
	(32.362)	(16.769)	(16.950)
6 persons	1.186	0.432	0.418
	(21.932)	(10.344)	(10.452)
7 persons or more	1.129	0.431	0.409
	(16.257)	(8.033)	(7.962)
Medium City	−0.057	−0.058	−0.049
	(−2.375)	(−3.132)	(−2.727)
Small City	−0.101	−0.149	−0.119
	(−5.118)	(−9.762)	(−8.117)
Rural Area	−0.137	−0.251	−0.195
	(−5.841)	(−13.782)	(−11.230)
West	0.112	0.082	0.074
	(5.346)	(5.048)	(4.769)
South	0.043	0.012	0.022
	(2.120)	(0.806)	(1.481)
Northeast	0.178	0.073	0.060
	(8.038)	(4.241)	(3.644)
Constant	4.649	3.847	4.125
	(39.453)	(42.252)	(47.368)
Number of Observations	3,449	3,449	3,449
Adjusted R^2	0.552	0.659	0.657

Note: t-statistics in parentheses. Unweighted data. Sample restricted to spending units with no change in family size over 12 months and those with income after tax greater than the sum of expenditures on food, clothing, shelter, and health care.

We report Engel curve results using three alternative definitions of necessities. First, we follow the original Engel approach and define necessities as food purchased for home consumption. These results are also useful for comparison with earlier U.S. research (Wirtz and Burdetsky, 1968). Next, we consider the Statistics Canada food/clothing/shelter bundle of necessities. This allows us to compare our estimated scales with those found in the Canadian Low-Income Cut-offs. Finally, we expand the Statistics Canada definition of necessities to include expenditures on health care. We believe health care to be an important necessity item and one which may affect relative household needs rather differently in Canada and the U.S., given the existence of universal medicare in Canada but not the U.S.

For both countries, the Engel curves fit extremely well. For example, the adjusted R^2 for the complete bundle of necessity items (food, clothing, shelter, and health care) is 0.701 for Canada and 0.657 for the U.S. These are very high R^2 values for estimates obtained using micro-data. Correspondingly, t-statistics

TABLE 3A

CALCULATED EQUIVALENCE SCALES FOR CANADA USING INCOME AFTER TAX

Number of Persons	Log of Expenditure on Food	Log of Expenditure on Food, Shelter & Clothing[a]	Log of Expenditure on Food, Shelter, Clothing & Health Care
1	1.000	1.000	1.000
2	2.048	1.383	1.389
	(0.036)	(0.020)	(0.020)
3	2.791	1.758	1.759
	(0.059)	(0.031)	(0.031)
4	3.545	2.130	2.119
	(0.074)	(0.036)	(0.035)
5	4.230	2.414	2.405
	(0.119)	(0.054)	(0.054)
6	4.931	2.612	2.612
	(0.233)	(0.099)	(0.099)
7 or more	6.236	3.164	3.121
	(0.457)	(0.187)	(0.184)

Note: Standard errors in parentheses. Unweighted data. Sample restricted to spending units with no change in family size over 12 months and those with income after tax greater than the sum of expenditures on food, clothing, shelter, and health care.

[a]The equivalence scales implicit in the 1986 Statistics Canada Low-Income cutoffs are 1.00, 1.36, 1.72, 1.98, 2.17, 2.35 (Phipps, 1993).

for the variables of primary interest (i.e. for income after tax and for the household-size categories) are extremely high. Thus, given the Engel framework, estimated equivalence scales (which depend on the parameter estimates for income and household size) are very precisely determined.

Calculated equivalence scales by number of household members are presented for Canada and the U.S. in Tables 3A and 3B, respectively. Approximate standard errors are reported in parentheses.[10]

Considering, first, the scales calculated using expenditures on food alone as the definition of necessities, it appears that there are no economies of scale for the addition of the second member to the household. Economies appear with addition of the third member, but they are estimated to be very small for both Canada and the U.S. This finding is perhaps not surprising, given the arguments of Deaton and Muellbauer (1986) that simply using a food share will overstate the income needs of larger households. However, the result of principal interests for this paper is that if we construct confidence intervals of plus/minus two standard errors around the point estimates of the equivalence scales for both countries, the confidence intervals overlap—equivalence scale estimates are not statistically different for the two countries.

The second columns of Tables 2A and 2B report scales calculated using the Statistics Canada necessity bundle of food for home consumption, clothing and shelter. For both Canada and the U.S., estimated economies of scale increase

[10]Equivalence scales depend upon two estimated parameters—b, the coefficient for log of income after tax and c, the coefficient on the relevant household-size category. Specifically, Scale $= \exp(c/(1-b))$. Thus, the standard error for the equivalence scales depend upon the estimated standard errors for these parameters. Using a Taylor expansion, the variance of the equivalence scale is calculated as $\text{var (Scale)} = (\partial\text{Scale}/\partial c)^2 \text{ var } (c) + (\partial\text{Scale}/\partial b)^2 \text{ var } (b) + 2(\text{Scale}/\partial b)\ (\partial\text{Scale}/\partial c) \text{ cov } (b, c)$.

TABLE 3B

CALCULATED EQUIVALENCE SCALES FOR U.S. USING INCOME AFTER TAX

Number of Persons	Log of Expenditure on Food	Log of Expenditure on Food, Shelter & Clothing	Log of Expenditure on Food, Shelter, Clothing & Health Care
1	1.000	1.000	1.000
2	1.948	1.245	1.345
	(0.051)	(0.039)	(0.039)
3	2.583	1.642	1.621
	(0.080)	(0.060)	(0.054)
4	3.279	1.990	1.909
	(0.105)	(0.074)	(0.066)
5	3.930	2.290	2.169
	(0.159)	(0.106)	(0.093)
6	4.804	2.375	2.243
	(0.344)	(0.196)	(0.171)
7 or more	4.452	2.368	2.203
	(0.408)	(0.252)	(0.216)

Note: Standard errors in parentheses. Unweighted data. Sample restricted to spending units with no change in family size over 12 months and those with income after tax greater than the sum of expenditures on food, clothing, shelter, and health care.

substantially when clothing and shelter are added to the necessity bundle, which seems very reasonable given that shelter should provide large economies of scale relative to food. Since the methodology employed to obtain this second set of results is very similar to that used by Statistics Canada in the derivation of the Canadian Low-Income Cutoffs, these results can be compared with the equivalence scales implicit in the LICOs.[11] We do not have standard errors for the LICO estimates, so it is not possible to decide whether the two sets of estimates are statistically different, but visually they are very close (and for two- and three-person households, the LICO estimate falls within a two-standard error confidence band around our point estimates). Finally, are equivalence scales the same for Canada and the U.S.? If we construct confidence bands of two standard errors around both sets of scales we can conclude that they are not statistically different except in the case of the scale for two-person households (where estimated economies of scale are larger in the U.S.).

The last columns of Tables 2A and 2B report calculated equivalence scales using Engel curve estimates where necessities are defined as food for home consumption, clothing, shelter and health care. For Canada, the addition of health care to the necessity bundle does not significantly alter estimated scales. This is also true for the U.S., but the extent of the change is sufficient for two-person households that the Canada/U.S. scales are in this case statistically indistinguishable. Using the expanded bundle of necessities, equivalence scales are statistically indistinguishable except for the categories of four-person and seven or more persons. While it is perhaps not surprising that the Canadian scales were not substantially affected by the addition of health care to the bundle, we were

[11]The LICOs are estimated using before-tax income, so the more appropriate comparison would be with the before-tax results. However, as noted above, the before- and after-tax results are not statistically different.

surprised that this did not have a larger impact on the U.S. scales and, moreover, that the addition of health care did not lead to bigger differences between the Canadian and U.S. scales.[12]

Statistics Canada currently calculates scales by level of urbanization,[13] though the possibility of dropping this adjustment has been discussed (Wolfson and Evans, 1990). However, no attempt is made to work out differences in income needs for households living in different regions of the country. We choose *not* to calculate differences in income needs for households living in different regions or in communities with different levels of urbanization. We argue that it is important to include region and urbanization in our estimated Engel curves to avoid omitted variable bias. However, the fact that region or urbanization are significant determinants of expenditures does not necessarily mean that we must use equivalence scales which vary, for example, by region. Decisions about whether or not, for example, we should adjust for differences in income needs across regions is a larger issue than statistical significance. Such decisions should presumably be made with reference to the policy question under consideration.

4. Implications for Poverty Measurement

Our results suggest that estimated scales for Canada and the U.S. are not, in general, statistically different. When we use the food/shelter/clothing/health care necessity bundle, we find only the scales for four-person and seven or more person households to differ between the two countries. But, there are a large number of four-person households. Moreover, if standard errors are "large," point estimates of scales can differ substantially without being statistically different. Thus, it is important to assess the practical implications of our findings. We choose, as one example, to ask whether our statistically similar scales give similar estimates of poverty. For this purpose, we employ data from the Luxembourg Income Study.[14] We use these income data rather than the income data included in the expenditure surveys we used to estimate the equivalence scales since the data included in LIS are those used in Canada and the U.S. for the calculation of income distribution statistics. We define households to be poor if

[12]We did calculate equivalence scales for Canadian and U.S. regions using income after tax. (These results are available on request.) We were curious to see whether equivalence scales differ within a country but across regions where price regimes, geography and culture may differ. Here, again, we found very few cases where statistically different results were obtained although fewer economies of scale appear to be available in the Canadian West and the U.S. Midwest.

[13]That is, the Statistics Canada procedure works out differences in income needs for households of the same size, but living in communities with different levels of urbanization. The idea is that it "costs more" for an otherwise similar family to live in a large centre than in a small town. Notice that since there are no interaction effects between family size and level of urbanization, the family size adjustments are constant across levels of urbanization.

[14]The Luxembourg Income Study is a set of internationally comparable microdata sets housed in Luxembourg, but easily accessible to remote users via the EARN/BITNET system (see Smeeding, *et al.* 1985, for a detailed description of this data source). The most recent Canadian data set included in LIS is the 1987 *Survey of Consumer Finances* (with 10,999 observations). The most recent U.S. data set is the 1986 March *Current Population Survey* (with 11,614 observations).

their after-tax adult-equivalent incomes[15] are less than 50 percent of median after-tax adult-equivalent income for the country. For both Canada and the U.S., we compare the estimated incidence of poverty when adult-equivalent incomes are calculted using the scales estimated for Canada and when adult-equivalent incomes are calculated using the scales estimated for the U.S. (We use the scales estimated using the food/clothing/shelter/healthcare necessity bundle.) Finally, we compare these estimates with those obtained using the equivalence scales implicit in the Canadian LICOs (Phipps, 1993) and the official U.S. poverty lines (U.S. Bureau of the Census, 1988).[16]

Results indicate that the measured incidence of poverty is not affected by the choice of the Canadian or the U.S. equivalence scales. For Canada, 13 percent of households are poor using either of our estimated scales or the equivalence scale implicit in the Statistics Canada LICOs.[17] For the U.S., 19 percent of households are poor using our estimated U.S. scale, our estimated Canadian scale or the scale implicit in the U.S. poverty lines. Thus, from a practical as well as a statistical perspective, we conclude that there is little difference between the Canadian and the U.S. equivalence scales when they are derived using the same methodology.

5. Conclusion

This research asked the question: "Are equivalence scales the same for Canada and the United States when we use exactly the same methodology to obtain them?" To answer this question, interview data from the 1986 Statistics Canada *Family Expenditure Survey* and the 1986-88 U.S. *Consumer Expenditure Survey* were used to estimate Engel curves, following as closely as possible Statistics Canada's methodology for calculating the Canadian Low-Income Cutoffs. The log of expenditures was regressed on number of household members, log of income after tax, region of residence, and area type (i.e. population size and degree of urbanization). For each country, models were estimated for three different necessity bundles (i.e. food, food/shelter/clothing, and food/shelter/clothing/health care). Equivalence scales were then calculated using estimated Engel curve parameters. The models fit extremely well. Comparisons of the family size equivalence scales revealed that the scales for the two countries are, in general, not significantly different from each other (exceptions were for two-person households, using the food/clothing/shelter necessity bundle and for four-person and seven or more person households using the food/clothing/shelter/health care bundle).

[15]Adult-equivalent income is defined as household income divided by the equivalence scale value appropriate for that household. Thus, a two-person Canadian household with total after-tax income of $30,000 would have adult-equivalent income of $30,000/1.389=$21,598, using the scales obtained for two-person households using the food/clothing/shelter/health care necessity bundle (see Table 3A).

[16]For households with seven or more members in the U.S, we calculate a simple average over the values for 7, 8 and 9-or-more members.

[17]This result is due to the statistical similarity of these three scales. Poverty measurement is highly sensitive to choices among different scales. For example, the incidence of poverty in Canada jumps to 17 percent when another relatively popular set of equivalence scales—those implicit in the Canadian Council on Social Development Poverty lines (see Phipps, 1993)—are employed.

But, from a practical perspective, might statistically indistinguishable equivalence scales lead to different estimates of, for example, the incidence of poverty in a country if standard errors were "large"? Would we estimate the same incidence of poverty for Canada using the U.S. scales rather than the Canadian scales? Calculations made using data from the Luxembourg Income Study reveal that the estimated incidence of poverty is 13 percent using either the Canadian or the U.S. equivalence scales; the incidence of poverty is 19 percent in the U.S. using either the Canadian or the U.S. scales.

Thus, if Canada and the U.S. both estimated equivalence scales using the methodology employed by Statistics Canada to derive the Canadian Low-Income Cutoffs, we conclude that they should derive scales which are indistinguishable statistically or practically. The larger question is then whether or not the two countries should wish to choose the same methodology for the estimation of equivalence scales. Any approach to estimating equivalence scales involves making assumptions about how we should make interpersonal comparisons of well-being.[18] The most appropriate choice will presumably reflect both social values and the purpose for which the equivalence scales are intended (e.g. measurement of poverty, design of transfer programmes, measurement of inequality).

Whether equivalence scales should be estimated is not an issue here. The fact is that they are being used for almost all tax and transfer policies. Through this research we have tried to examine more fully issues arising from their estimation. It is up to the policy maker to decide which scales to use.

Data Appendix

The FAMEX uses a multistage stratified clustered sample drawn from the Canadian *Labour Force Survey* sampling frame. The sample represents persons living in private households in the ten Canadian provinces. Residents of the Yukon and Northwest Territories, of Indian Reserves and patients and inmates living full-time in collective institutions (old-age homes, hospitals, prisons) are excluded. The overall response rate for the FAMEX was approximately 77 percent.

Data were collected during at least one and frequently more than one personal interview. Respondents were asked to recall expenditures during the previous calendar year. Repeat visits were often made due to the need for respondents to consult records. The basic sample unit is a "spending unit" defined as a group of people dependent on a common or pooled income (income is not top coded) and living in the same dwelling or one financially independent individual living alone. Never married sons or daughters living with their parents are counted as part of their parents' spending unit. Spending units such as immigrant families who arrived during the survey year or an elderly individual who moved into an institution during the survey year are excluded from the data. The basic public use tape includes 10,356 observations. For 23 observations, "region of residence" is masked, so these are dropped from the estimating sample.

As with the FAMEX, the U.S. *Consumer Expenditure Survey* collects detailed information on expenditures, income, and characteristics of the household. The

[18]See Coulter, et al. for an excellent discussion of these issues.

CEX is sponsored by the BLS, U.S. Department of Labor, with data collected by the U.S. Bureau of the Census by personal interviews using a rotating panel design. The panel's composition is determined by a national probability sample, stratified by primary sampling units (PSUs) that consist of counties (or parts thereof), groups of countries, or independent cities. The sample of households is designed to represent the civilian non-institutional population and a portion of the institutional population living in grouped quarters, including college and university housing, living in the four Census regions of the U.S. The sample size is targeted at approximately 5,000 interviews per quarter. About 86 percent of the eligible sample unit participated in an interview during the period for this study.

Data are collected from consumer units within households. A consumer unit is defined as (1) a single person living alone or sharing a household with others but who is financially independent, (2) members of a household related by blood, marriage, adoption, or other legal arrangement, or (3) two or more persons living together who are financially dependent. Financial independence is determined by the three major expense categories: housing, food, and other. To be considered financially independent, at least two of these three must be provided by the respondent. Each consumer unit is to be interviewed once per quarter for five consecutive quarters, and then rotated out of the sample. All persons listed as part of the consumer unit at the time of each interview date report for the current reference period. Consumer units that move are not followed to their new addresses in the survey. (See USDL, 1991 for additional detail.)

During the initial interview, information is collected on demographic and family characteristics and on the inventory of major durable goods of each consumer unit. The second through fifth interviews use uniform questionnaires to collect household and member information and expenditure data for the previous three months. Detailed income information is also obtained in the second and fifth interviews. Ninety to 95 percent of total consumer unit expenditures are collected using the Interview (USDL, 1991).

The time period for the U.S. CEX was selected to match as closely as possible the Canadian survey reference period of 1986, while at the same time maximizing the sample size. During the CEX survey period, 46,287 interviews were collected. However, since the Canadian data represent 12 months of data, the U.S. sample was restricted to those consumer units participating in four interviews, thereby reporting for 12 months. This reduced the sample to 5,347 consumer units.

Since income is one of the primary variables in the model to be estimated, included observations must satisfy several restrictions. First, only "complete income reporters," as designated by the BLS, were selected. This was done because missing income is not imputed by BLS for the CEX. Restricting the sample to "complete reporters" does not mean, however, that consumer units provided a full accounting of income from all sources (Garner and Blanciforti, 1992; USDL, 1991). Yet, as noted by Nelson (1992), the "complete income reporter" status tends to be a good overall indicator of cooperation with the survey, therefore the survey data are likely to be better than the sample including incomplete income reporters. The sample of complete income reporters was 4,687.

Given the double log Engel model used for estimation, consumer units reporting negative incomes or reporting after-tax incomes exceeding their expenditures on necessities were excluded from both the Canadian and U.S. data sets. This reduced the U.S. data set to 3,974 consumer units[19] and the Canadian data set to 10,117 consumer units. The final sample selection criterion was that consumer units had not experienced a change in composition during the survey period. This reduced the U.S. sample to 3,449 observations and the Canadian sample to 9,214 observations. As might be expected, these restrictions have implications for the representatives of the final samples.

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[19]Restricting to consumer units with positive incomes reduced the U.S. sample to 4,673 observations. The additional restriction that income after tax exceed expenditures on necessities caused the larger drop to 3,974 observations.

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