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# Measuring Household Income Inequality Using the CPS

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## ► Introduction

This paper examines the use of the Current Population Survey (CPS) to measure income inequality. It begins with a brief overview of the CPS followed by a presentation of how three income inequality measures track over time using CPS household data. It goes on to examine topcoding issues associated with CPS income data, how CPS topcoding affects the measurement of income inequality, and concludes with a discussion of CPS income data quality issues.

## ► An Overview of the CPS

The CPS is a national random household sample survey conducted monthly by the Census Bureau for the Bureau of Labor Statistics. The monthly sample size for the CPS is about 78,000 households.<sup>1</sup> The survey has been conducted for more than 50 years.

The CPS is the primary source of information on the labor force characteristics of the U.S. population. The sample is scientifically selected to represent the civilian noninstitutional population. Respondents are interviewed to obtain information about the employment status of each member of the household 15 years of age and older.

Estimates obtained from the CPS include employment, unemployment, earnings, hours of work, and other indicators. They are available by a variety of demographic characteristics including age, sex, race, ethnicity, marital status, and educational attainment. They are also available by occupation, industry, and class of worker.

Supplemental questions to produce estimates on a variety of topics, including school enrollment, income, previous work experience, health, employee benefits, and work schedules, are also often added to the regular CPS questionnaire.

One of the CPS's most widely used supplements is the Annual Social and Economic Supplement (ASEC).<sup>2</sup> The ASEC is the source of annual income, official poverty, and health coverage statistics for the U. S. The ASEC has been used to compile annual income summary measures for families and people since 1947 and for households since 1967. Households have become a more comprehensive unit of analysis over time due to changing living patterns (a smaller percentage of people currently live in family situations than 50 years ago). Household income data is constructed from income information collected about the civilian, noninstitutionalized population 15 years old and over.<sup>3</sup> Households exclude people living in group quarters.

Income collected in the CPS ASEC is defined as money income received on a regular basis, before deductions for taxes and other expenses, and does not include lump-sum payments or capital gains. It includes wages and salary, self-employment (net after expenses), unemployment compensation, worker's compensation, Social Security, Supplemental Security Income, cash public assistance, veterans' payments, survivor benefits, pension or retirement income, interest, dividends, rents, royalties, estates, trusts, educational assistance, alimony, child support, assistance from outside the household, and other miscellaneous money income received on a regular basis.

The income data collected in the CPS ASEC have become more detailed over time. In 1967, data were collected on eight sources of income. The 1967 sources included wages and salaries, which were one of the two original income sources asked in 1947, two sources of self-employment income (farm and nonfarm, which were added in 1950), and five additional sources added in 1967:

Social Security; interest, dividends, estate, trust, or rent; public assistance or welfare; unemployment compensation, worker's compensation, government employee pensions, or veterans payments; and private pensions, annuities, alimony, royalties, or regular contributions from people not living in the household. The number of income sources continued to expand until 1979 when the CPS ASEC allowed for the identification of over 50 income sources while recording up to 27 income values. The income sources have remained unchanged since 1979 (see Welniak for a complete discussion of the evolution of the CPS ASEC questionnaire and processing system).

In addition to an increasing number of income sources collected in the CPS ASEC, the values recorded for these sources also increased. In 1967, the format of the CPS questionnaire allowed for the recording of amounts up to \$9,999 for each of the eight income sources. In 1970, the format of the questionnaire changed allowing the recording limits to increase to \$99,999 for six of the eight income sources (wages and salaries; farm self-employment; nonfarm self-employment; interest, dividends, estate, trust, or rent; unemployment compensation, worker's compensation, government employee pensions, or veterans payments; and private pensions, annuities, alimony, royalties, or regular contributions from people not living in the household). In 1979, the questionnaire allowed the recording of up to \$99,999 for 23 income sources.<sup>4</sup> In 1985, the limit for recording earnings from longest job increased to \$299,999. The final recording limit increase occurred in 1993 when each of the four earned income sources allowed the recording of amounts to \$9,999,999.

### ► **Measuring Household Income Inequality**

Several measures of income inequality are available for analysis. Two important properties an inequality measure should possess are scale invariance and the principle of transfers. An inequality measure is said to be scale invariant if the measure does not change when a constant is added to all income values in the distribution. An inequality measure possesses the principle of transfers if the measure rises (falls) when income is transferred from the poorer household to a richer one (or vice versa).

This paper examines the changes in three measures of household income inequality that possess these qualities: the Gini Coefficient, the Mean Logarithmic Deviation of Income (MLD), and the Atkinson Index.

The Gini index is a measure of income concentration derived from the Lorenz Curve. The Lorenz Curve is obtained by plotting the cumulative percent of units on the X-axis against the cumulative percent of aggregate income accounted for by these units on the Y-axis. A diagonal line from 0 percent to 100 percent would represent the Lorenz Curve if all units had exactly the same income. Lorenz Curves plotted from actual data typically fall below the diagonal. The Gini index is the proportion of the total area below the diagonal that is between the diagonal and the Lorenz Curve. Thus, the Gini index ranges from 0 (perfect equality) to 1 (perfect inequality).

The Atkinson measure of inequality takes a current income distribution and translates it into a social welfare function. The measure is expressed as a ratio of the current welfare function to a welfare function of equally distributed income. The Atkinson measure incorporates a parameter,  $e$ , which allows the user to quantify an aversion to inequality. The greater the  $e$  value, the more aversion there is to inequality. The value of  $e$  ranges between 0 and 1, with 1 indicating maximum inequality aversion with emphasis on the lower end of the income distribution.

The MLD measures the average ratio of the log of the population mean to each observation. The MLD belongs to the Generalized Entropy family. It can be used to measure both within and between group income inequality.

### ► **Historical Perspective on Household Income Inequality**

Each of the inequality measures displayed in Table 1 was derived from the Census Bureau's internal data file. They show an increase in income inequality between 1967 and 2001, to varying degrees: the Gini index increased 17 percent, the MLD 36 percent, and the Atkinson increased between 28 percent ( $e=0.75$ ) and 38 percent ( $e=0.25$ ).<sup>5</sup> Between 1967 and 1980, the Gini index was relatively unchanged. The 1980 MLD and Atkinson measures were at or slightly below their 1967

levels. Each of these measures was at or near its all-time lows by 1974 and was beginning to show signs of increasing. In 1974, the Gini was already above its all-time low set in 1968. By 1982, all of these measures were at or above their 1967 levels and were increasing.

Most of these measures showed growth in income inequality through the late 1980's. By 1989, the Gini and Atkinson measures were measuring income inequality at levels comparable to their all-time highs. The Gini was 8 percent higher than in 1967; the Atkinson with its aversion parameter set to be more sensitive to changes in the upper end of the income distribution ( $e=0.25$ ) was 13 percent higher; the Atkinson with a midlevel inequality aversion parameter ( $e=0.5$ ) was 10 percent higher; the Atkinson with an inequality aversion parameter more sensitive to changes in the low end of the income distribution ( $e=0.75$ ) was 9 percent higher; and the MLD was 7 percent higher.<sup>6</sup>

There appeared to be little change in income inequality between 1989 and 1991.<sup>7</sup> Each of the measures showed growth in inequality between 1991 and 1993, though it is hard to quantify the growth because of survey methodology changes that took place in 1993. In 1994, the CPS ASEC introduced computer-assisted personal interviewing and increased the recording levels for earnings to \$1 million as well as increasing the recoding levels for other income sources. Ryscavage (1995) found that as much as one-half of the growth in inequality between 1992 and 1993 may have been the result of these methodological changes. Since 1993, each of the measures has shown periods of fluctuation, culminating in an increase in income inequality by 2001.

### ► Income Topcoding and Inequality Measurement

This section will examine the impact that income recording limits had on the measurement of income inequality. Discussion will focus on the changes to the CPS ASEC questionnaire in 1970, 1979, 1985, and 1993 and also the topcoding limits placed on the public-use file.

As discussed earlier, the CPS ASEC has undergone several changes with regard to changing income questions and income recording and processing limits. In 1970, income-recording limits increased to \$99,999. This

change affected 12,505 people in 12,101 households (33 percent). Ignoring the processing change, each of the income inequality measures showed a slight increase between 1969 and 1970. However, had income recording and processing limits remained at their 1969 and earlier levels, each of the 1970 inequality measures would have been considerably lower (see Table 2). The Gini index would have been 15 percent lower, the MLD 19 percent lower, and the Atkinson between 21 percent and 28 percent lower (28 percent when  $e=0.25$ , 25 percent when  $e=0.5$ , and 21 percent when  $e=0.75$ ).

The next change occurred in 1979, affecting 82 people in 81 households (0.1 percent). It had virtually no effect on measured income inequality.

The 1985 change affected 385 people in 380 households (0.6 percent). Between 1984 and 1985, ignoring the processing change, each of the income inequality measures showed a slight increase. However, had income limits remained at their 1984 levels, none of the income inequality measures would have shown any change between 1984 and 1985.

The most dramatic increase in income inequality occurred between 1992 and 1993. Only part of the increase, however, can be attributed to income limits (see Ryscavage). Increased income limits affected 170 people in 167 households (0.3 percent) and caused increases in each of the income inequality measures. The Gini increased 2 percent, the MLD increased 4 percent, and the Atkinson increased between 4 percent and 8 percent (8 percent when  $e=0.25$ , 6 percent when  $e=0.5$ , and 4 percent when  $e=0.75$ ).

Public access to microdata requires the Census Bureau to limit some information to ensure the privacy and confidentiality of respondents. Topcoding income is one of the privacy measures used. For some years, the public-use topcodes and internal processing limits on the CPS ASEC were the same. Table 2 shows measures of income inequality derived from the CPS ASEC public-use data along with measures derived from internal Census Bureau data (Old/ New Processing Limits) for selected years. Public-use data show that, as with internal data, all income inequality measures have increased over the 1967-2001 period, but each of the public-use derived

measures showed more growth than the internal measures. The public-use Gini grew by 19 percent, compared to 17 percent using internal data; the MLD grew by 40 percent, compared to 36 percent; and the Atkinson grew by between 34 percent and 45 percent, compared to between 28 percent and 38 percent for internal data.<sup>8</sup> The larger growth in income inequality using public-use data is the result of: 1) topcoded income in 1967 which reduced measured income inequality and 2) increased high income through the plugging of mean topcoded values beginning in 1996 (1997 CPS ASEC).

### ► **Income Inequality Without Reporting Limits**

In actuality, there are two restrictions that limit the reporting of high-income values on the CPS: a data collection limit and a processing limit. The questionnaire limits the reporting of income by restricting the number of digits available for recording an amount during data collection. This limit was set by physical restriction of a paper questionnaire. In 1993, this physical restriction virtually disappeared with the advent of computer-assisted data collection. A data processing limit is applied to minimize the possible impact of recording (keying) errors, help maintain respondent confidentiality, and prevent volatility and distortion of annual statistics. It also compromises the survey's coverage of the income distribution and may understate income inequality. Prior to 1993, income recording and processing limits were the same.

Table 3 shows the current questionnaire and processing limits and the number of people who exceeded the processing limits for selected income sources on the 2000 CPS. There were no cases that reported income in excess of the data capture limit.

Allowing unrestricted income reporting increased aggregate household income by about 0.1 percent and affected income inequality measures to varying degrees. The Gini index was the measure least affected by allowing unrestricted income reporting, showing an increase of 1.1 percent (see Table 4). The MLD was slightly more affected, increasing 1.9 percent. Unrestricted income reporting had the most effect on the three Atkinson measures. As would be expected, the measure with the highest sensitivity to changes in the upper end of the

income distribution ( $e=0.25$ ) increased 5.4 percent, while the measure most sensitive to changes in the lower end of the distribution ( $e=0.75$ ) increased only 2.2 percent.

### ► **High-Income Sample Turnover and Its Impact on Income Inequality Measures**

One major concern with allowing the unrestricted reporting for high-income cases is sample turnover and the impact the loss or gain of very high-income sample cases could have on interpreting annual changes in income inequality. For example, an examination of high income reporting on the 1999 CPS ASEC (1998 income) and the 2000 CPS ASEC (1999 income) showed that sample turnover accounted for the loss of four high income households, with one of the those households having a maximum \$9,999,999 in earnings reported. Between 1998 and 1999, there was virtually no change in any of the income inequality measures.<sup>9</sup>

### ► **Comparison of CPS Income Data With Administrative Sources**

Any income inequality measure is only as good as the data used to construct it. One way to gauge the quality of the CPS ASEC income is by comparing it to independent sources. This section uses National Income and Product Account (NIPA) summaries and matched Internal Revenue Service individual tax return information as benchmarks for evaluating CPS ASEC income data (see Roemer for a discussion of how to reconcile the NIPA and CPS ASEC income definitions).

The most recent comparison of CPS and NIPA data uses 1996 income data. Table 5 shows that CPS aggregate income in 1996 was at 93 percent of NIPA benchmarks. The quality of CPS data varied widely from 53 percent for self-employment income to 102 percent for wages and salaries. Since 1990, most of the income groupings (earnings, property, and transfers) have shown a general trend toward slightly improved CPS data quality. Pensions, however, registered a 12-percentage point decline.

Earnings are a major component of income. In 2001, over \$5.3 trillion (82 percent) of the total \$6.4 trillion collected in the CPS ASEC were from earnings; 77 per-

cent were from wages and salaries alone. A recent study matched 28,213 1996 IRS tax units to fully reported 1997 CPS ASEC records. Table 6 shows how well the CPS ASEC-reported wage data corresponded with tax data by tax wage interval. Approximately equal proportions of CPS wage earners reported amounts above tax amounts as did earners reporting amounts below. The total reporting discrepancy amounted to \$210 million, or 23 percent of the \$913 million reported by these CPS households. Roemer's work with these matched data (2001) found that the CPS ASEC netted excess aggregate wages in all of the income intervals except the highest, \$150,000 and over.

### ► Conclusions

Each of the inequality measures examined using internal CPS ASEC data painted a similar picture of changing household income inequality over the 1967-2001 period. Overall, income inequality rose between 17 percent and 38 percent, depending on the measure.

The methodological changes that occurred in the 1971 and the 1994 CPS ASECs had a noticeable impact on inequality measurement. With nearly one-third of the households on the 1971 CPS ASEC having restricted incomes due to income reporting limits, income inequality may have been understated by between 15 percent to 28 percent in prior years. A much smaller percentage of households (0.3 percent) were affected by the introduction of higher income recording limits in the 1994 CPS ASEC, resulting in a possible understatement of income inequality of between 2 percent and 8 percent.

The CPS ASEC has been criticized for its inability to accurately measure income inequality because it fails to collect high-income values. A review of income inequality measures using unrestricted income values reported on the March 2000 CPS showed that processing limits only modestly affected estimates of income inequality. Removing the processing limits would increase measured income inequality by between 1 percent and 5 percent.

Restricted income information on the public-use version of the CPS ASEC causes a further reduction of measured income inequality in years prior to 1996. The

plugging of mean values for topcoded respondents beginning with the 1997 public-use CPS ASEC brought public measurement of income inequality more in line with internal measurement. The net result, however, is an overstatement of income inequality growth over the 1967-2001 period.

A review of independent benchmarks showed that the quality of the CPS ASEC income data seemed reasonable. Overall, aggregate CPS ASEC income was at 93 percent of NIPA totals. A comparison to tax returns showed that the CPS ASEC had more reported wages than on tax returns in all but the highest income categories

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► **Footnotes**

<sup>1</sup> The CPS sample size increased in 2001 from approximately 50,000 households to 78,000 to improve estimates for the State Children's Health Insurance Program.

<sup>2</sup> The ASEC was formerly known as the CPS March Income Supplement.

<sup>3</sup> People 14 years old and over prior to 1989.

<sup>4</sup> The income limits were \$9,999 for Social Security; \$5,999 for Supplemental Security Income; \$19,999 for public assistance; and \$29,999 for veterans' payments.

<sup>5</sup> The growth rates in income inequality between 1967 and 2001 for the MLD and Atkinson ( $e=.25$  and  $e=.5$ ) were not statistically different from one another.

<sup>6</sup> The growth rates from 1967 to 1989 for the Gini and Atkinson ( $e=.25$ ) were statistically different from one another, as were the growth rates for the MLD and Atkinson ( $e=.25$ ).

<sup>7</sup> Between 1989 and 1991, the Atkinson Measure with  $e=.25$  declined 2.5 percent.

<sup>8</sup> There was no difference between the MLD growth rate and the growth rates for the Atkinson  $e=0.25$  and  $e=0.5$ .

<sup>9</sup> The MLD showed a significant decline of 2.7 percent.

**Table 1. Measures of Household Income Inequality: 1967 to 2001**

Year	Inequality Measures				
	Gini Index	MLD	Atkinson		
			e=0.25	e=0.50	e=0.75
1967	0.399	0.380	0.071	0.143	0.220
1968	0.388	0.356	0.067	0.135	0.208
1969	0.391	0.357	0.067	0.135	0.209
1970	0.394	0.370	0.068	0.138	0.214
1971	0.396	0.370	0.068	0.138	0.214
1972	0.401	0.370	0.070	0.140	0.216
1973	0.397	0.355	0.068	0.136	0.210
1974	0.395	0.352	0.067	0.134	0.207
1975	0.397	0.361	0.067	0.136	0.210
1976	0.398	0.361	0.068	0.137	0.211
1977	0.402	0.364	0.069	0.139	0.213
1978	0.402	0.363	0.069	0.139	0.213
1979	0.404	0.369	0.070	0.141	0.216
1980	0.403	0.375	0.069	0.140	0.216
1981	0.406	0.387	0.070	0.141	0.220
1982	0.412	0.401	0.072	0.146	0.226
1983	0.414	0.397	0.072	0.147	0.226
1984	0.415	0.391	0.073	0.147	0.225
1985	0.419	0.403	0.075	0.151	0.231
1986	0.425	0.416	0.077	0.155	0.237
1987	0.426	0.414	0.077	0.155	0.238
1988	0.427	0.401	0.078	0.155	0.236
1989	0.431	0.406	0.080	0.158	0.239
1990	0.428	0.402	0.078	0.156	0.236
1991	0.428	0.411	0.078	0.156	0.237
1992	0.434	0.416	0.080	0.160	0.242
1993	0.454	0.467	0.092	0.178	0.266
1994	0.456	0.471	0.092	0.180	0.268
1995	0.450	0.452	0.090	0.175	0.261
1996	0.455	0.464	0.093	0.179	0.266
1997	0.459	0.484	0.094	0.183	0.272
1998	0.456	0.488	0.093	0.181	0.271
1999	0.457	0.475	0.092	0.180	0.268
2000	0.462	0.490	0.096	0.185	0.275
2001	0.466	0.515	0.098	0.189	0.282

Source: U.S. Census Bureau, Current Population Survey, selected ASEC Supplements.

**Table 2. Impact of Income Limits on Household Inequality Measures**

Year	Gini Index			MLD		
	Public Use	Old Processing Limit	New Processing Limit	Public Use	Old Processing Limit	New Processing Limit
1967	0.390	NA	0.399	0.363	NA	0.380
1970	0.394	0.334	0.394	0.363	0.299	0.370
1979	0.394	0.404	0.404	0.342	0.369	0.369
1985	0.414	0.414	0.419	0.380	0.396	0.403
1993	0.425	0.444	0.454	0.424	0.451	0.467
2001	0.464	NA	0.466	0.510	NA	0.515

  

Year	Atkinson								
	e=0.25			e=0.50			e=0.75		
	Public Use	Old Processing Limit	New Processing Limit	Public Use	Old Processing Limit	New Processing Limit	Public Use	Old Processing Limit	New Processing Limit
1967	0.065	NA	0.071	0.133	NA	0.143	0.208	NA	0.220
1970	0.065	0.049	0.068	0.133	0.104	0.138	0.208	0.169	0.214
1979	0.065	0.070	0.070	0.133	0.140	0.141	0.206	0.216	0.216
1985	0.072	0.072	0.075	0.146	0.147	0.151	0.225	0.226	0.231
1993	0.076	0.085	0.092	0.154	0.168	0.178	0.238	0.255	0.266
2001	0.094	NA	0.098	0.184	NA	0.189	0.278	NA	0.282

Source: U.S. Census Bureau, Current Population Survey, selected ASEC Supplements.

**Table 3. High Income Reporting, by Income Source: 1999**  
(Limits in dollars)

Income Source	Questionnaire Limit	Processing Limit	Number of cases with reported values exceeding the processing limit	Number of cases with imputed values exceeding the processing limit
Earnings	9,999,999	1,099,999	26	7
Interest	9,999,999	99,999	19	54
Dividends	9,999,999	100,000	23	21
Rent	9,999,999	99,999	26	14
Retirement	999,999	99,999	26	NA

Source: Roemer 2001.

NA not available.

**Table 4. Household Income Inequality Measures by Presence of Income Reporting Limits: 1999**

Inequality Measure	With processing limits	Without processing limits	Percent change
Gini index	0.457	0.462	1.1
MLD	0.475	0.484	1.9
Atkinson:			
e=0.25	0.092	0.097	5.4
e=0.50	0.180	0.186	3.3
e=0.75	0.268	0.274	2.2

Source: Roemer (2001)



**Table 5. March CPS as a Percent of National Income and Product Account Benchmarks: 1990 to 1996**

Income Source	1990	1991	1992	1993	1994	1995	1996
Wages and Salary	95.9	96.4	95.6	99.7	101.9	101.4	101.9
Self-Employment	68.5	65.3	58.6	58.9	54.8	48.5	52.6
<b>Earnings</b>	<b>93.0</b>	<b>93.0</b>	<b>91.3</b>	<b>94.8</b>	<b>96.4</b>	<b>95.1</b>	<b>96.1</b>
Interest	67.1	68.3	67.6	79.7	72.3	83.9	83.8
Dividends	40.9	45.7	49.2	54.3	54.6	62.6	59.4
Rent and Royalties	85.0	74.1	69.8	65.2	64.8	58.7	58.6
<b>Property</b>	<b>62.8</b>	<b>63.3</b>	<b>63.2</b>	<b>69.8</b>	<b>65.7</b>	<b>72.9</b>	<b>70.9</b>
Social Security and Railroad Retirement	90.6	88.6	87.1	87.8	92.3	92.0	91.7
Supplemental Security Income	78.9	84.6	75.5	84.2	78.0	77.1	84.2
Family Assistance	74.4	74.4	72.2	76.4	73.1	70.5	67.7
Other Cash Welfare	85.6	77.5	81.6	101.3	105.2	95.8	80.5
Unemployment Compensation	79.9	82.5	72.8	77.6	90.0	91.3	81.6
Worker's Compensation	89.5	89.1	82.5	77.0	77.7	69.3	62.7
Veterans' Payments	73.9	82.9	77.7	85.5	84.7	94.9	89.6
Transfers	<b>87.6</b>	<b>86.8</b>	<b>83.6</b>	<b>85.6</b>	<b>89.5</b>	<b>89.2</b>	<b>88.3</b>
<b>Pensions</b>	<b>88.9</b>	<b>85.5</b>	<b>83.1</b>	<b>83.6</b>	<b>83.1</b>	<b>78.2</b>	<b>76.6</b>
<b>Total</b>	<b>89.3</b>	<b>89.4</b>	<b>88.0</b>	<b>91.7</b>	<b>92.9</b>	<b>92.2</b>	<b>92.6</b>

Source: Roemer 2000.

**Table 6. Comparison of Fully Reported CPS Wages and Matched IRS Tax Return Wages: 1996**  
(Includes both filers if joint return)

Tax Return Wage Range	Number of Tax Units	CPS below Tax Return (%)	CPS above Tax Return (%)	Total Discrepancy (thousands of dollars)	Share of Discrepancy (%)
Total	28,213	49.7	50.3	210,055	100.0
Zero	476	0.0	100.0	12,952	6.2
1 to 2,499	2,160	62.0	38.0	4,524	2.2
2,500 to 4,999	1,991	58.0	42.0	6,799	3.2
5,000 to 9,999	3,030	54.8	45.2	13,411	6.4
10,000 to 14,999	2,807	52.6	47.4	14,341	6.8
15,000 to 19,999	2,488	52.1	47.9	10,938	5.2
20,000 to 29,999	4,237	47.6	52.4	22,623	10.8
30,000 to 39,999	3,112	47.6	52.4	21,032	10.0
40,000 to 49,999	2,394	43.9	56.1	16,834	8.0
50,000 to 59,999	1,733	44.0	56.0	14,603	7.0
60,000 to 74,999	1,730	44.9	55.1	17,176	8.2
75,000 to 99,999	1,189	43.1	56.9	15,258	7.3
100,000 to 149,999	589	49.6	50.4	13,795	6.6
150,000 and over	277	69.7	30.3	25,769	12.3

Source: Roemer 2001.