Data Quality for the 2010 Survey of Labour and Income Dynamics (SLID)

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Table of contents

1. Introduction

The Survey of Labour and Income Dynamics (SLID) is a longitudinal survey initiated to produce estimates starting in 1993. The survey was designed to measure changes in the economic well-being of Canadians as well as the factors affecting these changes. The target population consists of all persons living in Canada with the following exclusions: persons living in Yukon, the Northwest Territories, and Nunavut, persons living on Reserves, persons living in institutions, and military personnel living in barracks.

The SLID sample is comprised of two panels. Each panel remains in the survey for six consecutive years and a new panel is rotated in every three years. In January following the reference year, SLID sample households are interviewed by telephone. Demographic information is collected for every person in the household while income, education and labour data are collected for every person in the household 16 years or older.

Before reference year 2004, respondents could be contacted for a January interview and a May interview. The May interview was used to collect income data for respondents who did not give permission to link to their income tax records. Since 2004, however, the May interview was dropped in order to save on collection costs. Therefore, all questions are being asked in the January interview. The respondent can grant permission to Statistics Canada to link to the T1 tax file, which will eliminate the necessity to go ahead with the second part of the interview.

Although originally designed as a longitudinal survey, SLID has always maintained the capability of producing cross-sectional estimates. This cross-sectional aspect took on new importance with the cancellation of the Survey of Consumer Finance after the 1997 reference year. At this time SLID became the primary source of cross-sectional household and family income data.

All persons who are members of selected SLID households in the first year of a panel's existence are longitudinal sample persons for SLID. As such, it is these individuals that are followed longitudinally. Any (non-longitudinal) person living in a household with a longitudinal person is referred to as a cohabitant. Cohabitants living with cross-sectionally eligible longitudinal persons will also be part of the cross-sectional sample.

For more information about survey concepts, definitions and design please refer to Statistics Canada publication: "*Survey of Labour and Income Dynamics - A survey overview*", http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?lang=eng&catno=75F0011X.

Sample surveys are subject to errors. As with all surveys conducted at Statistics Canada, considerable time and effort is taken to control such errors at every stage of the Survey of Labour and Income Dynamics. Nonetheless errors do occur. It is the policy at Statistics Canada to provide users with measures of data quality so that the user can interpret the data properly. This report summarizes these quality measures for SLID.

The following table presents highlights of data quality indicators for Canada for reference year 2010.

Table 1.1. Main SLID quality indicators for Canada, 2010

Indicator	Statistic
Longitudinal sample size	
• Panel 5	42,330
• Panel 6	40,912
Cross-sectional sample size (eligible longitudinal and cohabitants)	
• Panel 5	31,885
• Panel 6	31,739
Coefficient of variation	
• Median total income	0.8%
Slippage rate - person	13.5%
Slippage rate - household	
• Household size 1	8.4%
• Household size 2	13.0%
• All household	11.8%
Response rate	
• Cross-sectional - person	66.0%
• Cross-sectional - household	67.3%
• Longitudinal - person	
o Panel 5	67.2%
o Panel 6	71.9%
Permission rate	
• Panel 5	90.2%
• Panel 6	86.6%
Tax linkage rate (SIN found)	95.1%
Imputation rate - person	
• Total imputation	2.6%
• Partial imputation	20.9%
Imputation rate - household	
• Partial imputation	39.6%

2. Sample composition/attrition

Table 2.1 and 2.2 below show the breakdown of the 2010 longitudinal sample by province and CMA. Note that the province and CMA is available for in-scope respondents only.

Table 2.1. Longitudinal sample sizes, by province and panel, 2010

Province	Panel 5	Panel 6
Newfoundland	1,231	1,193
Prince Edward Island	743	794
Nova Scotia	1,646	1,533
New Brunswick	1,582	1,555
Quebec	4,867	5,153
Ontario	7,369	8,241
Manitoba	1,778	2,015
Saskatchewan	1,878	2,039
Alberta	2,685	2,829
British Columbia	2,321	2,967
N/A[1]	16,230	12,593
Total	**42,330**	**40,912**

1. This includes individuals who are in-scope non-respondents, moved to Yukon, Northwest Territories or Nunavut, moved outside Canada, are institutionalized, deceased, removed from the sample or were erroneously included.

Table 2.2. Longitudinal sample sizes, by Census Metropolitan Area and panel, 2010

Census Metropolitan Area	Panel 5	Panel 6
Halifax	502	651
Quebec City	409	418
Montréal	1,032	1,052
Ottawa - Gatineau	729	940
Toronto	1,337	1,490
Hamilton	340	442
St. Catharines - Niagara	311	407
Kitchener	383	361
London	413	453
Windsor	259	351
Winnipeg	952	1,142
Calgary	564	620
Edmonton	844	716
Vancouver	844	1,078
Victoria	218	426
Other CMA or CA	9,343	10,070
Not a CMA	7,620	7,702
N/A[1]	16,230	12,593
Total	**42,330**	**40,912**

1. This includes individuals who are in-scope non-respondents, moved to Yukon, Northwest Territories or Nunavut, moved outside Canada, are institutionalized, deceased, removed from the sample or were erroneously included.

The cross-sectional sample is composed of in-scope longitudinal respondents and non-longitudinal persons living with these longitudinal respondents (“cohabitants”). The breakdown of the 2010 cross-sectional sample by province is given in the table below.

Table 2.3. Number of people in the cross-sectional sample, by province and panel, 2010

	In-scope longitudinal respondents		Cohabitants		Cross-sectional sample size	
Province	**Panel 5**	**Panel 6**	**Panel 5**	**Panel 6**	**Panel 5**	**Panel 6**
Newfoundland	1,231	1,193	243	127	1,474	1,320
Prince Edward Island	743	794	159	70	902	864
Nova Scotia	1,646	1,533	343	188	1,989	1,721
New Brunswick	1,582	1,555	360	187	1,942	1,742
Quebec	4,867	5,153	1,238	625	6,105	5,778
Ontario	7,369	8,241	1,478	962	8,847	9,203
Manitoba	1,778	2,015	365	253	2,143	2,268
Saskatchewan	1,878	2,039	441	261	2,319	2,300
Alberta	2,685	2,829	700	444	3,385	3,273
British Columbia	2,321	2,967	458	303	2,779	3,270
Total	**26,100**	**28,319**	**5,785**	**3,420**	**31,885**	**31,739**

The cross-sectional SLID sample coverage is maintained through the addition of cohabitants each year. The one exception is immigrants who arrive after the beginning of one panel but before the start of the next one and who move into their own households; this introduces a small amount of under coverage. The longitudinal sample, however, is subject to attrition. Attrition is the gradual loss of respondents each year through the life of the panel.

3. Sampling errors

Sampling errors occur because inferences about the survey population are based on data from a sample of that population rather than the entire population. The sample design, the variability of the characteristic being measured, and the sample size will all contribute to the magnitude of the sampling error.

The standard error is a common measure of sampling error. The standard error measures the degree of variation introduced in estimates by selecting one particular sample rather than another of the same size and design. Another widely used measure of sampling error is the coefficient of variation (CV), which is the estimated standard error expressed as a percentage of the estimate.

In SLID, the bootstrap approach is used for the calculation of standard errors. SLID uses a multi-stage survey design and calibration, which means that there is no simple formula that can be used to calculate variance estimates. Therefore, an approximate method was needed. The Rao-Wu bootstrap method, described in their 1987 paper: Resampling inference with complex survey data. *Journal of the American Statistical Association, 83, 231-241*, is used because the sample design and calibration needs to be taken into account when calculating variance estimates. The method can be described as follow:

Independently, in each stratum, a simple random sample of $(n-1)$ of the n units in the sample is selected with replacement. Note that since the selection is with replacement, a unit may be chosen more than once. This step is repeated R times to form R bootstrap samples. For each of the R bootstrap samples, bootstrap weights are calculated for each unit in the bootstrap sample (units not selected in a given bootstrap sample are assigned a weight of zero). These bootstrap weights are based on the initial sample design weight, the number of times a given unit has been selected and the initial sample size as well as the bootstrap sample size. These weights are then adjusted according to the same weighting process as the regular weights: non-response adjustment, calibration, etc. The entire process (selecting simple random samples, recalculating weights for each stratum) is repeated several times, yielding R different bootstrap weights for each unit in the original sample. SLID uses $R=1{,}000$, to produce 1,000 bootstrap samples with 1,000 potential different weights for each unit. The variation among the 1,000 possible estimates based on the 1,000 bootstrap weights are related to the variance of the estimator based on the regular weights and can be used to estimate it.
Table 3.1 gives CVs for various cross sectional estimates at the provincial and national level for selected SLID estimates.

Table 3.1. National and provincial coefficients of variation for selected variables, 2010

Variable (at the family-level unless otherwise indicated)	**NL**	**PEI**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**Canada**
Median total income	3.3	3.6	1.8	2.7	1.3	1.7	2.7	2.0	1.9	2.4	0.8
Median market income	4.5	4.2	2.7	3.2	1.9	1.5	2.9	2.2	2.0	2.8	1.0
Median wages and salaries	5.8	4.0	3.1	3.1	1.8	2.0	3.6	2.9	3.1	3.0	1.0
Median EI benefits	5.4	6.3	6.5	7.5	6.0	7.2	7.9	14.8	9.5	8.8	3.8
Median social assistance	13.1	15.1	10.8	9.2	6.2	6.7	7.6	33.0	6.9	7.5	4.8
Median other income	15.8	20.9	8.7	16.3	11.4	9.7	17.6	10.5	15.4	7.7	4.9
Number of persons under LICO after tax	15.8	19.3	8.8	10.0	6.0	6.3	9.9	10.6	11.2	7.2	3.2
Number of persons with some employment[1]	2.1	2.6	1.7	1.6	1.2	1.5	1.8	1.7	2.4	2.0	0.7

1. This includes individuals who were:
- employed all year,
- employed part-year and unemployed part-year,
- employed part-year and not in the labour force part-year, or
- employed, unemployed and not in the labour force during the year.

As Prince Edward Island has the smallest sample size, the highest CVs for a particular variable can be found in that province. For the median EI benefits and the median social assistance, the largest CV has been recorded in Saskatchewan.

4. Coverage errors

To produce good survey estimates, it is necessary that a survey sample adequately represents the survey population. To ensure proper coverage, SLID weights are adjusted using census population projections as control totals. The slippage rate is a measure of the percentage difference between these census projections and the survey estimate using

weights prior to the application of this slippage related adjustment (calibration). More precisely, slippage is computed as

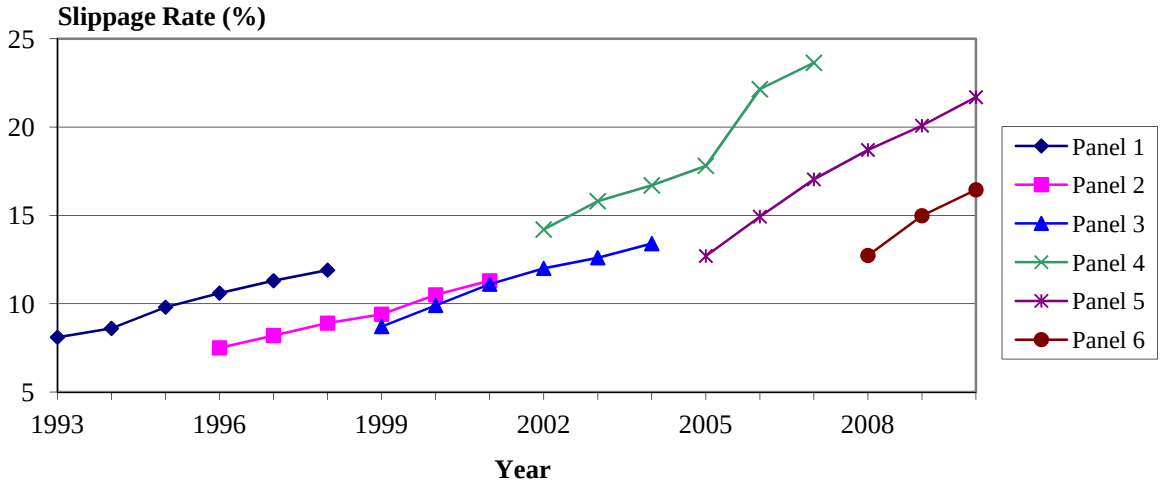
$$slippage_c = \frac{\left(CP_c - \sum_{k \in S_c} w_{kc}\right)}{CP_c} * 100$$

where Class C is the group or class for which slippage rates are required. For example, the group could be based on province, sex and/or age group.
CP_C is the census population projection for class C
w_{kc} is the survey weight before calibration for k^{th} responding unit in class C
S_C is the set of responding sample households in class C

Slippage rates for household surveys are generally positive because of frame under coverage.

Slippage rates at the person-level are given by panel and reference year in Figure 4.1 and by province for reference year 2010 in Table 4.1.

Figure 4.1. Person-level slippage rates, by reference year and panel



As can be seen in Figure 4.1, the slippage rate for all panels is always increasing between the first and the last wave, while the slippage rate for panels 4, 5 and 6 increases more rapidly than that for panels 1, 2 and 3 does. Panels 4, 5 and 6 have a higher slippage rate than panels 1, 2 and 3 at the first wave. The slippage rate for all panels after 2005 (excluding 2005) is computed, using the census projections based on Census 2006. This may explain a strong increase for panel 4 between 2005 and 2006 since the census projections based on Census 2001 were used for panel 4 in 2005.

The higher person-level and household-level (see Figure 4.1 and 4.2) slippage rates for Panel 4 are due, in part, to an improper enumeration of households selected for the SLID sample that did not appear on the sample file. At the beginning of a panel, it is believed that the effort to obtain a response from some households would be too high to send them to data collection. As a result, they are generally deemed non-respondents for the

duration of the panel. The increase in slippage due to the omission of these non-respondent households is estimated to be approximately 2%. However, the impact on survey estimates should be negligible as the error is corrected in part through the calibration of the final weights to census projections.

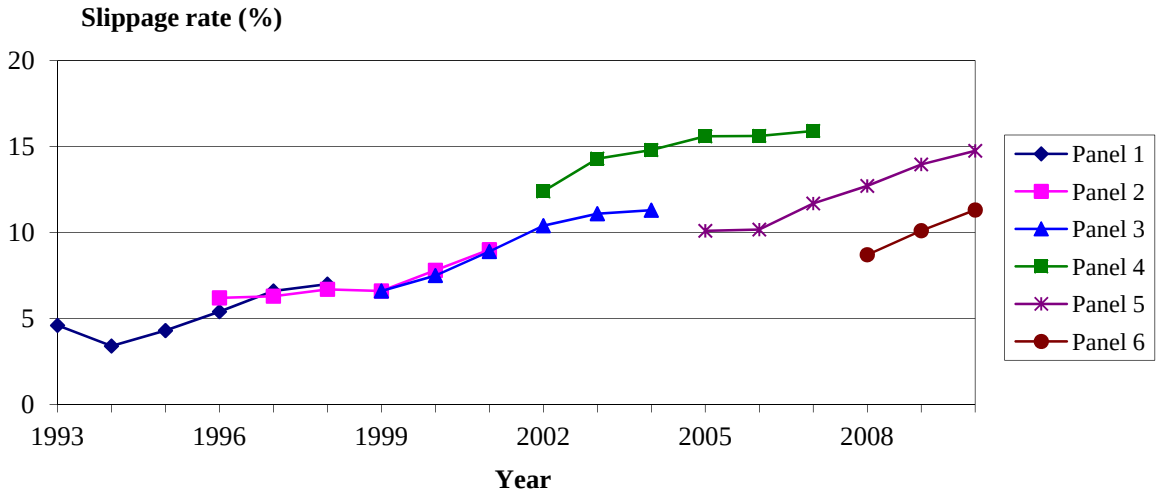
Table 4.1 shows that the highest person-level slippage rates can be found in Alberta and British Columbia.

Table 4.1. Person-level slippage rates by province, 2010

NL	PEI	NS	NB	QC	ON	MB	SK	AB	BC	Canada
-1.8	6.0	0.1	7.7	4.9	15.6	4.5	6.0	22.9	24.5	13.5

Slippage rates were also computed at the household-level; Figure 4.2 gives these rates by reference year and panel while Table 4.2 gives the slippage rates by province and household size.

Figure 4.2. Household-level slippage rates, by reference year and panel



The general trend that emerges in Figure 4.2 is that with the exception of one wave in panels 1 and 2 the slippage rate increases between one wave and the next.

Table 4.2. Household-level slippage rates by province and household size, 2010

	Household Size		
Province	**1**	**2**	**All**
Newfoundland	-6.6	-5.8	-2.2
Prince Edward Island	13.3	3.6	6.3
Nova Scotia	-4.5	1.1	-1.4
New Brunswick	-2.3	3.5	4.8
Quebec	-1.7	1.5	2.0
Ontario	13.5	18.5	14.9
Manitoba	6.9	5.3	4.5
Saskatchewan	7.4	6.5	6.8
Alberta	13.5	24.2	21.5
British Columbia	19.3	21.7	22.5
Canada	**8.4**	**13.0**	**11.8**

As with the person-level slippage rates, the highest household-level slippage rates can be found in Alberta and British Columbia.

5. Response rates

Since SLID has taken on the role of both a longitudinal and a cross-sectional survey, both types of response rates are calculated. Cross-sectional response rates are calculated at the person-level and at the household-level. Since sample persons have the option of giving tax permission and thereby avoiding the income questions, it is possible to have complete income data with no actual contact being made during the reference year. As a result, the definition of a non-respondent is not straightforward.

If all persons in a household are non-respondent to both labour and income questions, then these persons (and households) are non-respondents.

With respect to those persons in households which are non-respondent to the labour questions but for whom we have tax data, we determine whether the person is in the same household as in the previous year (as of December 31). If the household is different, this means that the person has left the original household. Since we have no information on the composition of the new household such persons are defined to be non-respondents.

Persons in households which are non-respondent to the labour questions but for whom we have income data and for whom the household has not changed from the previous year are considered to be non-respondents if the household was a non-respondent to the labour questions the previous January. Since updates to household composition are collected with the labour questions, this means that the household composition has not been updated for 2 consecutive years. Persons in households that have been non-respondent to labour questions for 2 consecutive January collections are therefore considered to be non-respondents to SLID.

Non-response can potentially introduce a bias in the data. A bias is created if characteristics of respondents differ from those of non-respondents and this difference has an impact on the variable being studied. It is difficult to determine whether non-response is introducing bias

because there is a limited amount of information for non-respondents. Table 5.1 gives the 2010 status for persons originally selected for the longitudinal sample for panels 5 and 6. The responding longitudinal sample is comprised of in-scope respondents, individuals who have moved to Yukon, the Northwest Territories or Nunavut, individuals who have moved outside Canada, institutionalized individuals and deceased individuals.
While the total number of persons in panels 5 and 6 are very similar, there are major differences between the two panels when looking at the longitudinal status. The proportion of non-respondents in panel 6 is much higher than that in panel 5. The number of people who were removed from the sample is considerably larger in panel 5 as a result of many households that could not be traced and several which were hard refusals. This is not an unexpected result given that panel 5 was into its last wave in 2010.

Table 5.1. Number of people in the longitudinal sample, by status and panel, 2010

Person status for the longitudinal sample	Panel 5	Panel 6
In-scope (respondents)	26,100	28,319
In-scope (non-respondents)	4,528	6,326
Moved to Yukon, NWT, Nunavut	9	9
Moved outside Canada	275	134
Institutionalized	649	323
Deceased	1,409	634
Removed from sample[1]	9,344	5,166
Duplicate person/error[2]	16	1
Total	**42,330**	**40,912**

1. Respondents are removed from the sample for one of two reasons. If entire households have refused for two consecutive cycles they are said to be hard refusals and no further attempts are made to enumerate these households. Similarly, if households cannot be traced for two years then they are no longer pursued.
2. Respondents who were erroneously included in the household in the first year of a panel's existence.

Figure 5.1 shows the cross-sectional person-level response rates for SLID by reference year. The person-level response rates are calculated by dividing the number of cross-sectionally eligible respondents to the labour and/or income questions by the total number of cross-sectional people. An assumption is made that non-respondents are still in the target population unless there is evidence to the contrary. As a result, this may somewhat underestimate response rates.

Figure 5.1. Cross-sectional person-level response rates, by reference year

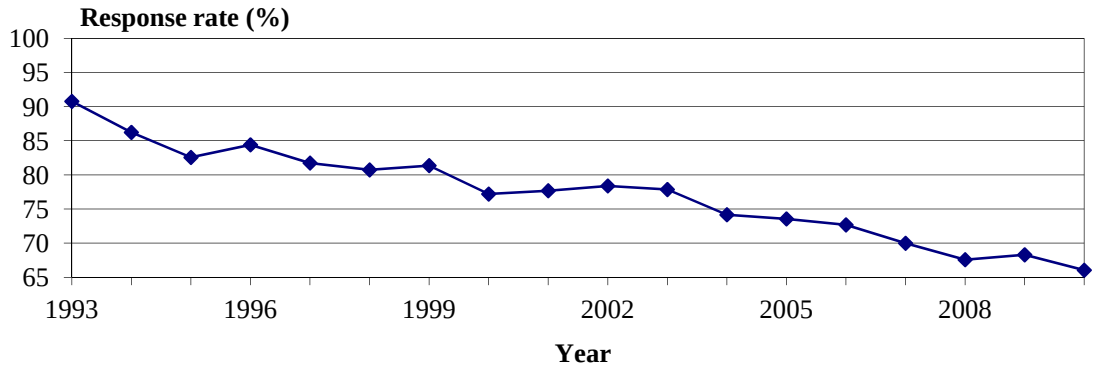
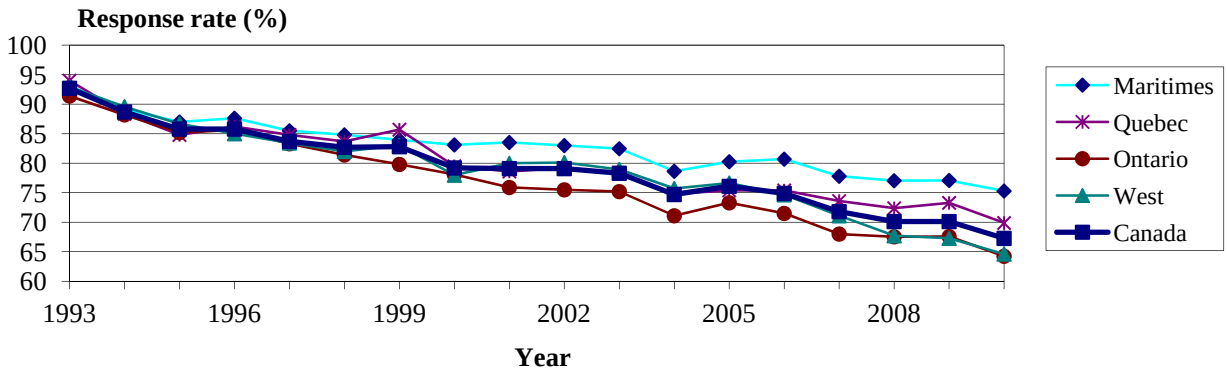


Figure 5.1 clearly illustrates that the person-level response rate has been declining since the start of the survey except for small increases in 1996, 1999, 2002 and 2009. The rate was at 90.8% in 1993 and has dropped to 66.0% in 2010.

Figure 5.2 presents the cross-sectional household response rates by region. A household is considered to be a respondent household if at least one person in that household is a respondent. Household-level response rates are calculated by dividing the number of cross-sectionally eligible respondent households by the total number of cross-sectionally eligible households. Once again the assumption is made that non-respondent households are still in the target population unless there is evidence to the contrary; this may somewhat underestimate response rates.

Figure 5.2. Cross-sectional household-level response rates, by reference year and region



The above graph also shows declining response rates over the years with a significant decrease in 2004. The rates increased slightly in 2005 but dropped afterwards falling to a low of 67.3% in 2010 at the Canada-level. In general, the Maritimes had the highest response rates while Ontario had the lowest.

Table 5.2 shows the person-level response rates by phase. 'Respondents to Labour Questions Only' and 'Respondents to Income Questions Only' reflect the proportion of

those who responded to only the labour or income sets of questions respectively whereas the 'Respondents to Both Labour and Income Questions' is the proportion of all those who responded in full or in part to both sets of questions.

Table 5.2. Cross-sectional person-level response rates, by reference year[1] and phase

Year	Respondents to Both Sets of Questions	Respondents to Labour Questions Only	Respondents to Income Questions Only	Non-response
1993	75.6	10.3	6.2	7.9
1994	75.1	10.5	2.8	11.6
1995	71.7	10.0	3.3	14.9
1996	71.6	10.8	2.9	14.6
1997	68.9	12.2	2.2	16.7
1998	68.8	10.4	2.6	18.2
1999	65.5	13.6	2.5	18.5
2000	56.1	17.3	4.6	22.0
2001	63.3	10.4	4.1	22.2
2002	61.6	10.8	5.4	22.2
2003	63.9	7.9	5.4	22.9
2004	62.3	5.8	5.1	26.8
2005	62.1	8.3	2.9	26.7
2006	59.3	7.2	6.0	27.5
2007	56.9	7.0	5.8	30.4
2008	56.4	7.2	3.9	32.5
2009	55.9	6.3	6.0	31.9
2010	53.7	5.7	6.2	34.4

1. Since reference year 2004, labour and income questions are both asked during the January interview.

As in Figure 5.1, Table 5.1 shows a general decline in the response rate for persons who responded to both the labour and income questions. The highest rate was recorded in the first year of the survey (75.6%) and the lowest in the most recent year (53.7%). Also, the proportion of non-respondents was at its lowest when the survey began in 1993 (7.9%) and then rose constantly to reach its maximum in 2010 (34.4%). This proportion decreased slightly in 2005 and 2009.

However, if we analyse rates for respondents who answered only one series of questions, the trend is different. For the labour questions, with the exception of 1997, 1999 and 2000, the rate stayed around 10% between 1993 and 2002. Since then, it has decreased significantly to a rate between 5.8% and 8.3%. For the income questions, after remaining stable between 1994 and 1999, the rate doubled and has been stable since then between 3.9% to 6.2% for all years except in 2005 when the rate dropped to 2.9%.

Due to the conceptual difficulty in defining a longitudinal household, only person-level longitudinal response rates are calculated. Table 5.2 gives person-level longitudinal response rates for all six panels. These rates are calculated by dividing the number of longitudinal respondents by the original number of longitudinal persons selected in the panel.

Table 5.2. Longitudinal person-level response rates, by panel and wave

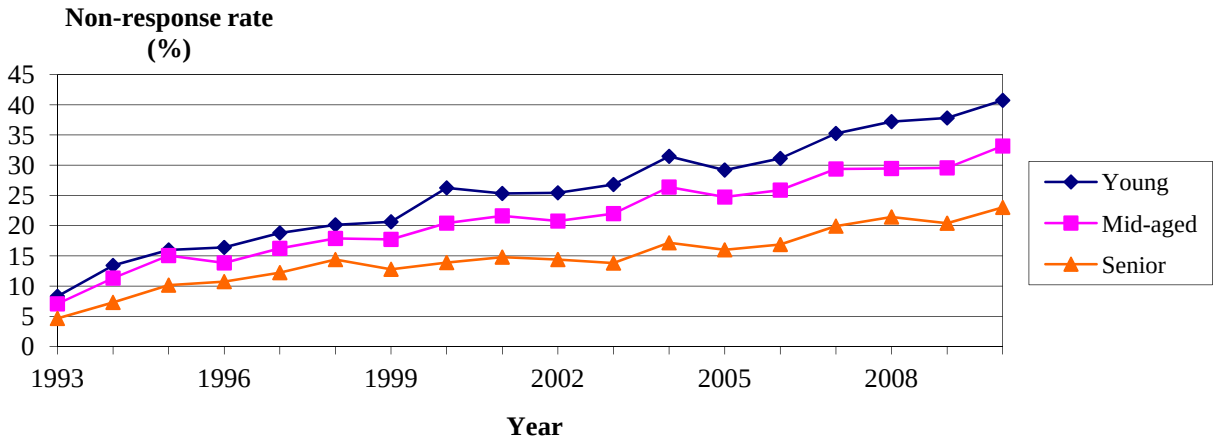
	Wave of panel					
Panel (first year of panel)	**1**	**2**	**3**	**4**	**5**	**6**
Panel 1 (1993)	93.3	89.6	86.5	83.9	82.6	81.5
Panel 2 (1996)	89.5	86.8	85.2	82.7	78.5	77.4
Panel 3 (1999)	83.9	83.0	83.0	79.6	76.4	73.7
Panel 4 (2002)	81.2	83.2	78.3	75.0	71.6	68.9
Panel 5 (2005)	78.8	80.6	77.3	72.8	69.3	67.2
Panel 6 (2008)	71.0	75.6	71.9	…	…	…

… Not applicable

Table 5.2 shows a declining trend in the longitudinal response rate. Not only does the longitudinal response rate drop over the life of the panel, it is also lower for each successive panel. For example, the rate went from 93.3% in wave 1 to 81.5% in wave 6 for the first panel while it dropped from 78.8% in wave 1 to 67.2% in wave 6 for the fifth panel. The rates are even lower for the first waves of panel 6.

Figure 5.3 shows the longitudinal non-response rates by reference year and age group. 'Young' is defined as those people between the ages of 16 and 29, 'Mid-aged' are between the ages of 30 and 59 and 'Senior' are at least 60 years of age. Age groups are defined at the beginning of the panel.

Figure 5.3. Longitudinal person-level non-response rates, by reference year and age group



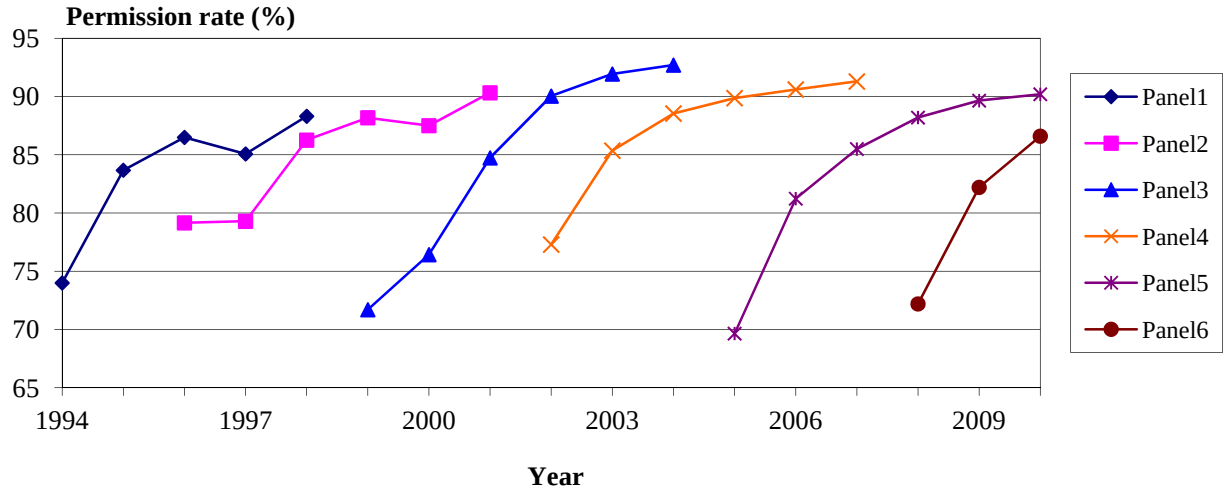
In looking at Figure 5.3, it is clear that there is an increase in non-response for all age groups. The non-response rates have quadrupled in the 18 years that SLID has been conducted. Young people, those between 16 and 29 years of age, have a non-response rate almost twice that for the seniors. In particular, in 2010, 40.7% of young people did not respond to the survey compared to 23.0% for senior citizens. This is not surprising given that, in general, young people are more difficult to reach than seniors who are more likely to be at home.

6. Tax permission rates

Prior to reference year 2004, there were two interviews conducted every year. In January, the interview concerned activities such as working, going to school, looking for work or retirement. The second interview in May involved income, but respondents would not be contacted if they had given Statistics Canada permission to obtain the required data from tax records. The tax source should provide consistent data of high quality; thus, a high permission rate should ensure good quality income estimates. Statistics Canada was asking the respondent for this permission at the end of the January interview. If this was refused, the respondent would be contacted again in May. At the May interview, the respondent was once again asked if he/she would prefer to give permission to access tax records. If the request was rejected, the interview proceeded. Starting in reference year 2004, permission was asked only once, in January. If the respondent declined, the interview continued immediately with the income questions.

Figure 6.1 shows permission rates by reference year and by panel. The option to give tax permission was implemented for the May collection for the 1994 reference year. Prior to this, all income data were collected through interview. The figures are based on the number of respondents over the age of 15 who are cross-sectionally eligible. Permission from the respondent is obtained once for the duration of the panel. Therefore, the cumulative effect of the permission rate may hide the effort made annually at the collection stage to obtain permission from new respondents.

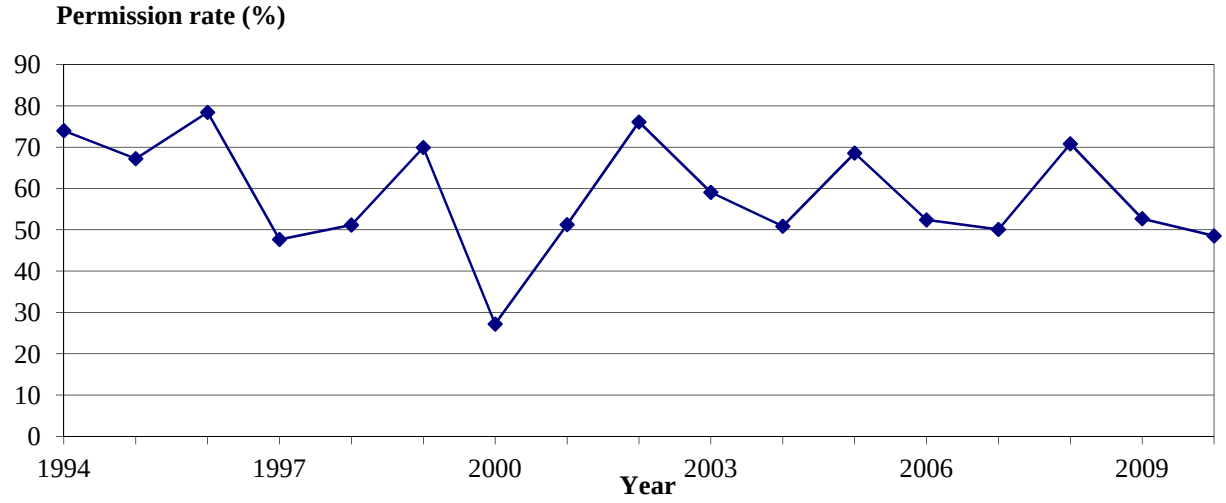
Figure 6.1. Permission rates, by reference year and panel



A similar trend appears for all panels in the annual permission rates. There is a strong increase in the rate in the first three waves (except for the second wave of the second panel where the rate remained stable). Permission rates continued to rise but less dramatically in the last three waves. There even was a decrease in the permission rate between the 4th and the 5th wave for the first two panels but an increase for the last wave.

Figure 6.2 below shows permission rates by reference year for new eligible respondents.

Figure 6.2. Permission rates for new respondents by reference year (%)



The permission rate for new respondents fluctuated dramatically; it varied between 27.2% in 2000 to 78.4% in 1996. The years in which new panels had been introduced (1996, 1999, 2002, 2005 and 2008) always had the highest permission rates for new respondents.

7. Tax linkage rates

While respondents may grant Statistics Canada permission to use their tax data, they are not asked for their Social Insurance Number (SIN). Without a SIN to identify SLID respondents on the tax file, it is necessary to perform a probabilistic match to obtain a respondent's SIN.

The first step is to standardize matching variables on the SLID and tax files to ensure that the formats are compatible. This process includes the removal of all spaces from the address field and the use of phonetic coding such as NYSIIS and SNDX[1]. The standardized variables that are available for the linkage process are: address, city, date of birth, first name, surname, sex, province, NYSIIS and SNDX code for surname, postal code, marital status, telephone number and first initial.

A SAS program developed at Statistics Canada compares data from the two data sources (tax and SLID). In order to make the match more manageable SLID and tax records are grouped into "pockets" based on date of birth, postal code and SNDX code for surname. Every SLID record within a pocket is compared to every tax record in the same pocket. A weight is assigned based on the likelihood that a pair of records (one from SLID and one from tax) represents the same person. Thresholds are defined whereby a pair is

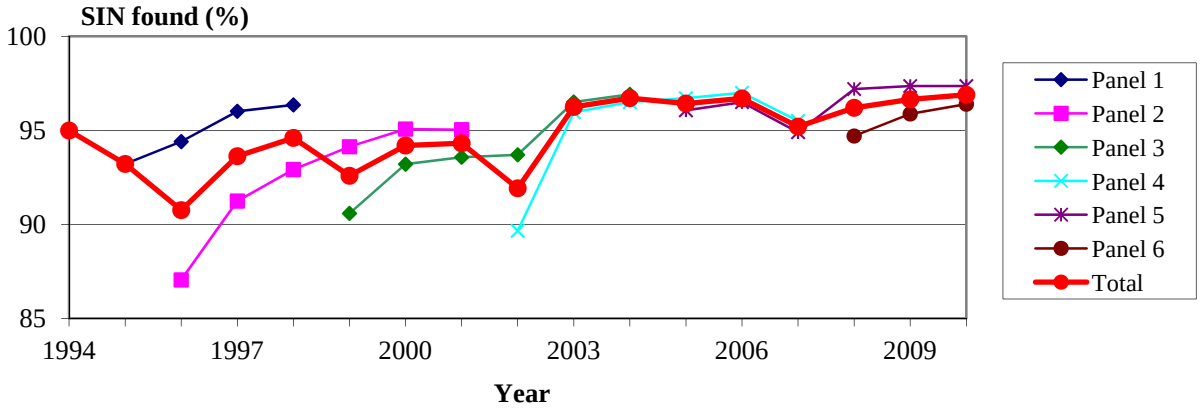
[1]. NYSIIS and SNDX are name coding routines used to remove common spelling errors from the surnames of respondents. This encoding is based on the sound of the surname.

deemed to be a definite match if the weight is greater than the upper threshold or to be a definite non-match if the weight is below the lower threshold.

The linkage of SLID records is undertaken twice for each processing cycle: once to the final tax file for the previous reference year and then again to the preliminary tax file for the current reference year. For potential matches, there are nine possible outcomes depending on whether a definite match or a questionable match (i.e. neither a definite match nor a definite non-match) has been made between a SLID record and a tax record (final and/or preliminary). The result is that potential matches are accepted or are manually reviewed. It is possible that two SLID records may be linked to the same SIN; duplicates are resolved at the end of the linkage process.

The newly obtained SINs are then used to obtain tax information for those SLID respondents who gave permission to access their tax data. Figure 7.1 gives the proportion of SLID respondents who gave tax permission for which a SIN could be found. As some respondents who gave tax permission had not filed a tax return, not all cases in which a SIN is found will result in a successful tax linkage.

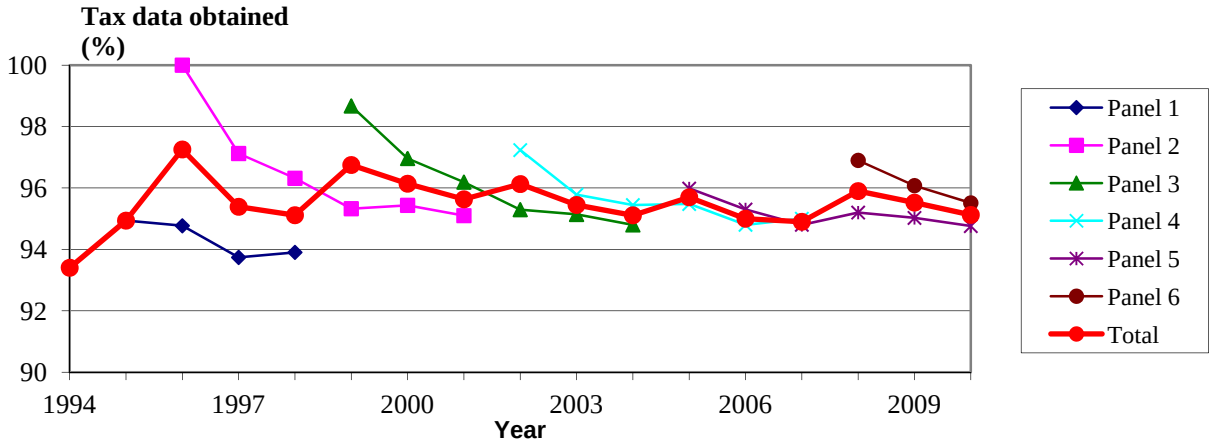
Figure 7.1. Percentage of people giving permission for which a SIN was found, by reference year and panel



In general, the proportion of respondents giving permission and for which a SIN was found showed an increasing trend over the six waves for all panels. Large increases were observed between the 1st and the 2nd wave of each panel but the increases were less pronounced for subsequent waves. Between the 5th and 6th wave, the rate stabilized and it actually decreased slightly for a few panels.

Figure 7.2 gives tax linkage rates for those SLID respondents who gave tax permission and for whom a SIN had been successfully assigned.

Figure 7.2. Tax linkage rates when a SIN was found, by reference year and panel



The same general trend is observed for all panels in the above figure. The maximum linkage rate occurs in the first wave but then steadily declines to 95% in the last wave. As can be seen clearly in the overall rate, the linkage peaks in those years in which a new panel was introduced (1996, 1999, 2002, 2005 and 2008).

However, the initial linkage rates decreased from panel 2 through to panel 5 (it went up a bit in panel 6); it was 100% for the first wave of panel 2 but was 98.7%, 97.2% and 96.0% for the first wave of panels 3, 4 and 5 respectively. This rate increased slightly to 96.9% for panel 6.

Table 7.1. compares the proportion of records coming from tax data to those collected during telephone interviews.

Table 7.1 Proportion of respondents coming from tax or interview, by reference year[1]

Year	Tax	Interview	Other[2]
1999	71.9	12.0	16.2
2000	74.0	0.0	26.0
2001	78.9	5.0	16.1
2002	74.2	8.8	17.0
2003	81.4	5.2	13.4
2004	83.4	5.0	11.7
2005	73.6	9.8	16.6
2006	78.8	5.9	15.3
2007	79.8	4.7	15.5
2008	74.4	8.9	16.7
2009	79.3	5.8	14.9
2010	81.5	4.4	14.1

1. Excluding records not eligible for income imputation.
2. These are respondents who were not linked to tax data and who did not respond to income questions.

In the above table, it can be seen that most of the income data comes from tax records; the proportion ranged from a low of 71.9% in 1999 to a maximum of 83.4% in 2004. This figure was generally around 80% except for years where a new panel started (1999,

2002, 2005 and 2008). In the first year of a new panel, a greater proportion of income data came from interviews (between 9% and 12 %) when compared to other years (around 5%).

8. Imputation rates

To compensate for non-respondent households in the SLID sample, a non-response adjustment is applied to SLID weights. However, partially responding households are kept in the sample and any income data that is missing for individuals within respondent households is imputed. These individuals may require complete imputation of all income variables or they may require only certain fields to be imputed. Imputation rates in SLID may be thought of as a measure of partial non-response in the survey.

Two methods of imputation are used in SLID: longitudinal imputation and cross-sectional imputation. Longitudinal imputation of income uses income from the previous wave to impute income for the current wave. Cross-sectional imputation of SLID income variables uses a nearest neighbour approach. Some variables are also imputed using a deterministic approach.

For the nearest neighbour method, a set of basic consistency rules is defined and a set of consistent donors is identified for a given record requiring imputation. A set of matching variables, each of which is correlated with the variables to be imputed, is also defined. Through the combined use of a score function (for categorical matching variables) and a distance function (for numeric matching variables), the most similar consistent donor record is identified and used to impute data for the record.

The proportion of persons within responding SLID households that were subject to total or partial imputation is given in Table 8.1. Recall that a respondent SLID household is one in which at least one household member has responded partially or completely to either the labour or income questions of the survey. In total, up to eighteen income variables can be imputed during SLID income imputation. Many individuals require only partial imputation where some (but not all) income items are substituted with information from another individual.

Table 8.1. Income variable imputation rates for households, by province and imputation type, 2010

Province	Total Imputation[1]	Partial Imputation[2]	No Imputation
Newfoundland	1.3	18.7	80.0
Prince Edward Island	2.3	20.1	77.7
Nova Scotia	1.8	18.7	79.5
New Brunswick	2.5	19.1	78.4
Quebec	2.1	17.2	80.7
Ontario	3.1	23.9	73.0
Manitoba	2.6	19.8	77.6
Saskatchewan	1.8	17.8	80.4
Alberta	3.3	23.3	73.3
British Columbia	2.8	23.3	73.9
Canada	2.6	20.9	76.5

1. No information was provided by the respondent. All data items were imputed.
2. One or more data items were imputed with some information provided by the respondent.

The above table shows that more than three-quarters of the records did not require any income imputation at the Canada-level. The lowest imputation rate was found in Quebec where 80.7% of the records did not undergo any imputation. However, the highest partial imputation rates (approximately 24%) were found in Ontario.

Few records needed total imputation; the rates ranged from 1.8% to 3.3% at the province-level.

In Table 8.2, the income imputation rates were compared for tax data records and records which were collected through telephone interviews. The need for partial imputation is determined after combining responses from the labour and income questions. Inconsistencies are corrected through the imputation process. This table also gives an indication of the extent to which partial imputation was employed (1 variable, 2 to 9 variables and 10 to 17 variables).

Table 8.2. Income variable imputation rates for households, by imputation type and data source, 2010

	Data Source			
Imputation	**Tax**	**Interview**	**Other[1]**	**All**
Partial (1 variable)	8.4	12.0	0.0	7.4
Partial (2 to 9 variables)	0.4	37.8	0.0	2.0
Partial (10 to 17 variables)	0.0	0.2	…	11.5
Total imputation	…	…	100.0	2.6
No imputation	91.2	50.1	…	76.5
Total	**100.0**	**100.0**	**100.0**	**100.0**

… Not applicable.
1. Records that are not linked to tax data and do not have responses to the income questions. Some of these records are partially imputed based on the information collected from the labour questions.

The above table shows that very few of the tax records required any imputation; 91.2% of records which could be linked to tax data did not undergo any income imputation.

Imputation of one variable only was required for 8.4% of the tax records. These two scenarios cover almost all the tax records.

For records collected through interviews, approximately half required some income imputation and more than a third required partial imputation of 2 to 9 variables. This is much higher than the rates observed for tax records.

Because of non-response associated with specific questions, imputation of housing related content was introduced. Two methods of imputation were used: longitudinal imputation and cross-sectional donor imputation. The cross-sectional donor imputation method is similar to that used in income imputation and involves the use of a score function.

Table 8.3 gives the proportion of responding SLID households that underwent imputation of housing variables.

Table 8.3 Housing variable imputation rates for households, by province and imputation type, 2010[1]

Province	Total Imputation[2]	Partial Imputation[3]	No Imputation
Newfoundland	…	38.4	61.6
Prince Edward Island	…	40.8	59.2
Nova Scotia	…	33.6	66.4
New Brunswick	…	35.0	65.0
Quebec	…	33.8	66.2
Ontario	…	43.3	56.7
Manitoba	…	38.7	61.3
Saskatchewan	…	39.6	60.4
Alberta	…	42.6	57.4
British Columbia	…	43.7	56.3
Canada	**…**	**39.6**	**60.4**

1. For reference year 2010, the variable that indicated whether a dwelling was a condominium was excluded from the calculation of the partial imputation rate as there had been a change in the way this variable was defined. Keeping this variable would have artificially boosted the partial imputation rates.
2. No information was provided by the respondent. All data items were imputed.
3. One or more data items were imputed with some information provided by the respondent.

At the Canada-level, 39.6% of households needed partial imputation of housing variables. The highest rate was found in British Columbia with 43.7% of the B.C. households requiring some imputation. The lowest rate was found in Nova Scotia at 33.6%.

In total, up to eighteen variables are imputed during SLID housing imputation. A high proportion of households require only partial imputation. Table 8.4 gives a breakdown of those requiring partial imputation.

Table 8.4 Housing variable imputation rates for households, by reference year and number of variables needing imputation

	Number of housing variables needing imputation			
Year	**1**	**2 to 5**	**6 to 17[1]**	**One or More**
2004	10.5	10.2	10.6	31.3
2005	10.2	10.6	15.2	36.0
2006	10.0	7.4	22.3	39.7
2007	9.8	6.9	22.3	39.0
2008	8.8	5.9	28.4	43.1
2009	8.8	6.1	27.4	42.2
2010	8.6	5.9	25.1	39.6

1. As of RY2006, the values for the two variables indicating the type of heating fuel used in a house were set to N/A for all households. As a result, in total, only up to eighteen variables are imputed.

The number of variables needing imputation has increased annually between 2004 and 2008, while it decreases steadily since RY2008.

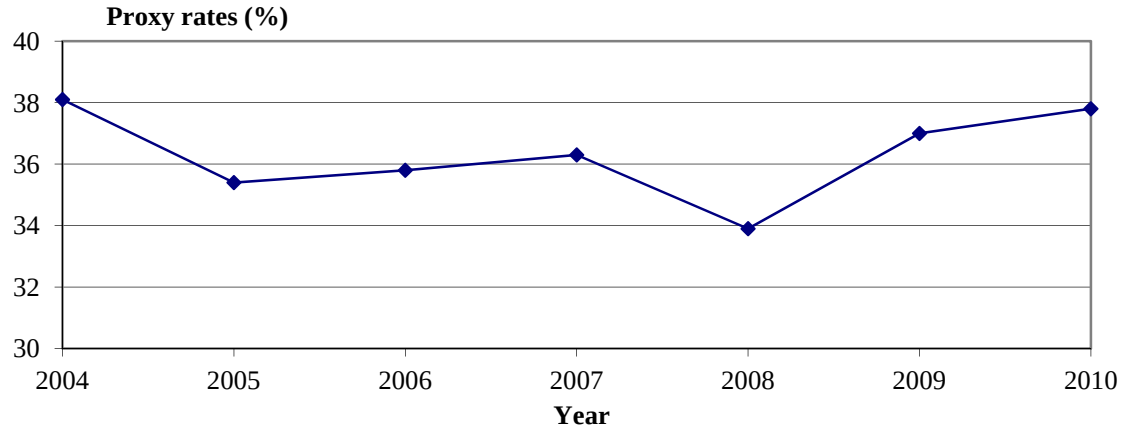
9. Proxy interview rates

A proxy interview occurs when an interviewer obtains information for a given person in the household from another household member who is willing to respond on his/her behalf. Information on the number of proxy interviews has been available since the reference year 2000. A variable is used to indicate if the interview information for a particular person was provided by proxy. Prior to the reference year 2004, respondents were interviewed twice a year, once in January and again in May so two proxy variables were created. Since reference year 2004, the May interview was dropped; therefore, only one proxy variable was created corresponding to the January interview. For comparison purposes, only the proxy rates from the reference year 2004 onwards are presented.

Proxy rates are calculated based on the number of SLID respondents aged 16 and over who furnished responses either directly or by proxy for the given reference year (overall number of respondents). Proxy rates are obtained by dividing the number of respondents by proxy by the overall number of respondents.

Figure 9.1 below shows the proxy rates starting from 2004.

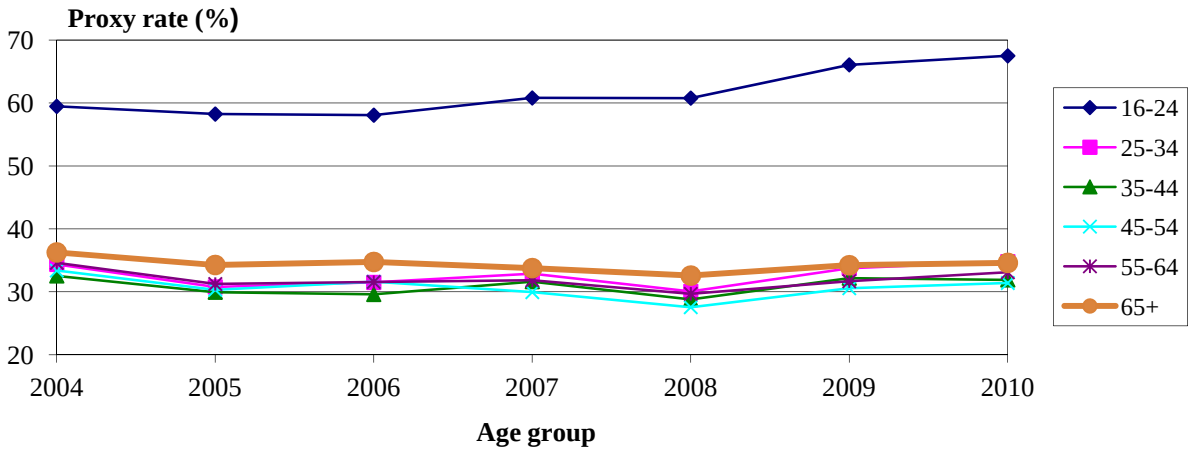
Figure 9.1 Proxy rates by reference year



The above graph shows that the proxy rate decreased from 2004 to 2005 from 38.1 % to 35.4 %. After that, there was an increasing trend until 2010, with the exception of 2008 where a minimum for the period under study was observed (33.9%).

Figure 9.2 below shows the proxy rate by age group for the reference years 2004 to 2010. In general, the same trend can be observed for each year under study. The proxy rate is very high among respondents aged 16 to 24 years, fluctuating around 60% before the reference year 2008 and increasing to 68% for 2010, while the other age groups have rates between 31% and 34%, on average. This difference can be explained by the fact that young people are more difficult to reach than the rest of the population and that most are still living with their parents who tend to respond for them. Support for this comes from the fact that, in 2010, 11% of the sample is composed of young people (age 16 to 24) which as a group has a longitudinal response rate of 63% compared to 69% for the rest of the population (age 25 or more).

Figure 9.2 Proxy rates, by reference year and age group



10. Rounding of income data

A small percentage of SLID income data is collected from telephone interviews. While data obtained from the tax file is thought to be consistent for the most part, the quality of data coming from collection is not known. While some respondents may give precise amounts, it is possible that many of the responses given are estimates or approximations and, as such, are stated in hundreds or thousands of dollars rather than precise dollars and cents.

To test for the possible presence of rounding, the distribution for each of the last four digits of reported variables were produced. The distribution would normally expect to be approximately uniform with the digits 0 to 9 each comprising about 10 percent of the distribution. A prevalence of zeroes in the last digit would indicate rounding to the nearest 10, in the second last digit rounding to 100, etc. Table 10.1 gives the distribution of each of these digits for all reported values of at least $10,000 for the wages and salaries variable from both collected data (e.g. collected by interview) and tax data.

Table 10.1 Distribution of the last four digits of wages and salaries[1], by collection mode, 2010

	Fourth last digit		Third last digit		Second last digit		Last Digit	
Digit	Collected	Tax	Collected	Tax	Collected	Tax	Collected	Tax
0	36.7	11.7	89.3	11.9	94.5	13.1	96.6	14.5
1	3.7	10.5	0.4	9.6	0.4	9.3	0.3	9.2
2	8.8	10.6	1.0	9.9	0.6	9.8	0.5	9.5
3	5.7	9.7	1.3	9.5	0.5	10.1	0.3	9.6
4	4.9	10.2	1.3	9.9	0.4	9.8	0.3	10.1
5	20.1	9.9	3.0	9.6	0.7	9.9	0.8	10.0
6	6.2	9.5	1.5	10.2	0.7	9.7	0.3	9.0
7	4.1	9.4	0.5	9.4	0.4	9.5	0.2	9.2
8	6.5	9.5	1.0	10.0	0.9	9.3	0.5	9.3
9	3.3	9.0	0.6	9.9	0.7	9.5	0.3	9.7

[1] Only for cases where the value was greater than $9,999.

Table 10.1 clearly shows that collected wages and salaries equal to or higher than $10,000 have been rounded. The third, second and last digit was a zero in 89.3%, 94.5% and 96.6% of the cases respectively for collected records while the distribution is more uniform for each of the numbers between 0 and 9 for data coming from tax records.

For the fourth last digit of collected data, a third of the records displayed a zero and 20% had a five. While these results are not as striking as for the last three digits, this is still an indication of some rounding.

Collected data was further examined to see if there was a difference between data gathered directly from the respondent and data obtained by proxy. For the wages and salary variable, the third last digit was a zero 89.1% of the time for collection by proxy and 89.4% for direct collection. In the case of the last digit, we found that it was a zero in 97.3% of the proxy cases and 96.1% directly. Similar results were observed for the other digits considered. Therefore, we conclude that the respondents whether they were

answering for themselves or providing a proxy response tended to round the reported amount of wages and salary.

Table 10.2 shows the prevalence of zeroes in each of the last 4 digits for all reported non-zero values for a selection of SLID variables.

Table 10.2 Proportion of zeroes in the last four digits declared for selected variables, 2010

	Digit			
Variable	**Fourth-last**	**Third-last**	**Second-last**	**Last**
Wages and salaries	36.7	89.3	94.5	96.6
Dividend income	17.6	35.1	76.7	86.7
EI benefits	7.5	53.3	83.9	93.5
Non-farm self-employment income	25.0	80.4	95.7	95.8

These last results generally demonstrate the constant increase in the proportion of zeroes when proceeding from the fourth last digit to the last digit. For wages and salaries and non-farm self-employment income, a higher proportion of zeroes was observed in the fourth-last, third-last and second-last digit.

For dividend income and EI benefits, there is a strong increase in the proportion of zeroes when comparing the third last digit to the second last. These increases vary from 41.6% to 30.6%.

All variables had a zero in the last digit in at least 90% of the cases except for dividend income (86.7%).