

**INEQUALITY AND POVERTY IN
ITALY: THEORETICAL MODELS
AND EMPIRICAL EVIDENCE**

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Inequality and Poverty in Italy: Theoretical Models and Empirical Evidence*

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Abstract

This study investigates the pattern of inequality and poverty in Italy in the 1980s and the 1990s, by means of both consumption and income measures, so as to separate their permanent and temporary components. The empirical analysis we conduct addresses not only economic issues, but also those of survey methodology and reliability of data.

The identification and estimation of the components of inequality are based on the model derived in Blundell and Preston (1998, 1999). We develop a Minimum Distance Estimator, and the procedure also allows us to test for correlation of the temporary and permanent shocks with the past values of income and consumption.

The model for the study of poverty is developed following the line of Chesher and Schluter (1999), and allows us not only to identify the two components but also to test if the variances of the shocks vary along the distributions of income and consumption.

For both inequality and poverty we find a slight increase of the transitory component, whereas the permanent one remains constant over the two decades.

Key-words: Income and consumption inequality; measurement error; permanent and transitory shocks; poverty.

JEL classification: D12, D31, I32, J31.

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1 Introduction

The study of welfare needs the careful distinction of its temporary and permanent aspects. Temporary fluctuations of income may hide the real, long-run, level of welfare of a household. Moreover, current income can catch the effects of depth in low-income spells, but may not be able to record differences due to the duration of the poverty period.

The centrality of the distinction of temporary and permanent inequality has been emphasised in many recent studies. The studies by Gottschalk and Moffitt (1994), Moffitt and Gottschalk (1995), Buchinsky and Hunt (1996), and Gittleman and Joyce (1996) all tackle the problem studying time series of individual incomes. Blundell and Preston (1998, 1999) highlight the value of the joint use of income and consumption measures in the identification of the temporary and permanent components, through the analysis of changes in their variances and covariance. Following their line, this study aims to investigate further the role of consumption in measurement of temporary and permanent inequality. This approach, developed in the study of inequality, is then applied in this paper also to the study of poverty.

There are a number of studies on the distribution of incomes and consumption in Italy; most of them are based on the two main Italian surveys, namely the ISTAT (Italian Central Statistical Office) Survey on Family Budgets (SFB) and the Bank of Italy Survey on Household Income and Wealth (SHIW). The SFB focuses mainly on consumption, while the SHIW clearly deals with incomes, but both surveys record at least one measure of the other variable of interest. Even if, obviously, such a measure is much rougher than that collected in the other survey, nonetheless it allows one to conduct some initial analyses. Most of the previous work has utilised one or other survey, while only recently attention has been paid to the opportunity of exploiting at the same time information coming from both surveys. This is true also for studies on inequality, which have analysed either income inequality or consumption inequality, but never looked at the joint behaviour of the two variables. This, in part, can be due to the features of the surveys, as outlined above; therefore the analyses attempted in this paper are new to the Italian studies on inequality and poverty, and can also throw light on a new possible way of utilising jointly our most informative national surveys.

The paper is organised as follows. In Section 2, a number of recent Italian studies on inequality and poverty are recalled and commented upon, reporting on both empirical findings and on data and methods used. This overview serves as benchmark and starting point for the analyses that are subsequently performed. Section 3 describes the two main Italian surveys on income and consumption, and justifies our choice of data. In Section 4 the descriptive results are presented, and compared to those obtained in other studies on several countries, both European and non-European. Sections 5 and 6 explain the theoretical model we rely on to identify the temporary and permanent components of inequality, and present the estimates obtained accordingly. Sections 7 and 8 set up a model for the analysis of poverty and present the empirical results. Section 9 concludes and presents some issues that deserve further research.

2 The picture of the Italian situation

As anticipated in the previous section, there are several papers on inequality and poverty patterns in Italy. We shall briefly review the most recent ones, namely those that appeared in the second half of the 1990s, as they provide a sufficient background and motivation for the analyses undertaken in the present study.

2.1 Consumption measures

One of the main studies is presented in the official report of the Commission for Poverty and Social Exclusion (Commissione d'Indagine sulla Povertà ed Emarginazione, 1996), where the picture of poverty from 1980 to 1994 is drawn. This study utilises the SFB, therefore investigating measures of consumption inequality. The profile of incidence of poverty, obtained referring to the international standard poverty line¹, shows a steady increase over the period 1980-1989 from 8% to 15% (roughly), then a drop in 1990 to around 12%, and a constant or slowly decreasing pattern until 1994.

Table 1: Incidence and intensity of poverty in Italy, 1980-1997. Source: Trivellato (1998).

Year	Poverty line (monthly thousand current Liras)	Incidence(%)				Intensity (%)
		North	Centre	South	Italy	
1980	267	4.6	4.5	16.0	8.3	16
1981	314	5.8	5.6	17.8	9.6	19
1982	368	5.6	5.6	17.7	9.5	19
1983	422	7.1	7.3	17.9	10.6	22
1984	470	7.1	7.5	19.7	11.3	22
1985	549	7.2	6.6	21.0	11.6	22
1986	624	7.7	7.3	22.8	12.6	23
1987	692	9.0	8.1	25.8	14.4	23
1988	749	8.7	9.9	26.0	14.8	23
1989	838	8.2	9.3	26.0	14.4	22
1990	914	7.4	7.7	20.0	11.7	19
1991	1,010	8.0	7.4	19.8	11.8	19
1992	1,042	7.0	7.2	20.7	11.7	19
1993	1,025	5.4	7.8	19.4	10.7	18
1994	1,094	4.4	6.8	20.6	10.2	21
1995	1,143	4.4	6.8	21.9	10.6	22
1996	1,190	3.9	5.7	22.3	10.3	21
1997	1,234	4.3	5.8	24.2	11.2	22

These figures have been updated until 1997 in Trivellato (1998) [see Table 1]; here the state-of-the-art on inequality studies in Italy is extensively documented and commented upon, not only reporting empirical evidence, but also addressing methodological issues. On the top of the results shown in Table 1, which are based on consumption

¹The poverty line for a 2-component family equals the mean per capita expenditure level.

measures from SFB, analyses of dynamics of inequality are performed, utilising incomes from the panel part of the SHIW to estimate the probabilities of transition into and out of the poverty state between 1989 and 1993. The poor in 1989 have a roughly 50% probability of still being poor in 1993, while only 9% of the non poor in 1989 will be poor in 1993.

Table 2: Incidence of poverty in EU12, 1993. Source: Eurostat (1997).

Country	Poverty line (in PPP ¹)	Incidence(%)		
		Household	Individuals	Youths aged < 16
Belgium	540	13	13	15
Denmark	527	9	6	5
Germany	562	13	11	13
Greece	325	24	22	19
Spain	377	19	20	25
France	516	16	14	12
Ireland	403	21	21	28
Italy ²	411	18	20	24
Luxembourg	990	14	15	23
Netherlands	516	14	13	16
Portugal	311	29	26	27
United Kingdom	541	23	22	32
EU12	489	17	15	20

¹ The poverty line is set at 50% of the mean after-tax monthly disposable pro capite income, equivalised. The equivalence scale is 1 for the first adult, 0.5 for the following adults and 0.3 for any youth aged less than 14.

² In Italian Liras this would be a poverty line at 667.600.

To locate Italy in a wider context, we report in Table 2 some figures based on the first wave (1994) of the ECHP (European Community Household Panel), from Eurostat (1997). The information refers to the year 1993; unluckily, these values cannot be compared to those of Table 1, since the poverty line is computed differently, but still give an indication of the phenomenon relative to other European countries. The position of Italy is somewhat intermediate: the incidence indices computed referring to households, individuals and youths aged less than 16, respectively, are only slightly above the EU12 average values.

From this first cursory overview, one fact emerges: the fall in incidence and intensity of poverty in 1990. This empirical evidence deserves some further attention, not only for the interpretation of the papers we just mentioned, but also because it motivated some choices we made in the present study.

Let us note, now, that for a unimodal and symmetric distribution, the incidence is strictly linked to the higher moments, since the poverty line takes into account only the mean. In fact, two unimodal and symmetric distributions with the same mean will generate the same poverty line, so that a distribution with, say, smaller variance

will give a lower incidence. Analyses of the distributions of data from SFB and SHIW show unimodal and symmetric behaviour for both income and consumption in the logarithmic scale². Therefore we can compare studies investigating incidence, like the Commissione (1996), with those that inspect the behaviour of variances, even if only qualitatively.

The analyses on the SFB reported in Miniaci and Preto (1999), which agree with the results we obtained on the same data, show a basically constant variance of log-consumption over the two periods pre- and post-1990, with a substantial drop in 1990. The same drop appeared in the profile of incidence of poverty in the Poverty Commission report, and there the authors justified it in terms of business cycle, commenting that "the index has shown a behaviour tendentially correlated with that of the cycle of Italian economy, increasing during economic expansions and decreasing during recessions". Such correlation is certainly true, but it has to be noted that ISTAT began in 1990 a substantial revision of the cleaning procedures through which the final files are obtained from raw data; the process reduced the amount of measurement error, yielding as a side effect a decrease in the variances³, as is evident from Figure 1.

Such decrease, as noted before, may have contributed to the fall in the incidence rate detected in 1990. It is not a coincidence if the fall is larger in the figures regarding the South, where the quality of data used to be lower than in the Centre and the North (See Table 1). This is confirmed also in other tables, not reported here, presented in Commissione d'Indagine sulla Povertà ed Emarginazione (1996), where more detailed indices are computed separately by geographical area. Again those of the South show the largest gaps pre- and post-1990. Since the drop is evident in the profile of intensity of poverty too, and this last index is again related to the variance of the distribution, the conclusions drawn by the Commission have to be considered in conjunction with the change in the data-cleaning procedures by ISTAT in 1990.

Analogous analyses carried out on the SHIW data seem to confirm the hypothesis of an influence of the ISTAT revision: in fact in the SHIW data there is no evidence of a drop in variances in 1990, as is clear from Figure 2.

Nevertheless, the SFB remains one of the richest surveys in Italy, and this remark does not intend to discourage its use, rather to highlight some key features in order to make a proper use of its information.

Consumption data from the SHIW are used in Attanasio and Jappelli (1997) to investigate the age pattern of consumption inequality, drawing within-cohort analyses to test some implications of the permanent income hypothesis. The SHIW, however, contains much richer information on incomes, and has therefore been largely used in studies on income inequality.

²See details on SHIW in Rosati (2000b).

³Such revision is in line with the main purpose of the survey, namely the study of the *average* expenditure behaviour in Italy, and not *distributional* analyses.

2.2 Income measures

There are many official publications on income distribution by both Bank of Italy (on SHIW data) and ISTAT (on SFB data). Most of the results are collected and compared in Brandolini (1998); this paper is a comprehensive presentation of all income surveys in Italy after the Second World War, where the different sources are described, the reliability of data assessed, and the time pattern of inequality arising from such data investigated. We will only comment on the SFB and the SHIW data, since the other sources are not of concern to us at the moment.

Brandolini computes Gini index series from SFB and from SHIW in different versions, according to different definitions of income and using different sets of weights. All these series show a similar behaviour, and the author concludes that the pattern of income inequality in the 1980s and early 1990s is "an oscillation around a flattened trend", however remarking that "these are nothing more than working hypotheses that need to be corroborated with further empirical evidence". Beyond the indications on the trends of inequality in the last two decades, the paper gives useful insights on the reliability of our two sources of interest, among which is an assessment of underreporting in SHIW relative to national accounts, estimated at around 7% for income from employment and around 50% for income from self-employment.

Table 3: Decile shares in the distribution of post-tax family incomes. Sources: Istat (1996), Banca d'Italia (1997) and Eurostat (1997).

Source	1	2	3	4	5	6	7	8	9	10
SFB (1994)	3.3	5.1	5.9	7.1	7.4	9.8	11.2	12.3	15.3	22.6
ECHP (1994)	2	4	5	7	8	9	11	12	16	26
SHIW (1995)	2.3	3.9	5.2	6.3	7.5	8.9	10.6	12.8	15.9	26.6

Further informations on reliability of data come from official publications. From Eurostat (1997), ISTAT (1996) and Bank of Italy (1997), Table 3 displays the decile shares in the distribution of post-tax family incomes in 1994 from SFB and ECHP, and in 1995 from SHIW. While SHIW and ECHP report substantially identical values, the SFB differs from them, especially in the lower part of the distribution and in the 10th decile. This is a very well-known characteristic of the SFB income data, that are heavily corrected according to the expenditure levels before they are released.

This correction in the SFB is meant to clean data from values of income not consistent with reported consumption expenditure, but is widely recognised as producing major distortions in the data, that make them unusable in most cases. The correction procedure is published in ISTAT (1983), and the results reported in Table 4, from the same reference, show the distortion in the 1980, 1981 and 1982 data. It has to be mentioned, moreover, that the income data are originally recorded in classes, but the corrected values appearing in the public files are imputed point values. Further results and comments can be found also in Brandolini (1998).

Table 4: Corrections in the SFB data, 1980-1982. Source: ISTAT (1983).

Reported income range (thousand Liras)	Pre-correction distribution			Post-correction distribution		
	1980	1981	1982	1980	1981	1982
below 400	25.1	17.3	9.90	12.3	8.60	5.90
400-600	28.4	17.9	15.9	20.4	13.2	7.70
600-800	18.9	24.3	21.7	17.7	16.7	14.4
800-1,000	12.7	14.9	17.5	15.3	14.3	13.4
1,000-1,200	7.30	10.0	10.7	11.7	12.6	12.8
1,200-1,500	4.50	8.80	12.0	10.6	14.6	16.3
1,500-2,000	1.60	4.60	8.10	7.30	11.7	16.2
2,000-2,500	0.50	1.20	2.50	2.40	4.40	6.70
2,500-3,000	0.20	0.40	0.80	1.10	1.90	3.00
over 3,000	0.80	0.60	1.10	1.20	1.80	3.50
Total	100.0	100.0	100.0	100.0	100.0	100.0

3 Data description

The data available for our study are the SFB and the SHIW over the 1980s and the 1990s. The SFB is a series of cross-sections that covers the period between 1986 and 1995, and collects every year data from more or less 32,000 households. The interviews are conducted quarterly, each quarter collecting data on around 8,000 households. The definitions of the variables over the 10 years are quite homogeneous, so that a direct comparison of the different waves is straightforward.

The SHIW is available from 1977 to 1995, data being collected annually from 1977 to 1987 except in 1985, and then every second year from 1989 to 1995. The survey changed many times in this period, in terms of sample size, information collected and sampling design. The number of households interviewed was around 3,000 in the period 1977-1980, rose to around 4,000 in 1981-1984 and finally to around 8,000 from 1986 onwards. The design is substantially a series of cross-sections, but from 1989 a portion of the sample has been followed over time, producing panel data on a restricted number of households. In this study we will only look at the cross-sections. Along with the sample size, the information collected grew too, not only in terms of number of variables, but also because finer definitions of the variables were adopted. This constant evolution over time, which certainly improved the quality of the survey, makes time-series studies somewhat complex, because recoding of most variables is needed. Moreover, the higher informational content of the newer waves cannot be exploited; in fact, in order to make comparisons across time, we are forced to use the rougher definitions of the variables adopted in the first waves.

The more regular pattern of the SFB, and the higher frequency of the observations, make this survey initially more attractive than the SHIW. However, the quality of income data is not very satisfactory, as anticipated in Section 2. We tried some first analyses, since the assessment of reliability of data by the Central Statistical Institute

was always conducted on grounds substantially different from ours, and this did not allow us to recognise clearly what might be the effects on the type of analyses we intend to perform.

Unluckily, a cursory overview confirmed the low level of income data quality, as is clear from Figure 3. In particular, note how the correction of income measures, made to obtain “expenditure-consistent” values, yields a nearly perfect overlapping of the time series of the variance of income and of the covariance between income and consumption. For the purposes of our analyses, this handicap is heavy, and makes the SFB unsuitable. Hence from now on we will focus our attention on the SHIW data.

Note that the low reliability of income data from SFB, together with the need for joint use of income and consumption measures for certain types of analysis⁴, generated interest in the possibility of using complementary data sources, i. e. the SFB together with the SHIW, where the income measures are of better quality, but the data on expenditure are very basic (even if of good quality). The joint use of the two sources would give both high-quality and detailed data on our two variables of interest. This new line of research is investigated in several recent papers, among which are Baldini (1998), Battistin *et al.* (1999), Brugiavini (1996) and Rosati (1999).

3.1 Selection of households and variables from SHIW

First of all note that we cannot use the first three waves, namely data from 1977 to 1979, since consumption is not available in these years. Therefore all analyses cover the period from 1980 to 1995.

We dropped those households whose consumption or income fell below the 1st percentile or above the 99th. Moreover, we kept only the households whose head is an employee, therefore excluding self-employed and retired. In fact our main interest is in labour income, hence we only consider heads still in the labour force; but it is also well-known that the measures of incomes from self-employment are usually hardly reliable⁵, therefore we choose to restrict our attention to employees only. Finally, we excluded the households where the variable “number of components” did not match the actual number of individuals recorded in the household. With this selection, we end up with the sample sizes reported in Table 5, which are roughly 50% of the initial ones⁶.

The analyses are conducted within three large cohorts, corresponding to heads of the family born in the 1930s, 1940s and 1950s. Further distinctions have been made according to three geographical areas (North, Centre and South), and according to education (High and Low⁷). Note that in 1980-1983 the age was recorded in ten-year classes, therefore we had to approximate the date of birth in 1981-1983 as follows: in the 1950s cohort fall all households with head aged 21 to 30 in the year they were

⁴See, for instance, the model presented in Sections 5.3–5.7.

⁵See, in this regard, the indications reported in section 2.2 from Brandolini (1998).

⁶Self-employed are around 20% of the sample, retired around 30%, and families with mismatching number of components around 1%.

⁷High = High School or above, Low = Secondary School or less.

Table 5: *Sample sizes of utilised data from SHIW, 1980-1995, by birth cohorts of the head of the household.*

Year	1930s	1940s	1950s	Total
1980	466	412	165	1043
1981	603	607	303	1513
1982	626	566	262	1454
1983	649	601	199	1449
1984	603	677	396	1676
1986	1065	1253	924	3242
1987	1007	1234	917	3158
1989	869	1278	1067	3214
1991	682	1246	1047	2975
1993	443	1058	1039	2540
1995	299	970	989	2258
Total	7312	9902	7308	24522

surveyed (over 1981-1983 this ends up including heads born between 1951 and 1962); in the 1940s those aged 31 to 40 and in the 1930s those aged 41 to 50 (born in 1941-1952 and 1931-1942 respectively). This approximation leads to overlapping of cohorts in those three years, but the only alternative is to drop completely three whole waves.

3.2 Choice of variables

As regards the variables we use, note that income, as said before, is monthly family labour income from employment. Such measure may under-report family disposable income when the head of the family is an employee, but the family has extra income from self-employment of other members. However the families with head employed and non-zero income from self-employment are few in our sample and their income from self-employment is much smaller than income from employment.

The most appropriate measure of expenditure to use would be that for non-durable goods⁸; unfortunately, two waves (1986 and 1987) do not report this measure, but only total expenditure, therefore we use monthly total consumption. However, we carried out parallel analyses on non-durable consumption only (including housing), leaving out the aforementioned waves, and the results were almost identical, for the years considered, to those obtained with total consumption. For the specific results, see Rosati (2000b).

Both income and consumption are rescaled according to an equivalence scale giving weight 1 to the head of the household, 0.7 to extra adults and 0.5 to any household

⁸In fact, our interest is in measuring the flow of services enjoyed by a family, and this definition would include expenditure in non-durables and, ideally, a measure of the stock of durable goods owned by the family. This is generally not measured and, moreover, cannot be approximated by expenditure on durables, as it only records purchase of those goods, and not the actual stock. Therefore a reasonable measure of the flow of services can be simply non-durable expenditure.

member aged less than 18. For further comments about the choice of the equivalence scale, and a sensitivity analysis is reported in Rosati (2000b).

Once equivalised income and consumption, we transform them into the logarithms, and run all the analyses in the logarithmic scale. The use of the logarithmic scale is common practice, and can be found in several other studies on poverty and inequality. A first advantage is, therefore, the comparability of our results to those of other studies. Other advantages derive from some specific features of the models we are going to use in our analyses. For instance, as we said before, in the study of inequality we decided to look at variances; the computation of the variances in the logarithmic scale is not affected by inflation as it is in the original scale⁹. Hence we do not need to use a price index, whose choice is to some extent arbitrary, and therefore we avoid introducing a further source of bias¹⁰. In the analysis of poverty, instead, we will use models inspired by the literature on measurement error, which mainly regards additive measurement errors. The measurement error that affects positive variables, like income and consumption, is normally multiplicative, and this yields an additive model in the logarithmic scale, which enables us to use directly the measurement error models available.

4 Descriptive results

All the analyses that follow have been performed within the three cohorts we constructed. The corresponding sample sizes have been presented in table 5.

The cohort of those born in the 1930s has 7,312 households, with an average cell size of 665, and a minimum of 299 in 1995. The head of the household is aged 41 to 50 in 1980, and 56 to 65 in 1995. The 1940s group is larger (9,902 families) with mean cell size of 900 (minimum 412 in 1980). The age ranges from 31-40 in 1980 to 46-55 in 1995. The youngest cohort (born in the 1950s) includes 7,308 households, on average 664 each year, with a minimum of 165 in 1980. Here the heads of the households are aged 21-30 in 1980 and 36-45 in 1995. The whole sample, therefore, includes nearly 25,000 families, whose head is never younger than 21 or older than 65.

The analyses by geographical area and by education have been drawn within these three groups, splitting each of them accordingly. In fact, the year-of-birth effect is quite important, and if the three cohorts are put together most of the other variables' effects are smoothed and not identifiable any more.

⁹If we re-scale Y with a price index p , we obtain pY , and $\text{Var}(pY) = p^2 \text{Var}(Y)$. But in the logarithmic scale we have $\log(pY) = \log p + \log Y$, and therefore $\text{Var}(\log pY) = \text{Var}(\log Y)$. It follows that, if we use the logarithmic scale, we do not need to correct for inflation.

¹⁰This argument is quite common in the literature to justify the use of the logarithmic scale. Note, however, that it assumes one common price index for all individuals, while in many cases it would be advisable to use different price indices for individuals in different parts of the distribution.

4.1 Inequality

In these first descriptive analyses, we estimated within each cohort the variances of the logarithm of income and the logarithm of consumption, and their covariance. In fact, the variance is the inequality index we are interested in, and the covariance will be needed later to identify the transitory and permanent components of inequality.

The estimates are based on the Method of Moments, and standard errors are computed accordingly. Note that the sample sizes allow us to use asymptotic approximations, thus reducing the complex formula for the standard deviation to only the dominant term of order $O(\frac{1}{n})$. The derivation of the standard errors is presented in Rosati (2000b).

Table 6: *Estimates of the variances of log-income (y) and log-consumption (c), and of their covariance. SHIW data 1980-1995, by birth cohort of the head of the household (standard errors in brackets).*

Year	1930s			1940s			1950s		
	var(y)	var(c)	cov(y, c)	var(y)	var(c)	cov(y, c)	var(y)	var(c)	cov(y, c)
1980	.2351 (.0088)	.1775 (.0096)	.1392 (.0498)	.2027 (.0074)	.1991 (.0091)	.1358 (.0448)	.2560 (.0135)	.2086 (.0114)	.1481 (.0608)
1981	.2295 (.0061)	.1925 (.0070)	.1436 (.0414)	.2401 (.0075)	.2089 (.0084)	.1566 (.0486)	.2382 (.0093)	.2215 (.0087)	.1476 (.0410)
1982	.2159 (.0065)	.1860 (.0071)	.1129 (.0284)	.2379 (.0073)	.2056 (.0075)	.1371 (.0361)	.2003 (.0108)	.2109 (.0143)	.1040 (.0523)
1983	.2062 (.0065)	.1792 (.0061)	.1160 (.0412)	.2290 (.0090)	.1902 (.0073)	.1430 (.0421)	.2633 (.0143)	.2231 (.0135)	.1484 (.0735)
1984	.2689 (.0070)	.1929 (.0067)	.1490 (.0421)	.2313 (.0065)	.1748 (.0058)	.1366 (.0398)	.2832 (.0078)	.2298 (.0076)	.1741 (.0449)
1986	.2619 (.0068)	.2138 (.0071)	.1617 (.0253)	.2706 (.0062)	.1967 (.0056)	.1692 (.0298)	.2619 (.0053)	.1864 (.0051)	.1598 (.0271)
1987	.2625 (.0073)	.2250 (.0067)	.1940 (.0368)	.2783 (.0071)	.2409 (.0068)	.2132 (.0312)	.2536 (.0078)	.2229 (.0066)	.1900 (.0322)
1989	.2386 (.0060)	.1719 (.0054)	.1526 (.0350)	.2375 (.0056)	.1898 (.0048)	.1668 (.0280)	.2600 (.0056)	.2074 (.0048)	.1886 (.0340)
1991	.2310 (.0076)	.2159 (.0069)	.1531 (.0275)	.2383 (.0059)	.2215 (.0054)	.1766 (.0280)	.2715 (.0067)	.2501 (.0063)	.2072 (.0311)
1993	.3232 (.0118)	.2510 (.0110)	.1991 (.0588)	.2970 (.0067)	.2164 (.0066)	.1695 (.0237)	.3144 (.0063)	.2208 (.0054)	.1809 (.0242)
1995	.3122 (.0113)	.2378 (.0113)	.1781 (.0388)	.2868 (.0065)	.2031 (.0061)	.1722 (.0280)	.2971 (.0065)	.2480 (.0054)	.1933 (.0355)

The results for the whole sample are reported in Table 6 and displayed in Figure 4; all the three variables show an upward trend, suggesting that inequality grows

with age within a group of fixed membership. This is in line with the Permanent Income Hypothesis (PIH), which implies that both consumption and income inequality variance should grow with age for any group of people born at the same time. The PIH will not be tested formally here, since its investigation is not the main aim of this study; however, it is worth noting that the first descriptive results are consistent with the hypothesis, as the results obtained, for other countries, in Deaton and Paxson (1994) and in Attanasio and Jappelli (1997).

Both papers use average cohort data, like us, but their cohorts are 5-year rather than 10-year wide. The first paper finds results in line with the PIH under certainty equivalence, estimating the age profile of the cross-sectional variance of consumption for the US, the UK and Taiwan. The second paper, instead, relaxes certainty equivalence and tests further predictions of the PIH on the marginal utility of consumption, using data from the US, the UK and Italy. The results in all three countries do not reject the restrictions implied by the theoretical model they assume. Note that the data used for Italy are from the SHIW too, but the cross-sections considered cover the period 1987-1993. In fact, the need for 5-year-wide cohorts impedes the use of the first waves, where - as we said - age is collected in 10-year classes; moreover, the use of non-durable consumption forces to start from 1987, since, as already remarked, some previous cross-sections record only total expenditure, with no chance to distinguish that for durable and non-durable goods.

There is no point to carry out now a deeper comparison of the two papers with this study, since, despite some analogies in the empirical evidence, their aims remain very different. However, it was important to recall them here, because the present analyses do not preclude further investigations in the directions of those two studies.

Let us, now, comment on some other key features of our empirical results. The growth of income variance is faster than that of the other two variables. In particular, in all cohorts there is a sharp increase between 1991 and 1993, whereas this does not happen for consumption variance and for the covariance. However, these last two variables show a common pattern (even if on different levels) in all cohorts over the period 1986-1991, increasing from 1986 to 1987, decreasing from 1987 to 1989, and increasing again from 1989 to 1991. Before and after this period, the variance of consumption is almost constant, and so is the covariance in the 1990s. In the early 1980s, instead, the covariance follows a less regular path, first decreasing and then rising until the peak in 1987. Income variance in the whole period is oscillating around a definitely increasing trend.

The three cohorts, therefore, show an overall similar behaviour, but the levels are slightly increasing from the cohort born in the 1930s to that born in the 1950s, suggesting that the younger the cohort the higher the inequality it is subject to. This is similar to the results obtained for the UK in Blundell and Preston (1998).

The analyses by education are displayed in Figure 5 and highlight first of all higher level of inequality for the low-educated (roughly 20% more than the high education group). The two oldest cohorts show profiles substantially similar to the previous ones in both educational groups. In the 1950s cohort, instead, the patterns differ across the two groups and are distant from those of the whole cohort as well. Here appear

even more clearly than before an almost constant profile of consumption variance and a slightly increasing trend of the covariance, but the faster growth of the variance of income is no longer evident. For the low educated such variance is still oscillating, but around a flatter trend, while for the high educated it is basically constant, especially from 1987 onwards. It follows that the initial values (in 1980) are already quite high. Note that the average cell size in this cohort is still large, 329 and 335 for the high and low educated, respectively.

The geographical areas show different behaviours (see Figure 6). The lowest levels are those of the Centre, where the profiles are also quite flat. The North has slightly higher levels (around 6% more), and shows increasing rather than constant trends, but still oscillating. The highest levels are those of the South (around 22% more than the Centre), and the profiles are steadily increasing, with much less oscillation than the North. In all areas the 1930s cohort has the faster increase in the last years, but we have to note that in 1993 and 1995 this cohort was quite reduced, giving smaller cell sizes, between 100 and 150 in all areas.

Further analyses have been conducted splitting the educational groups according to geographical area; qualitatively, the results are in line with the evidence observed in the previous analyses, and will not be commented upon in detail here. Note, however, that at this level of disaggregation the average cell sizes are much smaller than before, roughly around 150-200 for North and South, and around 100 for the Centre, for both educational groups. These last results are reported Rosati (2000b).

4.2 Descriptive statistics on poverty

The first picture of poverty comes from the computation of the headcount ratios from income and consumption, and their comparison with those obtained from the SFB data in the study by the national Commission on poverty (see Table 1). Our computation on SHIW data makes use of all available households, and not only of those whose head was born between the 1930s and the 1950s, as in the other analyses. This is to make easier the comparison with the official statistics based on SFB, where there is no birth-cohort selection.

The results are reported in Table 7 and shown in Figure 7. For our analyses on SHIW data, we set the poverty lines at the 50% of the mean income and consumption. The indices derived from consumption are lower than those from income (on average 2-3% less), as we expect from the higher volatility of income, given that for our kind of data a larger variance yields a larger headcount ratio.

If we compare the consumption indices from SHIW and SFB, we see that the latter are higher. This may reflect the fact that in SHIW consumption is collected by asking just few recall questions, while in SFB we have much more detailed information, diary-based¹¹, which yields a higher variance. Notice also that after 1990, when a major revision of the cleaning procedures for the SFB took place, the headcount drops (as also noticed before, see Section 2.1), and settles around the SHIW levels.

¹¹For further discussion about consumption recall vs diary-based data, see Battistin *et al.* (1999).

Table 7: *Incidence of poverty in 1980-1995. Headcount ratios from SHIW and SFB data.*

Year	SHIW data		SFB data				Mean/1.67 ³
	Income	Consumption	Income	Consumption	(Consumption)		
	Pov. line ¹	HR (%)	Pov. line ¹	HR (%)	Pov. line ²	HR (%)	
1980	179	10.9	151	7.8	267	8.3	160
1981	196	11.3	187	10.0	314	9.6	188
1982	243	11.4	214	9.1	368	9.5	220
1983	278	10.6	243	8.7	422	10.6	253
1984	316	12.4	281	8.2	470	11.3	281
1986	362	12.1	317	8.4	624	12.6	374
1987	437	15.1	421	12.4	692	14.4	414
1989	500	13.5	477	9.0	838	14.4	502
1991	544	12.2	539	11.5	1010	11.8	605
1993	599	15.1	584	10.4	1025	10.7	614
1995	638	14.8	668	10.8	1143	10.6	684

¹ The poverty line is for a 1-component family, and equals 50% of the mean monthly per capita income/expenditure, equivalised (in thousand Liras).

² The poverty line is for a 2-components family, and equals the mean monthly per capita expenditure.

³ This would be the corresponding poverty line for a 1-component family, if we re-scale according to the Carbonaro equivalence scale.

The SFB indices are derived by the Commission referring to the poverty line for a 2-components household, reported in the table. We also add a column with the corresponding poverty line for a 1-component family, obtained rescaling the given lines according to the Carbonaro equivalence scale, as suggested by the Commission, i.e. dividing by 1.67. These lines are quite close to those based on SHIW consumption until 1984 (difference less than 10,000 Liras, around 3 GBP), but become somewhat more distant from 1986 onwards. This reflects a change in the distributions from 1986, as the lines are distribution-dependent, typically a relative increase in the mean consumption if compared to SHIW, i.e. a shift of the SFB distribution towards higher values, since the variance - for what observed before - does not seem to have increased during such period. A comparison of the poverty lines is shown in Figure 8.

5 Inequality model

As we anticipated at different points of our discussion, one of the main issues in inequality measurement is the distinction of its temporary and permanent aspects. This is particular important in the policy decision process, where - in turn - we need to take into account only the permanent changes in the welfare level, and ignore any fluctuations of welfare of transitory nature, or vice-versa.

Some studies have tackled this problem looking at (unobservable) permanent income as a measure of permanent welfare; for instance, Abul Naga and Burgess (1997)

develop a model to predict household permanent income making use of both income expenditure plus an extra set of casual variables for permanent income, such as family size, housing asset ownership, educational and occupational status of the household. Other approaches instead, like the studies by Deaton and Paxson (1994) and Blundell and Preston (1997,1998,1999), add the PIH an intertemporal model of optimization over the life cycle, which yields an earnings and an expenditure equation that serve as a starting point to develop a complete economic model. We will follow this last approach, and in particular refer to the models used by Blundell and Preston.

We decided to use as a measure of inequality the variance of log-income and of log-consumption¹². We will add here the covariance between log-income and log-consumption, and will derive a model that, using the three above measures, allows to identify and estimate the variances of the permanent and temporary shocks of the economy.

5.1 A model for income

Suppose income can be decomposed into a permanent component y^p plus a transitory shock u , namely:

$$y_{it} = y_{it}^p + u_{it} \quad i \in k \quad (1)$$

for individual i in cohort k at time t , where y_{it}^p and u_{it} are uncorrelated. The u_{it} s have zero mean and are independent over time. We assume:

- y_{it}^p evolves according to: $\Delta y_{it}^p = v_{it}$, where v_{it} is a permanent shock uncorrelated with y_{it-1}^p and orthogonal to u_{it} . The v_{it} s have zero mean and are independent over time;
- $\text{Var}_{kt}(u)$ and $\text{Var}_{kt}(v)$ for fixed t are common among all $i \in k$, for all k , but differ across t ;
- $\text{Cov}_{kt}(y_{-l}, u) = \text{Cov}_{kt}(y_{-m}, v) = 0 \quad \forall l, m \geq 1$.

All-together, we obtain an MA(1) model for income:

$$\Delta y_{it} = \Delta u_{it} + v_{it} \quad (2)$$

It follows that the growth in cross-sectional variance of income is decomposed into the growth in short-term uncertainty plus permanent inequality:

$$\Delta \text{Var}_{kt}(y) = \Delta \text{Var}_{kt}(u) + \text{Var}_{kt}(v) \quad (3)$$

In fact from (1) we have $\Delta \text{Var}_{kt}(y) = \Delta \text{Var}_{kt}(y^p) + \Delta \text{Var}_{kt}(u)$. But we assumed $\Delta y_{it}^p = v_{it}$, hence $\text{Var}_{kt}(y^p) = \sum_{i=1}^t \text{Var}_{ki}(v)$, and therefore

$$\Delta \text{Var}_{kt}(y^p) = \text{Var}_{kt}(v) \quad (4)$$

¹²See Section 3.2.

Notice that if y is measured with error, but the error process has constant variance σ_ϵ^2 , then (3) still holds. In fact, adding to (1) the measurement error, we would have $\Delta \text{Var}_{kt}(y) = \Delta \text{Var}_{kt}(y^p) + \Delta \text{Var}_{kt}(u) + \Delta \sigma_\epsilon^2$, but the last term is clearly equal to zero. The rest follows again from the assumption for Δy^p .

5.2 Estimation with panel data

If panel data are available, then income alone is enough to separate the two terms in the right-hand-side of equation (3).

In fact, the covariance function of the income process (2) allows to identify the variance of the transitory shocks. Dropping the cohort index, we have:

$$\begin{aligned} \text{Cov}(\Delta y_{it}, \Delta y_{it-1}) &= \text{Cov}(\Delta u_{it} + v_{it}, \Delta u_{it-1} + v_{it-1}) \\ &= \text{Cov}(u_{it} - u_{it-1} + v_{it}, u_{it-1} - u_{it-2} + v_{it-1}) \\ &= -\text{Var}_{t-1}(u) \end{aligned}$$

Therefore, using income alone we can obtain estimates of the variances of the two shocks up to the second last period of observations.

If repeated cross sections only are available, income is no longer sufficient to identify the variances of the two shocks. However, the additional measurement of expenditure provides new identification conditions, under suitable assumptions. Such assumptions and the derived model are presented in the next section.

5.3 Estimating equations for repeated cross sections

We add now, to the framework of Section 5.1, consumption inequality and an intertemporal saving model. The joint availability of cross-sectional income and consumption will then allow us to identify the two terms in the right-hand-side of equation (3).

Assume that changes in consumption are only affected by permanent shocks for large $T - t$ (T = year of retirement):

$$\Delta c_{it} = v_{it} \quad (5)$$

i. e. consumption reflects permanent income if we are a long way from the end of the working life. This assumption is not only true in the simple model where $c_{it} = y_{it}^p$, but also in much more general models of consumer's behaviour. For instance.....

The assumption $\Delta c_{it} = v_{it}$ leads to the following three key (approximate¹³) relations, that we will exploit as estimating equations:

$$\Delta \text{Var}_{kt}(y) = \text{Var}_{kt}(v) + \Delta \text{Var}_{kt}(u) \quad (6)$$

$$\Delta \text{Var}_{kt}(c) = \text{Var}_{kt}(v) \quad (7)$$

$$\Delta \text{Var}_{kt}(s) = \Delta \text{Var}_{kt}(u) \quad (8)$$

¹³Valid for large $T - t$.

where (6) is the result of the previous section, (7) follows from (5) and (4), and (8) comes from our model (1), assumption (5) and the definition of savings as $s = y - c$.

Therefore, the growth in variances of the two shocks is given by:

$$\Delta \text{Var}_{kt}(u) = \Delta \text{Var}_{kt}(s) \quad (9)$$

$$= \Delta \text{Var}_{kt}(y) - \Delta \text{Var}_{kt}(c) \quad (10)$$

$$\Delta \text{Var}_{kt}(v) = \Delta^2 \text{Var}_{kt}(c) \quad (11)$$

$$= \Delta^2 \text{Var}_{kt}(y) - \Delta^2 \text{Var}_{kt}(s) \quad (12)$$

From equations (9)-(12) we can obtain two alternative estimates for each shock. If our assumptions hold, such estimates should differ only because of sampling errors, hence large differences indicate a violation of the assumptions.

We can obtain analogous estimating equations expressed in terms of $\text{Cov}(y, c)$ rather than $\text{Var}(s)$, recalling that

$$\Delta \text{Var}(s) = \Delta \text{Var}(y) + \Delta \text{Var}(c) - 2\Delta \text{Cov}(y, c) \quad (13)$$

In particular, under independence of shocks from past incomes and consumptions we obtain:

$$\Delta \text{Cov}_{kt}(c, y) = \Delta \text{Var}_{kt}(c) \quad (14)$$

substituting (6)-(8) into (13).

5.4 Estimation when the data are not collected every year

When the observations are not equally paced, for instance if the survey has not been done in certain years, relations similar to (9)-(12) still hold.

If we have observations, say, at time t and $t + 2$, but not for period $t + 1$, we would be interested in the estimation of $\text{Var}_{kt+2}(u) - \text{Var}_{kt}(u)$. By definition of first difference we have: $\text{Var}_{kt+2}(u) - \text{Var}_{kt}(u) = \Delta \text{Var}_{kt+2}(u) + \Delta \text{Var}_{kt+1}(u)$. Therefore from (9):

$$\begin{aligned} \text{Var}_{kt+2}(u) - \text{Var}_{kt}(u) &= \Delta \text{Var}_{kt+2}(s) + \Delta \text{Var}_{kt+1}(s) \\ &= \text{Var}_{kt+2}(s) - \text{Var}_{kt}(s) \end{aligned}$$

and from (10)

$$\begin{aligned} \text{Var}_{kt+2}(u) - \text{Var}_{kt}(u) &= \\ &= [\Delta \text{Var}_{kt+2}(y) + \Delta \text{Var}_{kt+1}(y)] - [\Delta \text{Var}_{kt+2}(c) + \Delta \text{Var}_{kt+1}(c)] \\ &= [\text{Var}_{kt+2}(y) - \text{Var}_{kt}(y)] - [\text{Var}_{kt+2}(c) - \text{Var}_{kt}(c)] \end{aligned}$$

Hence (9) and (10) are replaced by:

$$\text{Var}_{kt+2}(u) - \text{Var}_{kt}(u) = \text{Var}_{kt+2}(s) - \text{Var}_{kt}(s) \quad (15)$$

$$= [\text{Var}_{kt+2}(y) - \text{Var}_{kt}(y)] - [\text{Var}_{kt+2}(c) - \text{Var}_{kt}(c)] \quad (16)$$

It follows that, in the case of transitory shocks, the growth of the variance over two years is a function of the growth of the variances of y , c and s over the same two-year period. Hence the growth of $\text{Var}_k(u)$ between one period of observation and the next is estimated the same way, whatever the time-gap between the two periods. This is due to the structure of equations (9) and (10), where a first difference is function of other first differences, making irrelevant whether the two periods are one or two years apart.

The situation is not the same for the variance of permanent shocks, as clearly appears in equations (11)-(12): here a first difference is function of second differences, therefore we expect the change in pace to affect the structure of the estimating equations.

Let us assume again that we observe periods t and $t + 2$, but not $t + 1$; therefore we are interested in the estimation of $\text{Var}_{kt+2}(v) - \text{Var}_{kt}(v)$. From our model:

$$\begin{aligned} \text{Var}_{kt+2}(v) - \text{Var}_{kt}(v) &= \\ &= \Delta \text{Var}_{kt+2}(c) - \Delta \text{Var}_{kt}(c) \end{aligned} \quad (17)$$

$$= [\Delta \text{Var}_{kt+2}(y) - \Delta \text{Var}_{kt}(y)] - [\Delta \text{Var}_{kt+2}(s) - \Delta \text{Var}_{kt}(s)] \quad (18)$$

where the first equation follows from (7), and the second from (6) and (8).

As we cannot compute $\Delta \text{Var}_{kt+2}(c)$, we choose to approximate this quantity via linear interpolation, i. e.:

$$\Delta \text{Var}_{kt+2}(c) \simeq \frac{\text{Var}_{kt+2}(c) - \text{Var}_{kt}(c)}{2} \quad (19)$$

and similarly for $\Delta \text{Var}_{kt+2}(y)$ and $\Delta \text{Var}_{kt+2}(s)$.

For what concerns $\Delta \text{Var}_{kt}(c)$, and the analogous quantities for income and savings, there are two possibilities: if we have observations for the period $t - 1$, then we can have the usual estimates; if the period $t - 1$, instead, is not observed, we approximate again as follows:

$$\Delta \text{Var}_{kt}(c) \simeq \frac{\text{Var}_{kt}(c) - \text{Var}_{kt-2}(c)}{2} \quad (20)$$

Therefore in the biannual case we utilise equations (17) and (18), using approximations (19) and (20) as appropriate.

5.5 A system of restrictions for the biannual case

As we have seen in the last two sections, both in the case of annual and biannual data we can obtain two estimates for each parameter of interest. This is because we have one over-identifying restriction, based on savings (or on the covariance), that allows to obtain the second estimate.

We want now to exploit the over-identifying restriction to obtain a Minimum Distance estimator. To do so we need to specify the corresponding system of restrictions.

For the annual case we found three approximate relations, given in equations (6)–(8), which we report here:

$$\begin{aligned}\Delta \text{Var}_{kt}(y) &= \text{Var}_{kt}(v) + \Delta \text{Var}_{kt}(u) \\ \Delta \text{Var}_{kt}(c) &= \text{Var}_{kt}(v) \\ \Delta \text{Cov}_{kt}(y, c) &= \text{Var}_{kt}(v)\end{aligned}$$

For the biannual case, we obtain the following system of three equations:

$$\text{Var}_{t+2}(y) - \text{Var}_t(y) = \text{Var}_{t+1}(v) + \text{Var}_{t+2}(v) + \text{Var}_{t+2}(u) - \text{Var}_t(u) \quad (21)$$

$$\text{Var}_{t+2}(c) - \text{Var}_t(c) = \text{Var}_{t+1}(v) + \text{Var}_{t+2}(v) \quad (22)$$

$$\text{Cov}_{t+2}(y, c) - \text{Cov}_t(y, c) = \text{Var}_{t+1}(v) + \text{Var}_{t+2}(v) \quad (23)$$

Clearly, the third equation can be expressed also in terms of savings, as follows:

$$\text{Var}_{t+2}(s) - \text{Var}_t(s) = \text{Var}_{t+2}(u) - \text{Var}_t(u) \quad (24)$$

since

$$\text{Var}_{t+2}(s) - \text{Var}_t(s) = \text{Var}_{t+2}(y) - \text{Var}_t(y) + \text{Var}_{t+2}(c) - \text{Var}_t(c) - 2[\text{Cov}_{t+2}(y, c) - \text{Cov}_t(y, c)]$$

The details of the derivation are presented in Rosati (2000b).

5.6 A Minimum Distance estimator

We derive now a Minimum Distance estimator, adapting to the case of biannual data the results presented in Attanasio *et al.* (2000) for equally spaced data. To obtain the MDE for non equally spaced data, we need to introduce some new notation and to make use of the over-identifying restrictions for biannual observations that we derived in Section 5.5.

Denote the periods of observation by $t = t_1, t_2, \dots, t_T$, where $t_i - t_{i-1} \geq 1$. We omit, for simplicity, the cohort index, and define the following quantities:

$$V_t = \begin{pmatrix} \text{Var}(y_t) \\ \text{Var}(c_t) \\ \text{Cov}(y_t, c_t) \end{pmatrix} \quad \text{and} \quad \sqrt{n_t}(\hat{V}_t - V_t) \rightarrow \mathcal{N}(0, \Sigma_t)$$

Combining all the time periods:

$$V = \begin{pmatrix} V_{t_1} \\ \vdots \\ V_{t_T} \end{pmatrix} \quad \Delta V = \begin{pmatrix} \Delta V_{t_2} \\ \vdots \\ \Delta V_{t_T} \end{pmatrix} = LV$$

where $\Delta V_{t_i} = V_{t_i} - V_{t_{i-1}}$ and

$$L = \begin{pmatrix} -1 & 0 & 0 & 1 & 0 & 0 & \dots & 0 \\ 0 & -1 & 0 & 0 & 1 & 0 & \dots & 0 \\ & & & \ddots & & & & \\ & & & & \ddots & & & \\ 0 & \dots & & 0 & -1 & 0 & 0 & 1 \end{pmatrix}$$

L has dimensions $3(T-1) \times 3T$, and can be expressed in a more compact way as $L = (0_{3(T-1) \times 3}, I_{3(T-1)}) - (I_{3(T-1)}, 0_{3(T-1) \times 3})$.

We have $\sqrt{n}(\hat{V} - V) \rightarrow \mathcal{N}(0, \Sigma)$, where $\Sigma = \text{diag}((n/n_{t_1})\Sigma_{t_1}, \dots, (n/n_{t_T})\Sigma_{t_T})$, and $\sqrt{n}(\Delta\hat{V} - \Delta V) \rightarrow \mathcal{N}(0, L\Sigma L')$.

Define now

$$\theta_{t_i} = \begin{pmatrix} \text{Var}_{t_i}(u) - \text{Var}_{(t_i)-1}(u) \\ \text{Var}_{t_i}(v) \end{pmatrix} \quad \text{if } t_i - t_{i-1} = 1$$

whereas in the biannual case:

$$\theta_{t_i} = \begin{pmatrix} \text{Var}_{t_i}(u) - \text{Var}_{(t_i)-2}(u) \\ \text{Var}_{t_i}(v) + \text{Var}_{(t_i)-1}(v) \end{pmatrix} \quad \text{if } t_i - t_{i-1} = 2$$

Furthermore, define the matrix

$$A_{t_i} = \begin{pmatrix} 1 & 1 \\ 0 & 1 \\ 0 & 1 \end{pmatrix} \quad \text{for all } t_i$$

We can then rewrite (6)–(8) and (21)–(23) as:

$$\Delta V_t = A_t \theta_t \quad t = t_2, \dots, t_T$$

In vector notation $\Delta V = A\theta$, where $A = \text{diag}(A_{t_2}, \dots, A_{t_T})$ and

$$\theta = \begin{pmatrix} \theta_{t_2} \\ \vdots \\ \theta_{t_T} \end{pmatrix}$$

The system is over-identified, since A has full column rank, but more rows than columns. To estimate θ we can solve:

$$\min_{\theta} \frac{1}{n} [\Delta\hat{V} - A\theta]' (L\Sigma L')^{-1} [\Delta\hat{V} - A\theta]$$

and obtain

$$\hat{\theta} = (A'(L\Sigma L')^{-1}A)^{-1}A'(L\Sigma L')^{-1}\Delta\hat{V} \quad (25)$$

The asymptotic distribution of the estimator is

$$\sqrt{n}(\hat{\theta} - \theta) \rightarrow \mathcal{N}(0, (A'(L\Sigma L')^{-1}A)^{-1})$$

5.7 Correlated shocks

If the permanent or temporary shocks are correlated with past values of income or consumption, then (14) does not hold any more.

- *If permanent shocks are correlated.* Then (10) cannot be used. In fact, (8) still holds, but (14) doesn't, hence $\Delta \text{Var}_{kt}(s) \neq \Delta \text{Var}_{kt}(y) - \Delta \text{Var}_{kt}(c)$. It follows that (10) does not give a valid estimate for $\Delta \text{Var}_{kt}(u)$, since $\Delta \text{Var}_{kt}(u) = \Delta \text{Var}_{kt}(s) \neq \Delta \text{Var}_{kt}(y) - \Delta \text{Var}_{kt}(c)$. Instead we can use (9), since (8) holds. Moreover, (7) does not hold, therefore we cannot use (11) either.
- *If transitory shocks are correlated.* Then (11) is still usable, since (7) holds. But (8) does not hold, therefore we cannot use (9), and cannot combine $\text{Var}_{kt}(y)$ and $\text{Var}_{kt}(c)$ any more to get estimates from (10). Thus there is no way of estimating the variance of the transitory shocks.

Therefore, the joint availability of income and consumption allows us to test for correlation of shocks with past values of the two variables.

5.7.1 Testing for correlation

To test whether the permanent or transitory shocks are correlated with past values of income or consumption, we start from the usual three equations (6)–(8). Here the first two equations were sufficient to obtain estimates of $\text{Var}(v)$ and $\text{Var}(u)$, but adding a third equation based on the covariance allowed us to obtain alternative estimates, and added one over-identifying restriction per period, that we now use to test for correlation. In fact, the χ^2 test for over-identifying restrictions can be interpreted as a test for the specification of the income process, which assumed uncorrelation of the shocks.

The test is based on the results for the Minimum Distance Estimator presented in Section 5.6. The associated χ^2 test for the over-identifying restrictions is given by

$$\chi^2 = \frac{1}{n} \Delta \hat{V}' [I - (L \Sigma L')^{-1} A (A' (L \Sigma L')^{-1} A)^{-1} A'] (L \Sigma L')^{-1} \Delta \hat{V}$$

and has $T - 1$ degrees of freedom.

6 Results on inequality

6.1 Estimates of the changes in the variances of the shocks

According to the model just introduced, we estimated the growth in the variance of the shocks twice, as joint income and consumption measures are available. One set of estimates is based on the variances alone, while the other is based on the variance of income and the covariance between income and consumption. Hence the estimates for the transitory shocks have been derived from both (9) and (10), and those for the permanent shocks from (11) and (12). We also computed a Minimum Distance estimate from (25). When the observations were biannual, we utilised the appropriate modified versions of the above equations.

The results for the whole sample are shown in Figures 9-12 and reported in Tables 8-9.

For each shock, the two simple estimates give obviously different values, but the patterns are generally quite similar. The estimates based on the covariance have generally much higher standard errors. There is no apparent systematic behaviour, namely one is higher or lower than the other quite randomly. Therefore, to comment on the growth of the variances of the shocks, we will refer to the MD estimates that make use both of the variances of income and consumption and of their covariance.

In general, the Minimum Distance estimates are much closer, almost overlapping, to the estimates obtained from the variances only, rather than to those obtained from the variance of income and the covariance. This can easily be explained if we look at the estimates of the variances and the covariance presented in Section 4. There we found that the standard errors of the covariances were much larger than the standard errors for the variances, and this implies that the Minimum Distance estimates will be basically a combination of the variances only, i.e. very similar to our first simple estimate. In fact, the “distance” that we minimize to obtain the Minimum Distance estimate is proportional to the inverse of the variance-covariance matrix Σ of the estimators for the variances of income and consumption and for their covariance, and therefore the large standard errors of the covariances imply a minor role for the covariance in the Minimum Distance estimate.

Both $\Delta \text{Var}(u)$ and $\Delta \text{Var}(v)$ oscillate around zero, but the pattern of the permanent shocks is generally flatter than that of the transitory shocks. In all cases, both in the whole sample and in subgroups, the growth of variance of temporary shocks has an evident rise from around zero in 1991 to much higher positive values in 1993, to fall back around zero in 1995. This is in conjunction with the recession of the Italian economy of the early 1990s: “this is the first period in recent Italian history when there was a drop in annual real consumer expenditure (−2.6% in 1993), and it marks the start of a low growth phase for the Italian economy” (Grant *et al.*, 1998). For both shocks, there is not much difference across cohorts: even if the extent of the growth can be sometimes different, nonetheless the evolution over time in terms of rises and falls is basically the same.

To have a clearer idea of the evolution of the variances over time, we report in Figures 11 and 12 the cumulative changes for the two shocks. As we can see, the variance of the transitory shock has been following a slightly increasing trend over time, especially in the cohorts of the 1940s and 1950s, while instead the variance of the permanent shocks has been oscillating around a rather flat trend.

We performed further analyses within subgroups by geographical area and by education, and obtained evidence very close to the whole sample. The results on the changes of the variances are reported in Rosati (2000a), while in this study we present in Figures 13-16 the graphs on the cumulative changes. In few occasions we observe slightly larger differences between the two simple estimates, if compared to the whole sample. This can be noticed in the estimates of the variance of permanent shocks in the group of low-educated, and in both transitory and permanent shocks in the central regions. This suggests some further investigations would be appropriate in these three cases, to check whether the differences are simply due to random noise, or the assumption of independence of shocks from past values of income and consumption is

actually violated. The test for correlation presented in Section 5.7 has been computed, and the results are reported in the next section.

6.2 Testing the correlation of the shocks

The test for the over-identifying restriction presented in Section 5.7 has been computed for each cohort, in the general sample and in the subgroups by level of education and by region. All the p-values of the tests are very large, hence there is no evidence against the hypothesis of uncorrelation of the errors from past values of consumption and income.

Looking at the structure of the test statistic, we can give one first explanation of these results. The statistic is proportional to the inverse of the matrix $L\Sigma L'$, where several large values are present, corresponding to the variances of the covariance between income and consumption in the various years. This gives small values for the test statistic, which in turn yield large p-values, and therefore the hypothesis is never rejected. We have to notice, moreover, that the presence of biannual observations can have contributed to the non-rejection of the hypothesis. In fact we are testing for the correlation of the shocks to the past values of income and consumption; if for instance, there was correlation with only income and consumption with lag one, this would not be detected in biannual observations, since the period $(t_i) - 1$ is not observed. The results are reported in Tables 10-12.

7 The study of poverty

The model for income and consumption we assumed so far allowed us to investigate the patterns of inequality, in particular how it is affected by permanent and temporary shocks in the process of income. We illustrate now how the same model can be used for the study of poverty. The line we are going to follow is that of Chesher and Schluter (1999), who derive a number of models to deal with different types of errors in the measurement of welfare. The authors observe that "the relationship between income reported over a fixed period and 'permanent' income may have the same structure as the relationship between error contaminated and error free income with transitory income playing the role of measurement error". From this starting point, the standard measurement error techniques can be applied to estimate the true welfare level.

Under the permanent income hypothesis, we obtain the same results as for changes in inequality: here the changes in the indices of poverty based on income are affected by both permanent and transitory shocks, while the changes in those derived from consumption are only driven by permanent shocks. We present a model regarding the headcount ratio index and a simple test for the independence of the measurement errors.

7.1 Measurement issues

As we discussed at many stages before, there are some crucial issue that need to be considered when studying poverty.

First of all is the definition of poor. In our case, we consider poor any household whose income or consumption falls below a pre-defined line.

Here the second point arises, namely the choice of the poverty line. We use a set of poverty lines, defined each as a certain proportion of the mean of the distribution, for instance 50% or 25% of the mean, and so on.

Finally, once chosen the poverty line, one has to decide which index to use. We develop a model for two very commonly used indices, i.e. the headcount ratio index of poverty and the poverty gap ratio index. We recall here their definitions, which we gave earlier. The headcount ratio index of poverty is the proportion of households whose income (or consumption, accordingly) is below the poverty line, and is an index of incidence of poverty. Looking instead at the intensity, we have the poverty gap ratio index, which is the average gap (in %) between the poverty line and, for example, income for those below the line. Basically it measures, in percentage, how much lower than the poverty line is the average income among the poor.

It is clear that the poverty lines could be defined in many other ways, and the indices could be others as well. A thorough discussion of these and other issues appears in several studies in the literature, among which, for instance, Atkinson (1987), Foster *et al.* (1984), Sen (1997) and Trivellato (1998).

7.2 Classical multiplicative measurement errors

In this section we consider the simplest form of measurement error that could contaminate a non-negative variable (e. g. income), namely a multiplicative error, independent of the error free variable. The model is given by:

$$W = X U^\sigma \quad (26)$$

where W is the contaminated variable, X is the error free variable, and U is independent of X and such that $\log U$ has zero mean and unit variance.

This model yields additive measurement error in the log scale:

$$\log W = \log X + \sigma \log U \quad (27)$$

and σ^2 can therefore be interpreted as the variance of the errors in the log scale.

Chesher (1991) derives an approximation for the densities in the case of independent additive measurement error. Call $R = \log W$, $S = \log X$, and $V = \log U$, so that $R = S + \sigma V$, where V is independent of S . Then:

$$f_R(r) \simeq f_S(r) + \frac{\sigma^2}{2} f_S''(r) \quad (28)$$

We now use this result to obtain an approximation for poverty indices.

For example, let us consider the headcount index. It is defined as the cumulative distribution function at the poverty line c : $H_X(c) = F_X(c)$. Notice that $F_X(c) = F_{\log X}(z)$, where $z = \log c$, so we can compute the index using the variables in the logarithmic scale. From (28) we obtain

$$F_R(z) \simeq F_S(z) + \frac{\sigma^2}{2} f'_S(z) \quad (29)$$

The approximation for the growth in the headcount index is derived in the next Section, applying this formula to the variables appearing in our economic model.

7.3 Application to the income and consumption model: the headcount ratio index

We can apply the approximation (29) to the income and consumption processes introduced earlier. We assumed (omitting the individual's index for simplicity):

$$y_t = y_t^p + u_t \quad (30)$$

$$y_t^p = y_{t-1}^p + v_t \quad (31)$$

where y_t and y_t^p are the logarithms of income and permanent income, respectively. Moreover we assumed that the logarithm of consumption responds only to the permanent shock

$$c_t = c_{t-1} + v_t \quad (32)$$

The use of the approximation in the case of the income process (30) is a natural choice, since we are interpreting current income as an error-ridden measure of permanent income. The same argument does not apply to processes (31) and (32), but the use of the approximation is still legitimate, since v_t has the same stochastic properties as the measurement errors considered above. We obtain:

$$F_{y_t}(z) \simeq F_{y_t^p}(z) + \frac{\sigma_{u_t}^2}{2} f'_{y_t^p}(z) \quad (33)$$

$$F_{y_t^p}(z) \simeq F_{y_{t-1}^p}(z) + \frac{\sigma_{v_t}^2}{2} f'_{y_{t-1}^p}(z) \quad (34)$$

$$F_{c_t}(z) \simeq F_{c_{t-1}}(z) + \frac{\sigma_{v_t}^2}{2} f'_{c_{t-1}}(z) \quad (35)$$

where z is the logarithm of the poverty line.

In a study where the target is to obtain indices of poverty corrected for measurement error, one would proceed estimating some way the variances of the errors, and then using them to obtain the corrected indices. In our case, however, we are mainly interested in the study of the evolution of poverty over time, so we intend to use the above approximations to obtain an expression for $\Delta F_{y_t}(z)$ and $\Delta F_{c_t}(z)$ as a function of the variances of the shocks. In fact, as the above equations show, the variances of the errors play a central role in the evolution of the indices, so our aim is to exploit those equations to obtain estimates of the variances.

Adding, to (33)-(35), the approximation for y_{t-1}

$$F_{y_{t-1}}(z) \simeq F_{y_{t-1}^p}(z) + \frac{\sigma_{u_t}^2}{2} f'_{y_{t-1}^p}(z) \quad (36)$$

and assuming $f'_{y_t^p}(z) \simeq f'_{y_{t-1}^p}(z) \simeq f'_{c_{t-1}}(z) \simeq f'_{c_{t-2}}(z)$, we have:

$$F_{y_t}(z) - F_{y_{t-1}}(z) \simeq \frac{\sigma_{v_t}^2 + \Delta\sigma_{u_t}^2}{2} f'_{c_{t-1}}(z) \quad (37)$$

$$F_{c_t}(z) - F_{c_{t-1}}(z) \simeq \frac{\sigma_{v_t}^2}{2} f'_{c_{t-1}}(z) \quad (38)$$

for one-year differences, and

$$F_{y_t}(z) - F_{y_{t-2}}(z) \simeq \frac{\sigma_{v_t}^2 + \sigma_{v_{t-1}}^2 + \Delta\sigma_{u_t}^2 + \Delta\sigma_{u_{t-1}}^2}{2} f'_{c_{t-2}}(z) \quad (39)$$

$$F_{c_t}(z) - F_{c_{t-2}}(z) \simeq \frac{\sigma_{v_t}^2 + \sigma_{v_{t-1}}^2}{2} f'_{c_{t-2}}(z) \quad (40)$$

for two-year differences. Denote now, as usual, the time periods by $t = t_1, t_2, \dots, t_T$, where $t_i - t_{i-1} = 1, 2$. Then we can use the notation $\Delta F_{y_{t_i}}(z)$ for both $F_{y_t}(z) - F_{y_{t-1}}(z)$ and $F_{y_t}(z) - F_{y_{t-2}}(z)$, the context indicating whether we are dealing with one- or two-year differences. The same applies to the measures based on consumption. For simplicity of notation, we will denote from now on $F_{y_{t_i}}$ by $F_{y_{t_i}}$.

The changes in the headcount can therefore be related to the level of the variance of permanent shocks and the change in the variance of transitory shocks.

In the above equations, we can estimate the changes in the headcount indices and the derivatives of the densities of income and consumption at the poverty line, therefore obtaining estimates of $\Delta \text{Var}_{kt}(v)$ and $\Delta \text{Var}_{kt}(u)$. If our assumptions are correct, such estimates should coincide with those obtained in Section 6 in the inequality framework, so we can use these estimates to test the validity of the model.

Notice also that the above results hold for any value of the poverty line z , so another test on the model can be derived from estimation of $\Delta \text{Var}_{kt}(v)$ and $\Delta \text{Var}_{kt}(u)$ for different values of z . If the estimates change with z , there is an indication that the variances of the shocks (in the log scale) are not common among all individuals in a cohort. This was one of the main assumptions of the model presented in Section 5. To investigate this issue, in Section 7.5 we propose a test for heteroskedasticity.

In future research, it may be worth trying to extend this to other poverty measures. One first extension, to the case of the poverty gap index, is presented in Rosati (2000b).

7.4 Computation of the standard errors

We compute now the standard errors for the headcount ratios and for their changes. To do so, we consider two different poverty lines, since as we just anticipated we will compare in Section 7.5 the values obtained at different lines, in order to test for the presence of heteroskedasticity.

Given a fixed time period $t = t_1, \dots, t_T$, consider two poverty lines z_1 and z_2 . The estimates of the headcount index are based on income and consumption measures, so that we obtain the following vector of estimates:

$$\hat{F}_t(z_1, z_2) = \begin{bmatrix} \hat{F}_{ct}(z_1) \\ \hat{F}_{yt}(z_1) \\ \hat{F}_{ct}(z_2) \\ \hat{F}_{yt}(z_2) \end{bmatrix}$$

All these are estimates of proportions, so their distribution will be asymptotically normal:

$$\sqrt{n_t}[\hat{F}_t(z_1, z_2) - F_t(z_1, z_2)] \rightarrow \mathcal{N}(0, \Pi_t)$$

where the variance-covariance matrix is:

$$\Pi_t = \begin{bmatrix} F_c(z_1)[1 - F_c(z_1)] & & & & & & & & \\ F_{cy}(z_1, z_1) - F_c(z_1)F_y(z_1) & F_y(z_1)[1 - F_y(z_1)] & & & & & & & \\ F_c(\min\{z_1, z_2\}) - F_c(z_1)F_c(z_2) & F_{cy}(z_2, z_1) - F_c(z_2)F_y(z_1) & F_c(z_2)[1 - F_c(z_2)] & & & & & & \\ F_{cy}(z_1, z_2) - F_c(z_2)F_y(z_2) & F_y(\min\{z_1, z_2\}) - F_y(z_1)F_y(z_2) & F_{cy}(z_2, z_2) - F_c(z_2)F_y(z_2) & F_y(z_2)[1 - F_y(z_2)] & & & & & \end{bmatrix}$$

and all the quantities above refer to year t .

For what concerns the growth in the headcount, we start from the following result:

$$\sqrt{n} \left[\begin{pmatrix} \hat{F}_{t_{i-1}}(z_1, z_2) \\ \hat{F}_{t_i}(z_1, z_2) \end{pmatrix} - \begin{pmatrix} F_{t_{i-1}}(z_1, z_2) \\ F_{t_i}(z_1, z_2) \end{pmatrix} \right] \rightarrow \mathcal{N} \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \frac{n}{n_{t_{i-1}}} \Pi_{t_{i-1}} & 0 \\ 0 & \frac{n}{n_{t_i}} \Pi_{t_i} \end{pmatrix} \right]$$

since the observations over different years are independent. Here $n = n_{t_{i-1}} + n_{t_i}$. Denote from now on the above variance-covariance matrix by Π_{t_{i-1}, t_i} . The growth in the headcount can be expressed as:

$$\Delta \hat{F}_{t_i}(z_1, z_2) = \begin{bmatrix} \Delta \hat{F}_{ct_i}(z_1) \\ \Delta \hat{F}_{yt_i}(z_1) \\ \Delta \hat{F}_{ct_i}(z_2) \\ \Delta \hat{F}_{yt_i}(z_2) \end{bmatrix} = B \begin{bmatrix} \hat{F}_{t_{i-1}}(z_1, z_2) \\ \hat{F}_{t_i}(z_1, z_2) \end{bmatrix}$$

where

$$B = \begin{pmatrix} -1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 1 \end{pmatrix}$$

i.e. $B = [-I_4, I_4]$.

It follows that the asymptotic distribution for the growth in the headcount index is:

$$\sqrt{n}[\Delta \hat{F}_{t_i}(z_1, z_2) - \Delta F_{t_i}(z_1, z_2)] \rightarrow \mathcal{N}(0, B \Pi_{t_{i-1}, t_i} B')$$

Notice that $B\Pi_{t_{i-1},t_i}B' = n \left(\Pi_{t_{i-1}}/n_{t_{i-1}} + \Pi_{t_i}/n_{t_i} \right)$. Therefore, the standard errors for $\Delta\hat{F}_{t_i}(z_1, z_2)$ are given by the diagonal elements of the matrix:

$$\left(\frac{\Pi_{t_{i-1}}}{n_{t_{i-1}}} + \frac{\Pi_{t_i}}{n_{t_i}} \right)^{\frac{1}{2}}$$

7.5 A simple test for heteroskedasticity

So far, we have assumed independent measurement error; this was because our economic model assumed constant variance of the economic shocks within cohorts. This assumption might be too strict, since it is quite likely that households in different parts of the distribution of income or consumption are affected by the shocks in different ways. Therefore we present here a simple test for heteroschedasticity, derived directly from the results on estimation of the previous section. The test is not very sensitive, but is easy to develop and compute, so it can be used for a first screening.

From the results of Section 7.3, we have:

$$R_{t_i}(z) = \left(\frac{\Delta F_{yt_i}(z)}{\Delta F_{ct_i}(z)} \right) = 1 + \frac{\Delta\sigma_{ut_i}^2}{\sigma_{vt_i}^2} \quad (41)$$

for annual data and

$$R_{t_i}(z) = 1 + \frac{\Delta\sigma_{ut_i}^2 + \Delta\sigma_{ut_{i-1}}^2}{\sigma_{vt_i}^2 + \sigma_{vt_{i-1}}^2} \quad (42)$$

for biannual data.

According to our hypotheses, σ_{vt}^2 and σ_{ut}^2 are constant (within cohorts) for fixed t , and therefore the above ratios are constant as well. It follows that, if we compute $R_{t_i}(z)$, for different values of z , it should be constant.

We can construct a simple test for the null hypothesis:

$$H_0 : R_{t_i}(z_1) = R_{t_i}(z_2) \quad (43)$$

Rejection of H_0 implies non-constancy of the variances; however, non-rejection can also occur in the presence of heteroskedasticity, in some particular cases. For instance, this would happen if σ_{vt}^2 and σ_{ut}^2 are not constant for fixed t , but are such that the ratios above (41) and (42) remain constant.

It is clear that this test is not ideal to test for heteroskedasticity, but as it is very easy to obtain, it can still help to have a general idea about the behaviour of the variances. A specific and precise test for heteroskedasticity is sketched in Rosati (2000b).

To test the above hypothesis (43), let us derive the distribution for the quantity $R_{t_i}(z_1, z_2) = R_{t_i}(z_1) - R_{t_i}(z_2)$. Define the function $f(a, b, c, d)' = b/a - d/c$. If we apply it to the vector $\Delta\hat{F}_{t_i}(z_1, z_2)$, we obtain the quantity we are looking for, namely:

$$R_{t_i}(z_1, z_2) = f(\Delta\hat{F}_{t_i}(z_1, z_2))$$

The Jacobian matrix for this transformation is

$$J = \left[-\frac{b}{a^2}, \frac{1}{a}, \frac{d}{c^2}, -\frac{1}{c} \right]$$

In our case we obtain:

$$J_{t_i}(z_1, z_2) = \left[-\frac{\Delta F_{y_{t_i}}(z_1)}{(\Delta F_{ct_i}(z_1))^2}, \frac{1}{\Delta F_{ct_i}(z_1)}, \frac{\Delta F_{y_{t_i}}(z_2)}{(\Delta F_{ct_i}(z_2))^2}, -\frac{1}{\Delta F_{ct_i}(z_2)} \right]$$

Therefore¹⁴

$$\sqrt{n} \left(\hat{R}_{t_i}(z_1, z_2) - R_{t_i}(z_1, z_2) \right) \rightarrow \mathcal{N}(0, \sigma_{R_{t_i}}^2)$$

where $\sigma_{R_{t_i}}^2 = J_{t_i} B \Pi_{t_{i-1}, t_i} B' J_{t_i}'$.

Under the null hypothesis (43), we have $R_{t_i}(z_1, z_2) = 0$, hence

$$\sqrt{n} \left(R_{t_i}(z_1, z_2) \right) \rightarrow \mathcal{N}(0, \sigma_{R_{t_i}}^2)$$

Therefore we can construct the test

$$\chi^2 = \frac{[R_{t_i}(z_1, z_2)]^2}{\sigma_{R_{t_i}}^2/n}$$

which has an asymptotic Chi-squared distribution with 1 d.f.

8 Empirical evidence on poverty

In our analyses, we used both income and consumption to compute headcount indices. According to our model, we need to fix a certain value for the poverty line, and use it for both variables. Since we also want to investigate the effects of the choice of the poverty line, we choose four different values. This, in turn, will enable us to run the simple test for heteroskedasticity as well.

The lines we choose, in each year, correspond to mean consumption, and to 25%, 50% and 75% of mean consumption; they are reported in Table 13. Tables 14-19 present the corresponding headcount indices from income and consumption. All results are computed within the usual three cohorts, and are also displayed in Figures 17-18.

The values of the headcount ratios are clearly different for the four poverty lines, but the profiles over time are quite similar, and this is also reflected in quite small differences in the changes over time.

The main findings are in line with the empirical evidence on inequality. In fact, we notice that the headcount ratios based on consumption are generally constant, while those based on income show an upward trend. According to the theory, the growth of the headcount ratio from consumption is driven by the variance of permanent shocks, and that of the index from income is affected by the variance of both transitory and permanent shocks. Therefore, our findings are consistent with the estimates for the

variances of the shocks obtained in the inequality context, where we found a flat trend for the permanent shocks and a slightly increasing one for the transitory shocks.

Tables 20-22 present the results of the test for heteroskedasticity. The test provides no evidence against our hypothesis, but as we anticipated, it is not very sensitive. In fact, we are testing for constancy of the ratio (42), but this could be true even with heteroskedasticity, as a non-constant variance could be disguised by the fact that we are computing a ratio. Therefore we do not take this as a final answer regarding heteroskedasticity; this issue has been investigated further in Rosati (2000b).

9 Conclusions and further developments

This paper offered a new, formalised approach to the study of economic inequality and poverty, and new empirical evidence on Italy to add to the past mainly descriptive studies.

Starting from an economic model of intertemporal optimization, we derived equations that related the growth of inequality and poverty to the variances of the transitory and permanent shocks of the economy. This allowed us to identify and estimate separately the permanent and transitory components of the two phenomena by using jointly income and consumption measures. We found evidence of an increase in both transitory inequality and poverty, but overall constant levels for the permanent components, in line with the findings of other studies on the UK and the US. Separate estimates of the variances of the shocks showed consistent results, i.e. an increase for the transitory shocks and a flat trend for the permanent.

The model allowed also to derive two tests for some of the assumptions, but the results did not give a final answer and some further research would be appropriate. We first tested for the correlation of the shocks with past values of income and consumption, but the data we used were not collected every year, so not all the lagged values of income and consumption were available, and therefore the test was not able to detect significant correlations. This issue is worth further investigation, since similar analyses on other countries identified the presence of correlation in some cohorts. However, to do so, we would need data with a regular time pattern, which was not the case in the present study.

The second assumption to test was that of common variance of the shocks among all individuals in the same birth cohort. A first very simple test did not detect directly heteroskedasticity, but gave results that can be consistent with both constant and non-constant variance, and therefore this issue deserves further investigation too. A preliminary empirical analysis and an extension of the model to the case of non-constant variance can be found in Rosati (2000b). The further estimates involved in the extended model are quite difficult to compute, and have not been obtained yet. It would certainly be worth dedicating some more research to this computation, as such estimates would also provide a way to test directly for heteroskedasticity, and

¹⁴This follows from the asymptotic result: if $\sqrt{n}(\hat{\theta} - \theta) \rightarrow \mathcal{N}(0, \Sigma)$ then $\sqrt{n}(g(\hat{\theta}) - g(\theta)) \rightarrow \mathcal{N}(0, G\Sigma G')$, where $G = [\partial g_i / \partial \theta_j]$.

separately for the two shocks. Moreover, the identification of the shape of the variance functions would give new insight for the economic interpretation, identifying the differences in the impact of the economic shocks along the distributions of income and consumption.

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Year	Estimate A	SE	Estimate B	SE	MSE	SE
81	0.0028	(0.0003)	0.0100	(0.0004)	0.0019	(0.0003)
82	0.0024	(0.0003)	0.0101	(0.0004)	0.0023	(0.0003)
83	0.0029	(0.0003)	0.0118	(0.0004)	0.0021	(0.0003)
84	0.0030	(0.0003)	0.0207	(0.0004)	0.0025	(0.0003)
85	0.0030	(0.0003)	0.0100	(0.0004)	0.0025	(0.0003)
86	0.0035	(0.0003)	0.0217	(0.0004)	0.0026	(0.0003)
87	0.0032	(0.0003)	0.0173	(0.0004)	0.0030	(0.0003)
88	0.0035	(0.0003)	0.0081	(0.0004)	0.0033	(0.0003)
89	0.0034	(0.0003)	0.0093	(0.0004)	0.0037	(0.0003)
90	0.0033	(0.0003)	0.0100	(0.0004)	0.0039	(0.0003)

Year	Estimate A	SE	Estimate B	SE	MSE	SE
81	0.0027	(0.0003)	0.0105	(0.0004)	0.0022	(0.0003)
82	0.0010	(0.0003)	0.0173	(0.0004)	0.0041	(0.0003)
83	0.0025	(0.0003)	0.0147	(0.0004)	0.0023	(0.0003)
84	0.0018	(0.0003)	0.0086	(0.0004)	0.0041	(0.0003)
85	0.0017	(0.0003)	0.0087	(0.0004)	0.0017	(0.0003)
86	0.0015	(0.0003)	0.0051	(0.0004)	0.0025	(0.0003)
87	0.0013	(0.0003)	0.0055	(0.0004)	0.0041	(0.0003)
88	0.0008	(0.0003)	0.0020	(0.0004)	0.0017	(0.0003)
89	0.0022	(0.0003)	0.0053	(0.0004)	0.0010	(0.0003)
90	0.0001	(0.0003)	0.0019	(0.0004)	0.0028	(0.0003)

Year	Estimate A	SE	Estimate B	SE	MSE	SE
81	0.0007	(0.0013)	0.0073	(0.0013)	0.0024	(0.0014)
82	0.0073	(0.0013)	0.0038	(0.0013)	0.0021	(0.0014)
83	0.0008	(0.0013)	0.0083	(0.0013)	0.0002	(0.0013)
84	0.0032	(0.0013)	0.0002	(0.0013)	0.0017	(0.0013)
85	0.0021	(0.0013)	0.0071	(0.0013)	0.0023	(0.0013)
86	0.0019	(0.0013)	0.0081	(0.0013)	0.0019	(0.0013)
87	0.0019	(0.0013)	0.0075	(0.0013)	0.0024	(0.0013)
88	0.0012	(0.0013)	0.0070	(0.0013)	0.0022	(0.0013)
89	0.0025	(0.0013)	0.0081	(0.0013)	0.0024	(0.0013)
90	0.0019	(0.0013)	0.0088	(0.0013)	0.0021	(0.0013)

The first estimate is computed from the variance alone.

The second estimate is computed from the variance of income and the covariance between income and consumption.

Table 8: *Estimates of the changes in the variances of the transitory shocks. SHIW data, head of the household born in the 1930s (top), 1940s (centre) and 1950s (bottom).*

Year	Estim. A ¹	SE	Estim. B ²	SE	MDE	SE
81	-0.0205	(0.0098)	-0.0099	(0.0669)	-0.0209	(0.0096)
82	-0.0071	(0.0088)	0.0171	(0.0517)	-0.0082	(0.0086)
83	-0.0029	(0.0088)	-0.0128	(0.0519)	-0.0021	(0.0087)
84	0.0490	(0.0083)	0.0297	(0.0612)	0.0495	(0.0082)
86	-0.0280	(0.0079)	-0.0198	(0.0517)	-0.0283	(0.0077)
87	-0.0106	(0.0065)	-0.0317	(0.0475)	-0.0096	(0.0061)
89	0.0292	(0.0053)	0.0175	(0.0535)	0.0293	(0.0049)
91	-0.0516	(0.0056)	-0.0081	(0.0473)	-0.0533	(0.0053)
93	0.0571	(0.0079)	0.0462	(0.0683)	0.0577	(0.0072)
95	0.0022	(0.0092)	0.0100	(0.0724)	0.0019	(0.0088)

Year	Estim. A ¹	SE	Estim. B ²	SE	MDE	SE
81	0.0277	(0.0090)	0.0166	(0.0659)	0.0282	(0.0089)
82	0.0010	(0.0090)	0.0173	(0.0609)	0.0001	(0.0089)
83	0.0065	(0.0095)	-0.0147	(0.0579)	0.0073	(0.0092)
84	0.0178	(0.0079)	0.0086	(0.0604)	0.0181	(0.0077)
86	0.0173	(0.0065)	0.0067	(0.0513)	0.0177	(0.0063)
87	-0.0365	(0.0056)	-0.0363	(0.0451)	-0.0363	(0.0053)
89	0.0103	(0.0046)	0.0055	(0.0438)	0.0104	(0.0042)
91	-0.0308	(0.0043)	-0.0089	(0.0414)	-0.0317	(0.0040)
93	0.0638	(0.0058)	0.0658	(0.0385)	0.0636	(0.0056)
95	0.0031	(0.0060)	-0.0129	(0.0385)	0.0038	(0.0058)

Year	Estim. A ¹	SE	Estim. B ²	SE	MDE	SE
81	-0.0307	(0.0143)	-0.0173	(0.0780)	-0.0324	(0.0134)
82	-0.0273	(0.0149)	0.0058	(0.0705)	-0.0262	(0.0144)
83	0.0508	(0.0191)	0.0185	(0.0982)	0.0502	(0.0183)
84	0.0132	(0.0161)	-0.0058	(0.0940)	0.0147	(0.0151)
86	0.0221	(0.0086)	-0.0071	(0.0539)	0.0233	(0.0083)
87	-0.0448	(0.0060)	-0.0384	(0.0439)	-0.0449	(0.0056)
89	0.0219	(0.0053)	0.0078	(0.0492)	0.0224	(0.0047)
91	-0.0312	(0.0048)	-0.0070	(0.0480)	-0.0322	(0.0044)
93	0.0722	(0.0056)	0.0691	(0.0414)	0.0724	(0.0053)
95	-0.0444	(0.0057)	-0.0296	(0.0448)	-0.0450	(0.0054)

¹ The first estimate is computed from the variances alone.

² The second estimate is computed from the variance of income and the covariance between income and consumption.

Table 9: *Estimates of the changes in the variances of the permanent shocks. SHIW data, head of the household born in the 1930s (top), 1940s (centre) and 1950s (bottom).*

Year	Estim. A ¹	SE	Estim. B ²	SE	MDE	SE
82	-0.0214	(0.0184)	-0.0350	(0.1007)	-0.0214	(0.0184)
83	-0.0003	(0.0170)	0.0337	(0.0815)	-0.0002	(0.0170)
84	0.0205	(0.0157)	0.0299	(0.0969)	0.0208	(0.0156)
86	0.0036	(0.0082)	-0.0101	(0.0486)	0.0034	(0.0081)
87	-0.0098	(0.0172)	0.0196	(0.0755)	-0.0091	(0.0171)
89	-0.0321	(0.0081)	-0.0368	(0.0427)	-0.0323	(0.0080)
91	0.0485	(0.0072)	0.0209	(0.0419)	0.0479	(0.0072)
93	-0.0044	(0.0092)	0.0227	(0.0439)	-0.0036	(0.0091)
95	-0.0242	(0.0129)	-0.0335	(0.0635)	-0.0244	(0.0128)

Year	Estim. A ¹	SE	Estim. B ²	SE	MDE	SE
82	-0.0130	(0.0205)	-0.0403	(0.1129)	-0.0122	(0.0205)
83	-0.0122	(0.0187)	0.0253	(0.0967)	-0.0131	(0.0187)
84	-0.0001	(0.0175)	-0.0121	(0.1000)	0.0007	(0.0174)
86	0.0187	(0.0074)	0.0195	(0.0475)	0.0188	(0.0074)
87	0.0222	(0.0143)	0.0114	(0.0781)	0.0218	(0.0142)
89	-0.0476	(0.0077)	-0.0452	(0.0373)	-0.0475	(0.0077)
91	0.0414	(0.0065)	0.0281	(0.0350)	0.0412	(0.0065)
93	-0.0184	(0.0068)	-0.0085	(0.0335)	-0.0183	(0.0068)
95	-0.0041	(0.0078)	0.0049	(0.0309)	-0.0039	(0.0078)

Year	Estim. A ¹	SE	Estim. B ²	SE	MDE	SE
82	-0.0235	(0.0252)	-0.0432	(0.1150)	-0.0228	(0.0252)
83	0.0228	(0.0328)	0.0881	(0.1351)	0.0222	(0.0326)
84	-0.0055	(0.0314)	-0.0188	(0.1625)	-0.0033	(0.0308)
86	-0.0250	(0.0105)	-0.0199	(0.0596)	-0.0259	(0.0103)
87	0.0799	(0.0143)	0.0443	(0.0774)	0.0805	(0.0143)
89	-0.0260	(0.0075)	-0.0157	(0.0388)	-0.0261	(0.0075)
91	0.0291	(0.0066)	0.0100	(0.0407)	0.0289	(0.0066)
93	-0.0360	(0.0072)	-0.0224	(0.0375)	-0.0358	(0.0072)
95	0.0282	(0.0068)	0.0193	(0.0338)	0.0281	(0.0068)

¹ The first estimate is computed from the variance of consumption.

² The second estimate is computed from the covariance between income and consumption.

Table 10: *Test for over-identifying restrictions, by birth cohort of the head of the household. Whole sample, SHIW data.*

	Born 1930s	Born 1940s	Born 1950s
χ^2_{10}	2.1448	1.9882	3.5729
p-value	0.9951	0.9964	0.9646

Table 11: Test for over-identifying restrictions, by geographical area and birth cohort of the head of the household. Top: northern regions, centre: central regions, bottom: southern regions. SHIW data.

	Born 1930s	Born 1940s	Born 1950s
χ^2_{10}	1.7749	1.0129	2.9498
p-value	0.9978	0.9998	0.9825
χ^2_{10}	1.3443	1.2596	0.6923
p-value	0.9993	0.9995	0.99999
χ^2_{10}	1.8527	1.0599	3.9586
p-value	0.9973	0.9997	0.9492

Table 12: Test for over-identifying restrictions, by educational level and birth cohort of the head of the household. Top: high educated, bottom: low educated. SHIW data.

	Born 1930s	Born 1940s	Born 1950s
χ^2_{10}	1.0112	1.3768	1.5732
p-value	0.9998	0.9992	0.9986
χ^2_{10}	1.9578	1.4039	2.1050
p-value	0.9967	0.9992	0.9955

Table 13: Poverty lines: 25%, 50% and 75% of mean consumption, and mean consumption. Thousand Liras.

Year	25% mean	50% mean	75% mean	Mean cons.
80	70	140	210	280
81	88	176	264	352
82	99	198	297	396
83	115	230	345	460
84	133	265	398	530
86	152	304	457	609
87	207	414	620	827
89	226	452	677	903
91	263	526	789	1051
93	293	585	878	1170
95	315	630	946	1261

Table 14: *Headcount ratios¹ from consumption for four different poverty lines². Cohort of born in the 1930s, SHIW data.*

Year	HR25	SE	HR50	SE	HR75	SE	HR100	SE
80	0.0064	(0.0037)	0.0687	(0.0117)	0.2983	(0.0212)	0.5880	(0.0228)
81	0.0033	(0.0023)	0.0912	(0.0117)	0.3284	(0.0191)	0.5788	(0.0201)
82	0.0000	(0.0000)	0.0879	(0.0113)	0.3115	(0.0185)	0.5927	(0.0196)
83	0.0015	(0.0015)	0.0724	(0.0102)	0.3220	(0.0183)	0.5840	(0.0193)
84	0.0000	(0.0000)	0.0713	(0.0105)	0.3466	(0.0194)	0.6119	(0.0198)
86	0.0009	(0.0009)	0.0986	(0.0091)	0.3380	(0.0145)	0.5775	(0.0151)
87	0.0020	(0.0014)	0.1301	(0.0106)	0.3525	(0.0151)	0.5770	(0.0156)
89	0.0000	(0.0000)	0.0702	(0.0087)	0.3222	(0.0159)	0.5926	(0.0167)
91	0.0015	(0.0015)	0.1041	(0.0117)	0.3504	(0.0183)	0.5806	(0.0189)
93	0.0000	(0.0000)	0.1242	(0.0157)	0.3837	(0.0231)	0.6005	(0.0233)
95	0.0033	(0.0033)	0.1104	(0.0181)	0.3779	(0.0280)	0.6020	(0.0283)

¹ HR25, HR50 and HR75 are the headcount ratio indices computed for a poverty line equal to 25%, 50% and 75% of mean consumption, respectively. HR100 refers to a poverty line equal to mean consumption.

² See Table 13.

Table 15: *Headcount ratios¹ from income for four different poverty lines². Cohort of born in the 1930s, SHIW data.*

Year	HR25	SE	HR50	SE	HR75	SE	HR100	SE
80	0.0064	(0.0037)	0.0644	(0.0114)	0.2425	(0.0199)	0.4635	(0.0231)
81	0.0083	(0.0037)	0.0945	(0.0119)	0.3367	(0.0192)	0.5605	(0.0202)
82	0.0016	(0.0016)	0.0639	(0.0098)	0.2380	(0.0170)	0.4856	(0.0200)
83	0.0046	(0.0027)	0.0570	(0.0091)	0.2219	(0.0163)	0.4592	(0.0196)
84	0.0149	(0.0049)	0.0862	(0.0114)	0.2985	(0.0186)	0.4992	(0.0204)
86	0.0085	(0.0028)	0.0854	(0.0086)	0.2732	(0.0137)	0.4798	(0.0153)
87	0.0040	(0.0020)	0.1291	(0.0106)	0.3476	(0.0150)	0.5412	(0.0157)
89	0.0035	(0.0020)	0.0990	(0.0101)	0.3211	(0.0158)	0.5420	(0.0169)
91	0.0088	(0.0036)	0.1100	(0.0120)	0.3343	(0.0181)	0.5587	(0.0190)
93	0.0158	(0.0059)	0.1535	(0.0171)	0.3679	(0.0229)	0.5576	(0.0236)
95	0.0234	(0.0087)	0.1773	(0.0221)	0.4281	(0.0286)	0.6020	(0.0283)

¹ See note 1 in Table 14.

² See Table 13.

Table 16: Headcount ratios¹ from consumption for four different poverty lines². Cohort of born in the 1940s, SHIW data.

Year	HR25	SE	HR50	SE	HR75	SE	HR100	SE
80	0.0024	(0.0024)	0.0898	(0.0141)	0.3422	(0.0234)	0.5777	(0.0243)
81	0.0033	(0.0023)	0.0956	(0.0119)	0.3427	(0.0193)	0.5964	(0.0199)
82	0.0000	(0.0000)	0.0989	(0.0126)	0.3445	(0.0200)	0.6025	(0.0206)
83	0.0017	(0.0017)	0.0799	(0.0111)	0.3394	(0.0193)	0.6007	(0.0200)
84	0.0000	(0.0000)	0.0694	(0.0098)	0.3117	(0.0178)	0.5968	(0.0189)
86	0.0024	(0.0014)	0.0782	(0.0076)	0.3543	(0.0135)	0.5802	(0.0139)
87	0.0016	(0.0011)	0.1207	(0.0093)	0.3930	(0.0139)	0.5989	(0.0140)
89	0.0000	(0.0000)	0.0822	(0.0077)	0.3466	(0.0133)	0.6041	(0.0137)
91	0.0024	(0.0014)	0.1027	(0.0086)	0.3604	(0.0136)	0.5963	(0.0139)
93	0.0038	(0.0019)	0.0964	(0.0091)	0.3393	(0.0146)	0.6040	(0.0150)
95	0.0041	(0.0021)	0.0856	(0.0090)	0.3381	(0.0152)	0.6031	(0.0157)

¹ See note 1 in Table 14.

² See Table 13.

Table 17: Headcount ratios¹ from income for four different poverty lines². Cohort of born in the 1940s, SHIW data.

Year	HR25	SE	HR50	SE	HR75	SE	HR100	SE
80	0.0000	(0.0000)	0.0607	(0.0118)	0.2524	(0.0214)	0.4830	(0.0246)
81	0.0115	(0.0043)	0.0923	(0.0117)	0.3130	(0.0188)	0.5651	(0.0201)
82	0.0018	(0.0018)	0.0777	(0.0113)	0.2827	(0.0189)	0.4947	(0.0210)
83	0.0067	(0.0033)	0.0616	(0.0098)	0.2812	(0.0183)	0.4775	(0.0204)
84	0.0030	(0.0021)	0.0650	(0.0095)	0.2747	(0.0172)	0.4786	(0.0192)
86	0.0120	(0.0031)	0.0726	(0.0073)	0.2650	(0.0125)	0.4709	(0.0141)
87	0.0041	(0.0018)	0.1394	(0.0099)	0.3938	(0.0139)	0.5916	(0.0140)
89	0.0023	(0.0014)	0.1095	(0.0087)	0.3607	(0.0134)	0.5665	(0.0139)
91	0.0048	(0.0020)	0.1083	(0.0088)	0.3628	(0.0136)	0.5738	(0.0140)
93	0.0198	(0.0043)	0.1238	(0.0101)	0.3535	(0.0147)	0.5577	(0.0153)
95	0.0247	(0.0050)	0.1588	(0.0117)	0.3763	(0.0156)	0.5928	(0.0158)

¹ See note 1 in Table 14.

² See Table 13.

Table 18: *Headcount ratios¹ from consumption for four different poverty lines². Cohort of born in the 1950s, SHIW data.*

Year	HR25	SE	HR50	SE	HR75	SE	HR100	SE
80	0.0000	(0.0000)	0.0727	(0.0202)	0.4242	(0.0385)	0.6303	(0.0376)
81	0.0066	(0.0047)	0.1056	(0.0177)	0.3564	(0.0275)	0.5941	(0.0282)
82	0.0076	(0.0054)	0.0802	(0.0168)	0.3435	(0.0293)	0.6298	(0.0298)
83	0.0050	(0.0050)	0.1106	(0.0222)	0.3769	(0.0344)	0.6080	(0.0346)
84	0.0000	(0.0000)	0.1086	(0.0156)	0.3838	(0.0244)	0.6263	(0.0243)
86	0.0011	(0.0011)	0.0779	(0.0088)	0.3290	(0.0155)	0.5952	(0.0161)
87	0.0011	(0.0011)	0.1080	(0.0102)	0.3860	(0.0161)	0.6020	(0.0162)
89	0.0000	(0.0000)	0.1022	(0.0093)	0.3646	(0.0147)	0.6007	(0.0150)
91	0.0038	(0.0019)	0.1337	(0.0105)	0.3935	(0.0151)	0.5912	(0.0152)
93	0.0048	(0.0021)	0.1011	(0.0094)	0.3677	(0.0150)	0.6160	(0.0151)
95	0.0030	(0.0017)	0.1173	(0.0102)	0.3964	(0.0156)	0.6016	(0.0156)

¹ See note 1 in Table 14.

² See Table 13.

Table 19: *Headcount ratios¹ from income for four different poverty lines². Cohort of born in the 1950s, SHIW data.*

Year	HR25	SE	HR50	SE	HR75	SE	HR100	SE
80	0.0000	(0.0000)	0.0727	(0.0202)	0.2727	(0.0347)	0.4061	(0.0382)
81	0.0066	(0.0047)	0.1122	(0.0181)	0.3597	(0.0276)	0.5809	(0.0283)
82	0.0000	(0.0000)	0.0687	(0.0156)	0.2824	(0.0278)	0.5420	(0.0308)
83	0.0000	(0.0000)	0.0905	(0.0203)	0.3266	(0.0332)	0.5276	(0.0354)
84	0.0152	(0.0061)	0.0960	(0.0148)	0.3182	(0.0234)	0.5076	(0.0251)
86	0.0108	(0.0034)	0.0812	(0.0090)	0.2608	(0.0144)	0.5076	(0.0164)
87	0.0065	(0.0027)	0.1123	(0.0104)	0.3501	(0.0158)	0.5972	(0.0087)
89	0.0047	(0.0021)	0.1153	(0.0098)	0.3543	(0.0146)	0.5953	(0.0064)
91	0.0086	(0.0029)	0.1299	(0.0104)	0.4031	(0.0152)	0.5934	(0.0041)
93	0.0202	(0.0044)	0.1319	(0.0105)	0.3667	(0.0150)	0.5914	(0.0017)
95	0.0293	(0.0054)	0.1719	(0.0120)	0.4277	(0.0157)	0.5895	(-0.0006)

¹ See note 1 in Table 14.

² See Table 13.

Table 20: *Test for heteroskedasticity¹. Cohort of born in the 1930s, SHIW data.*

Year	R25	R50	R75	T2550	p2550	T2575	p2575	T5075	p5075
81	-0.5941	1.3375	3.1309	0.6999	0.4028	1.3680	0.2422	0.4668	0.4945
82	2.0184	9.1399	5.8512	0.0273	0.8688	0.1916	0.6616	0.0067	0.9350
83	1.9633	0.4460	-1.5324	0.2522	0.6155	0.3627	0.5470	0.1329	0.7154
84	-6.6866	-26.3526	3.1192	0.0031	0.9553	1.5030	0.2202	0.0070	0.9332
86	-6.8955	-0.0289	2.9477	0.5758	0.4480	0.7569	0.3843	0.1645	0.6851
87	-4.2769	1.3858	5.1246	0.5465	0.4597	0.8050	0.3696	0.3258	0.5681
89	0.2618	0.5031	0.8742	0.0294	0.8639	0.1605	0.6887	0.3958	0.5293
91	3.6456	0.3246	0.4694	0.8059	0.3693	0.7125	0.3986	0.0457	0.8307
93	-4.7765	2.1712	1.0098	0.8741	0.3498	0.6013	0.4381	0.4453	0.5046
95	2.2754	-1.7234	-10.3333	0.3982	0.5280	0.0340	0.8536	0.0171	0.8958

¹ R25, R50 and R75 are the ratios (41) or (42) computed in correspondence of a poverty line equal to 25%, 50% or 75% of mean consumption. With obvious notation, the test T2550 tests the hypothesis that R25 = R50, and similarly the tests T2575 and T5075.

Table 21: *Test for heteroskedasticity¹. Cohort of born in the 1940s, SHIW data.*

Year	R25	R50	R75	T2550	p2550	T2575	p2575	T5075	p5075
81	13.2903	5.4955	139.0074	0.0226	0.8806	0.0002	0.9896	0.0002	0.9889
82	2.9638	-4.2852	-16.3578	0.0907	0.7632	0.0058	0.9391	0.0025	0.9602
83	2.9382	0.8480	0.2923	0.4914	0.4833	0.2428	0.6222	0.0159	0.8995
84	2.2245	-0.3283	0.2325	0.9052	0.3414	0.6131	0.4336	0.1583	0.6908
86	3.7661	0.8685	-0.2291	1.1452	0.2846	2.8045	0.0940	0.5367	0.4638
87	10.2383	1.5696	3.3318	0.1383	0.7100	0.0873	0.7676	1.5595	0.2117
89	1.0516	0.7733	0.7139	0.0307	0.8610	0.0443	0.8333	0.0233	0.8787
91	1.0250	-0.0583	0.1488	0.8679	0.3515	0.2932	0.5882	0.0326	0.8568
93	10.9492	-2.4479	0.4404	0.5241	0.4691	0.3313	0.5649	0.2271	0.6337
95	14.2670	-3.2233	-19.3948	0.0244	0.8759	0.0084	0.9269	0.0021	0.9636

¹ See note in Table 20.

Table 22: *Test for heteroskedasticity¹. Cohort of born in the 1950s, SHIW data.*

Year	R25	R50	R75	T2550	p2550	T2575	p2575	T5075	p5075
81	1.0000	1.2007	-1.2832	0.0249	0.8747	2.2496	0.1336	2.2128	0.1369
82	-6.3902	1.7091	5.9805	0.0318	0.8585	0.0693	0.7924	0.0623	0.8029
83	0.0000	0.7155	1.3241	0.6342	0.4258	0.6289	0.4277	0.1295	0.7190
84	-3.0152	-2.8000	-1.2153	0.0000	0.9961	0.0224	0.8810	0.0009	0.9756
86	-4.0000	0.4824	1.0461	0.2951	0.5870	0.3837	0.5356	0.6886	0.4066
87	-518.0029	1.0371	1.5645	0.0000	0.9957	0.0000	0.9957	0.7004	0.4026
89	1.7029	-0.5088	-0.1961	0.2466	0.6195	0.2721	0.6019	0.0120	0.9127
91	1.0234	0.4632	1.6865	0.3949	0.5297	0.2615	0.6091	1.4184	0.2337
93	11.7108	-0.0601	1.4068	0.1325	0.7158	0.1009	0.7507	1.7951	0.1803
95	-5.1214	2.4664	2.1257	0.6037	0.4372	0.5426	0.4613	0.0303	0.8619

¹ See note in Table 20.

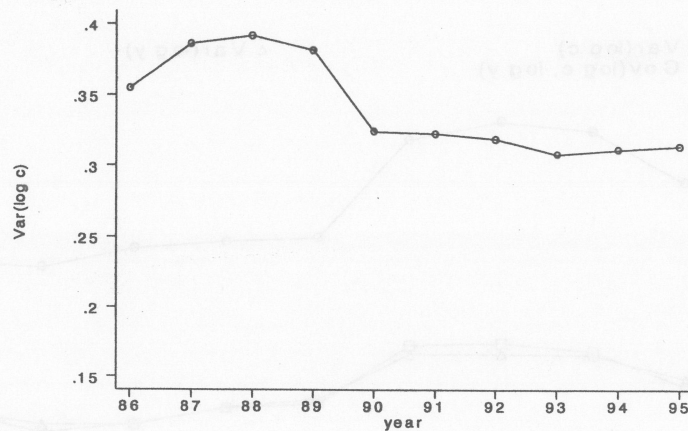


Figure 1: Variance of log-consumption, SFB data. The scale is the same as in Figure 2, for easier comparison.

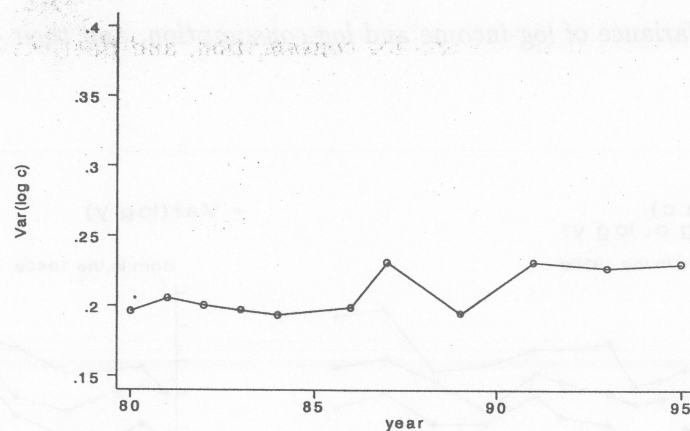


Figure 2: Variance of log-consumption, SHIW data. The scale is the same as in Figure 1, for easier comparison.

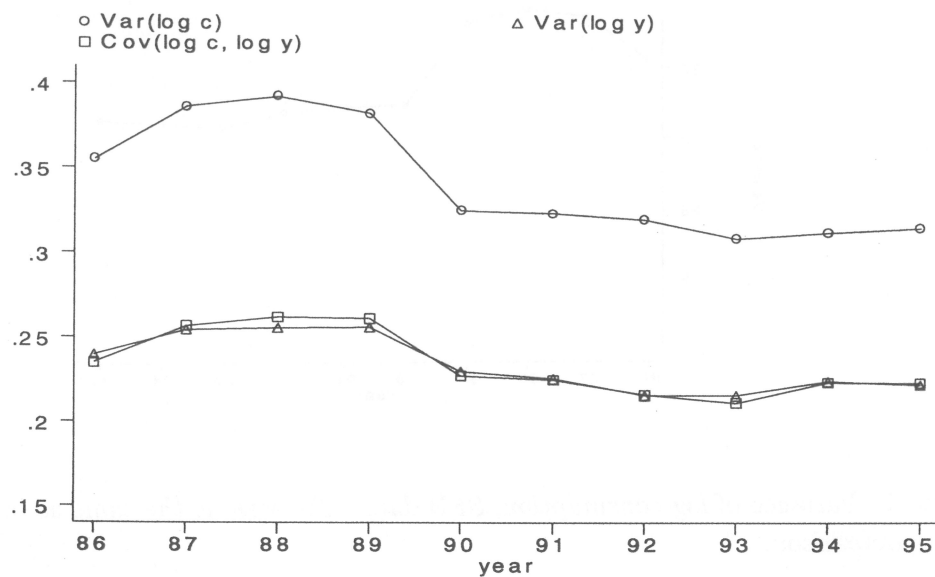


Figure 3: Variance of log-income and log-consumption, and their covariance. SFB data.

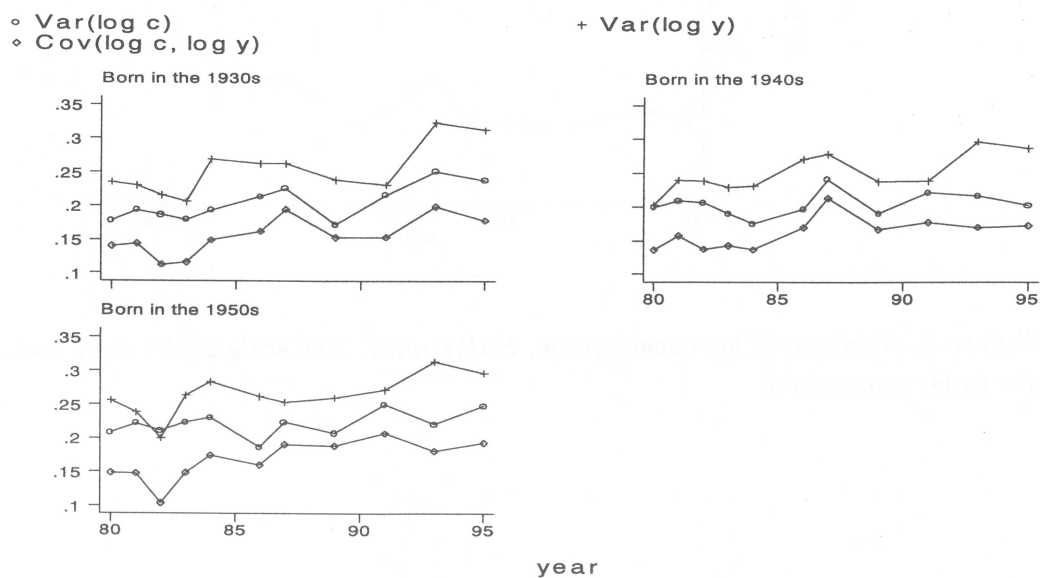
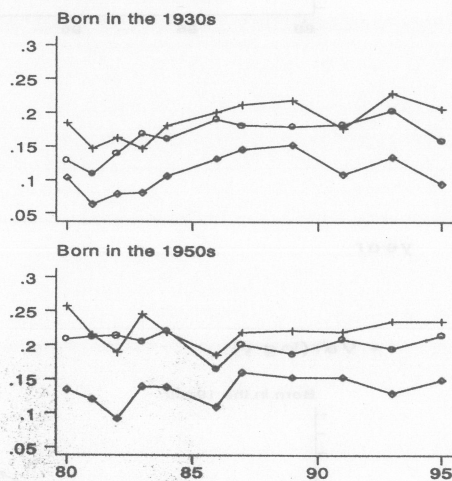
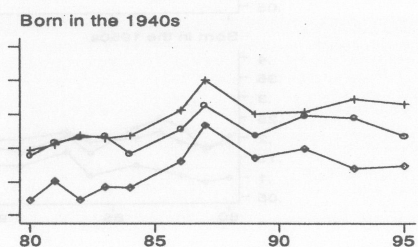


Figure 4: Variance of log-income and log-consumption, and their covariance, by birth cohort. Whole sample, SHIW data.

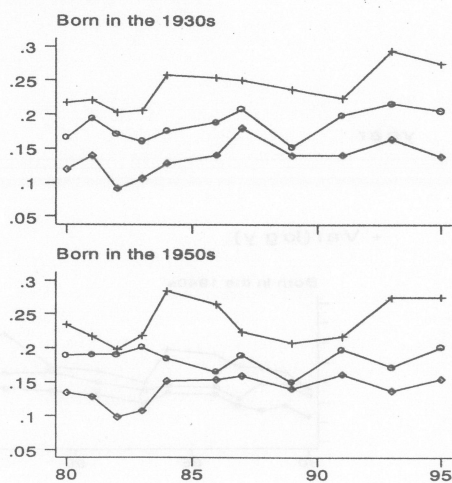
◦ $\text{Var}(\log c)$
◊ $\text{Cov}(\log c, \log y)$



+ $\text{Var}(\log y)$



◦ $\text{Var}(\log c)$
◊ $\text{Cov}(\log c, \log y)$



+ $\text{Var}(\log y)$

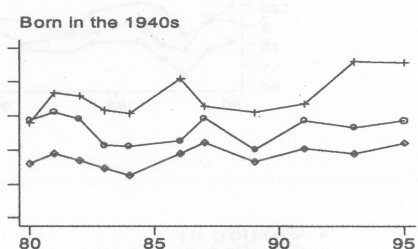


Figure 5: Variance of log-income and log-consumption, and their covariance, by birth cohort. Top: high educated, bottom: low educated. SHIW data.

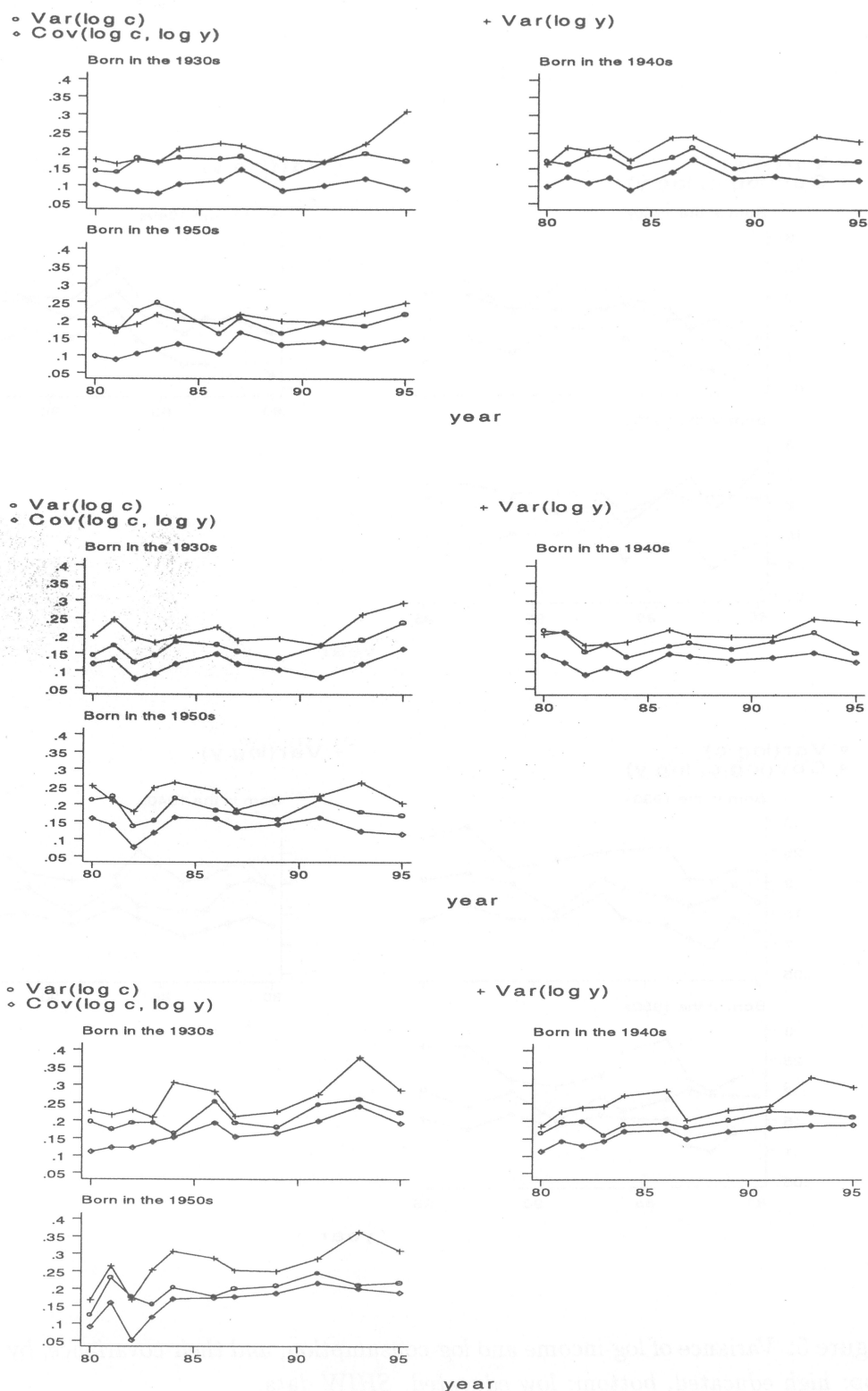


Figure 6: Variance of log-income and log-consumption, and their covariance, by birth cohort. Top: northern regions, centre: central regions, bottom: southern regions. SHIW data.

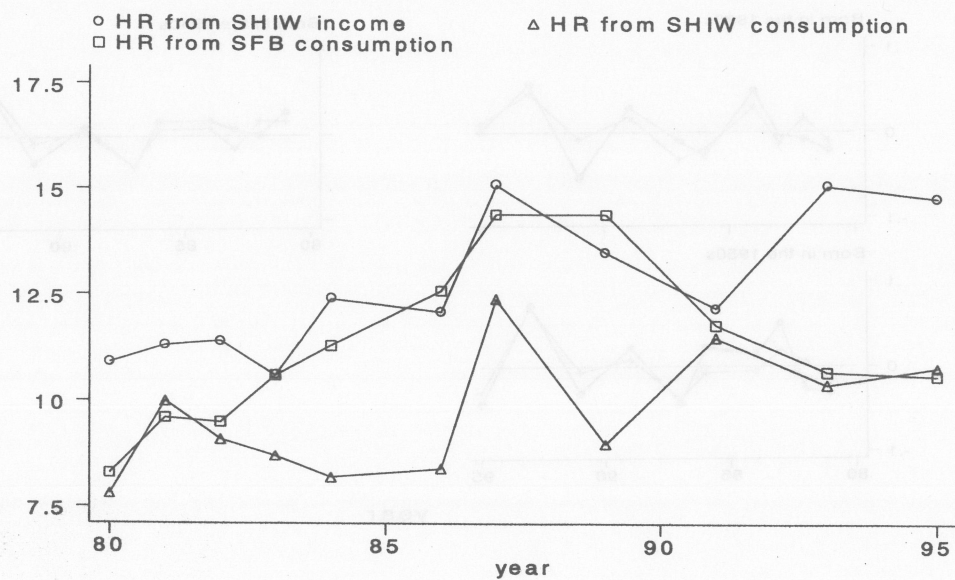


Figure 7: Headcount ratios based on income and consumption, SHIW and SFB data.

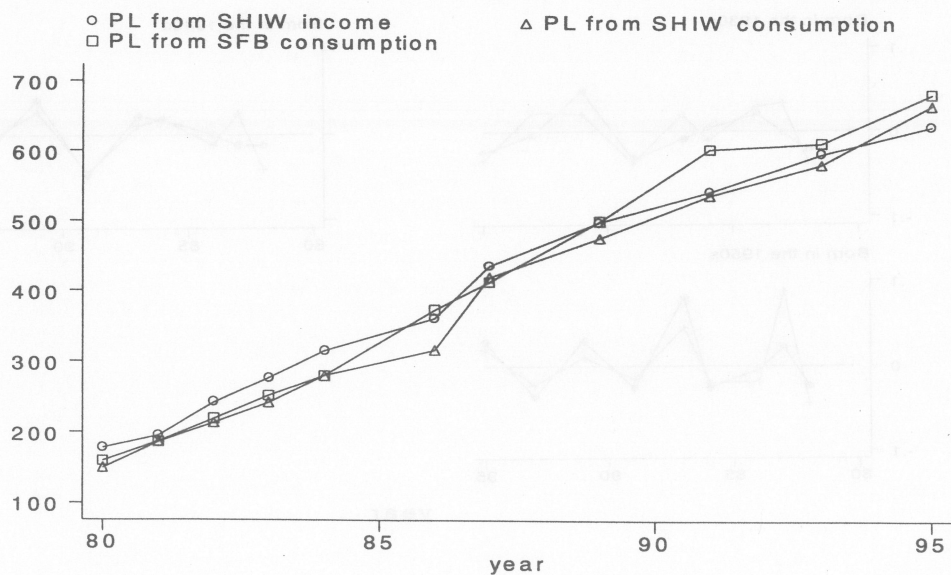


Figure 8: Poverty lines based on income and consumption, SHIW and SFB data.

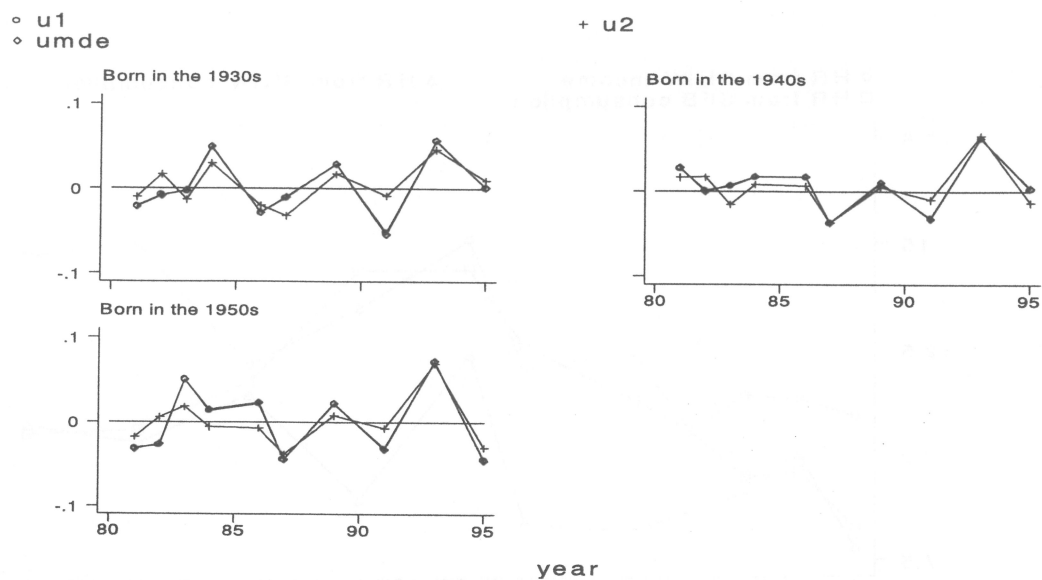


Figure 9: *Changes in the variances of the transitory shocks. Estimates based on variances alone (u1), on variance of income and covariance (u2), and MDE (umde). Whole sample, by cohorts, SHIW data.*

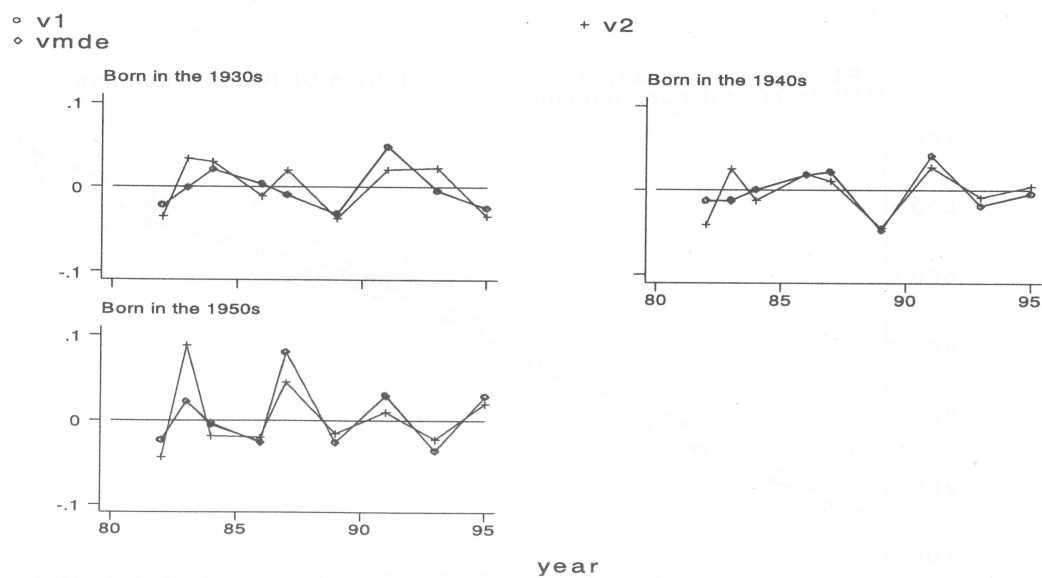


Figure 10: *Changes in the variances of the permanent shocks. Estimates based on variance of consumption (v1), on covariance between income and consumption (v2), and MDE (vmde). Whole sample, by cohorts, SHIW data.*

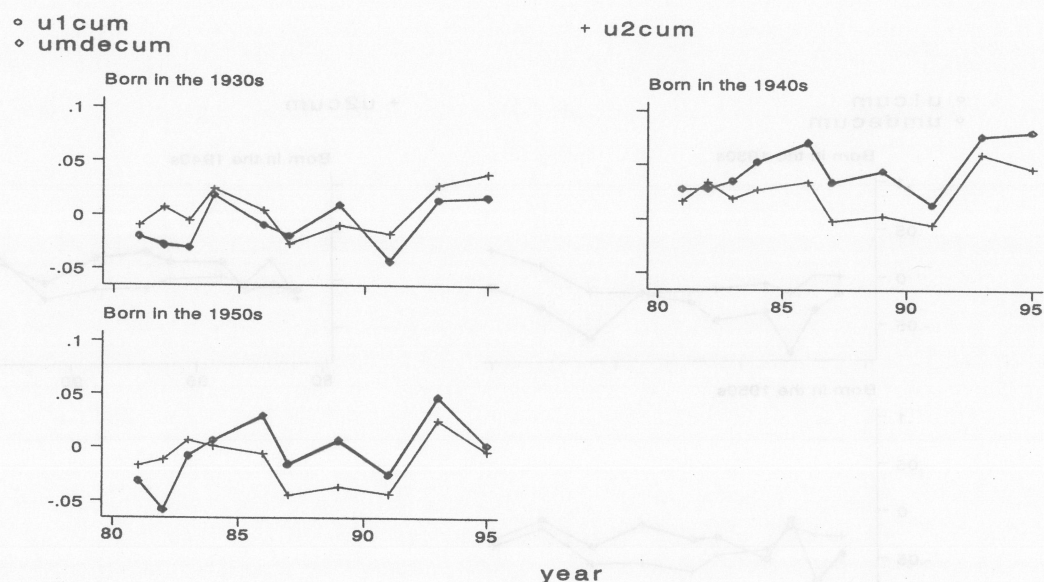


Figure 11: Cumulative changes in the variances of the transitory shocks. Estimates based on variances alone (u1cum), on variance of income and covariance (u2cum), and MDE (umdecum). Whole sample, by cohorts, SHIW data.

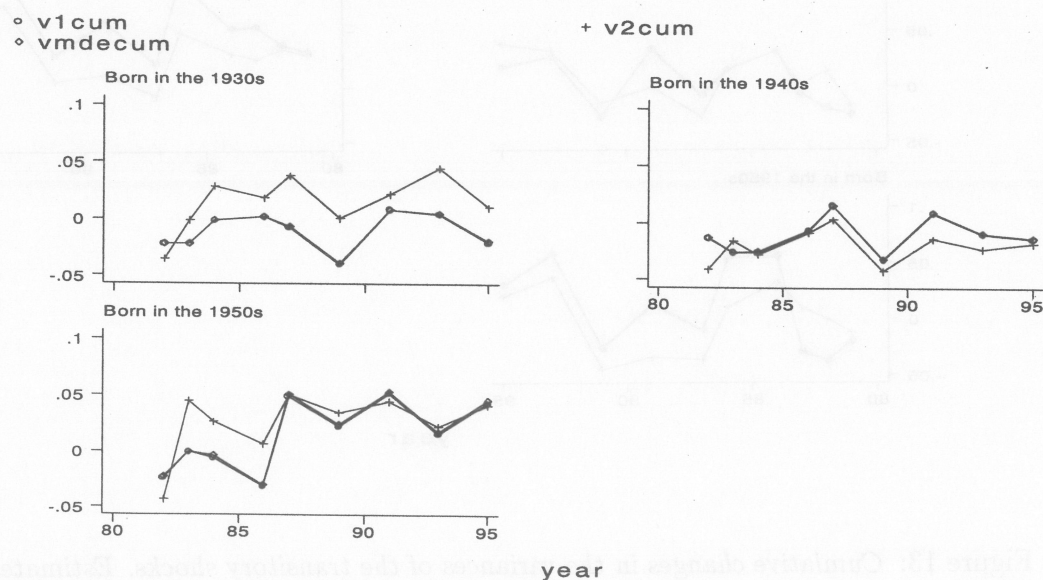


Figure 12: Cumulative changes in the variances of the permanent shocks. Estimates based on variance of consumption (v1cum), on covariance between income and consumption (v2cum), and MDE (vmdecum). Whole sample, by cohorts, SHIW data.

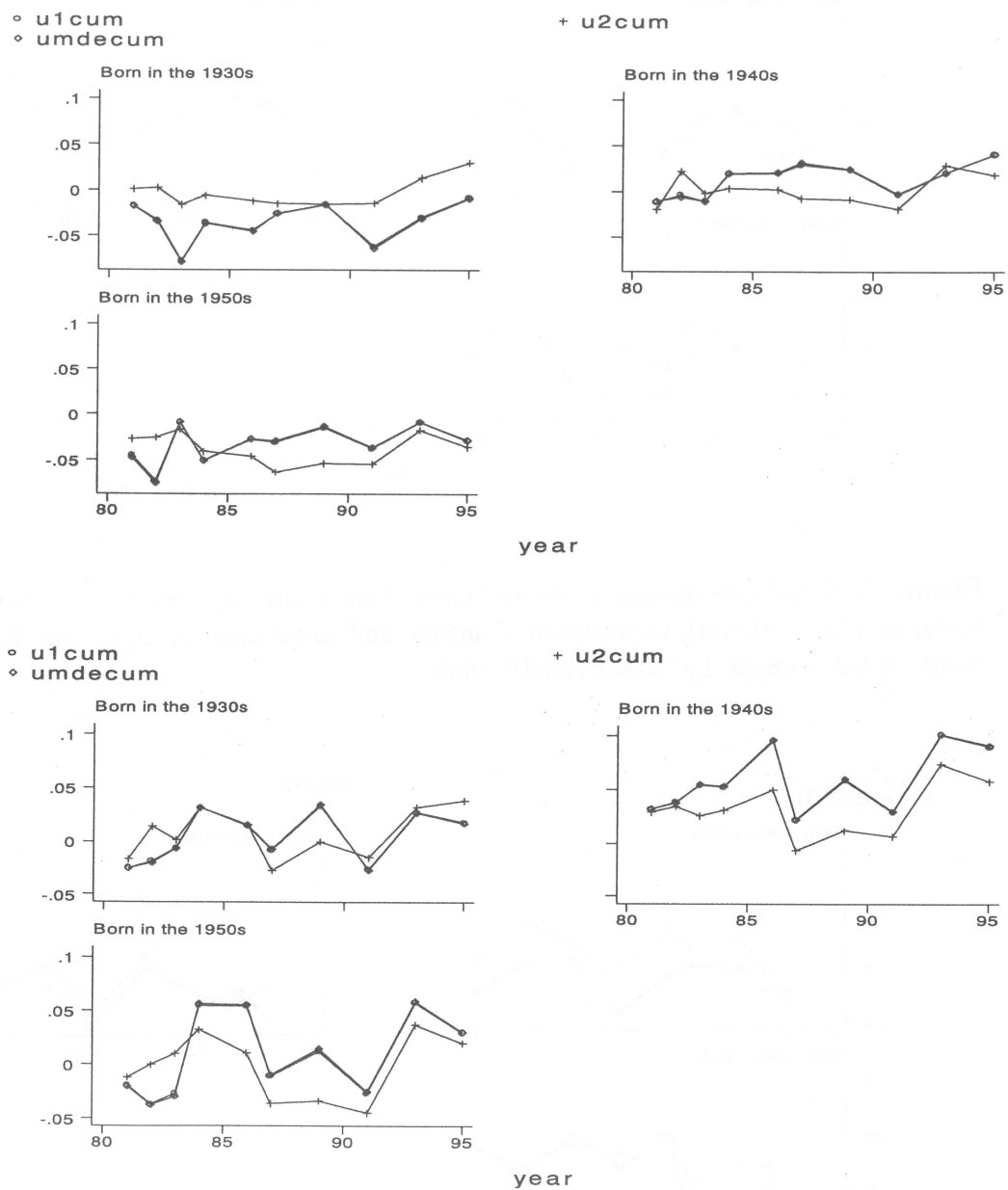


Figure 13: Cumulative changes in the variances of the transitory shocks. Estimates based on variances alone (u1cum), on variance of income and covariance (u2cum), and MDE (umdecum). SHIW data, by birth cohort and education. Top: high educated, bottom: low educated.

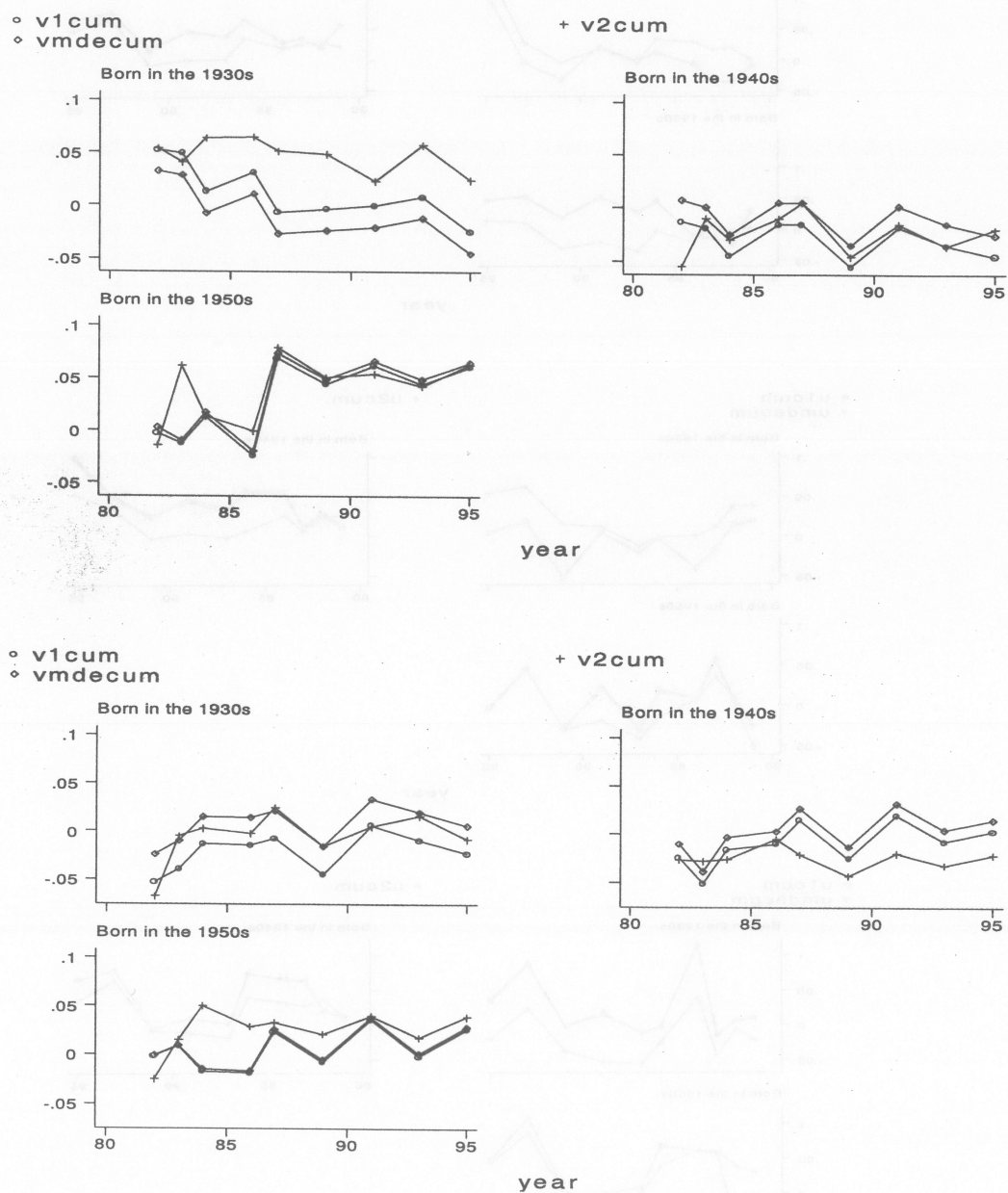


Figure 14: Cumulative changes in the variances of the permanent shocks. Estimates based on variance of consumption (v1cum), on covariance between income and consumption (v2cum), and MDE (vmdecum). SHIW data, by birth cohort and education. Top: high educated, bottom: low educated.

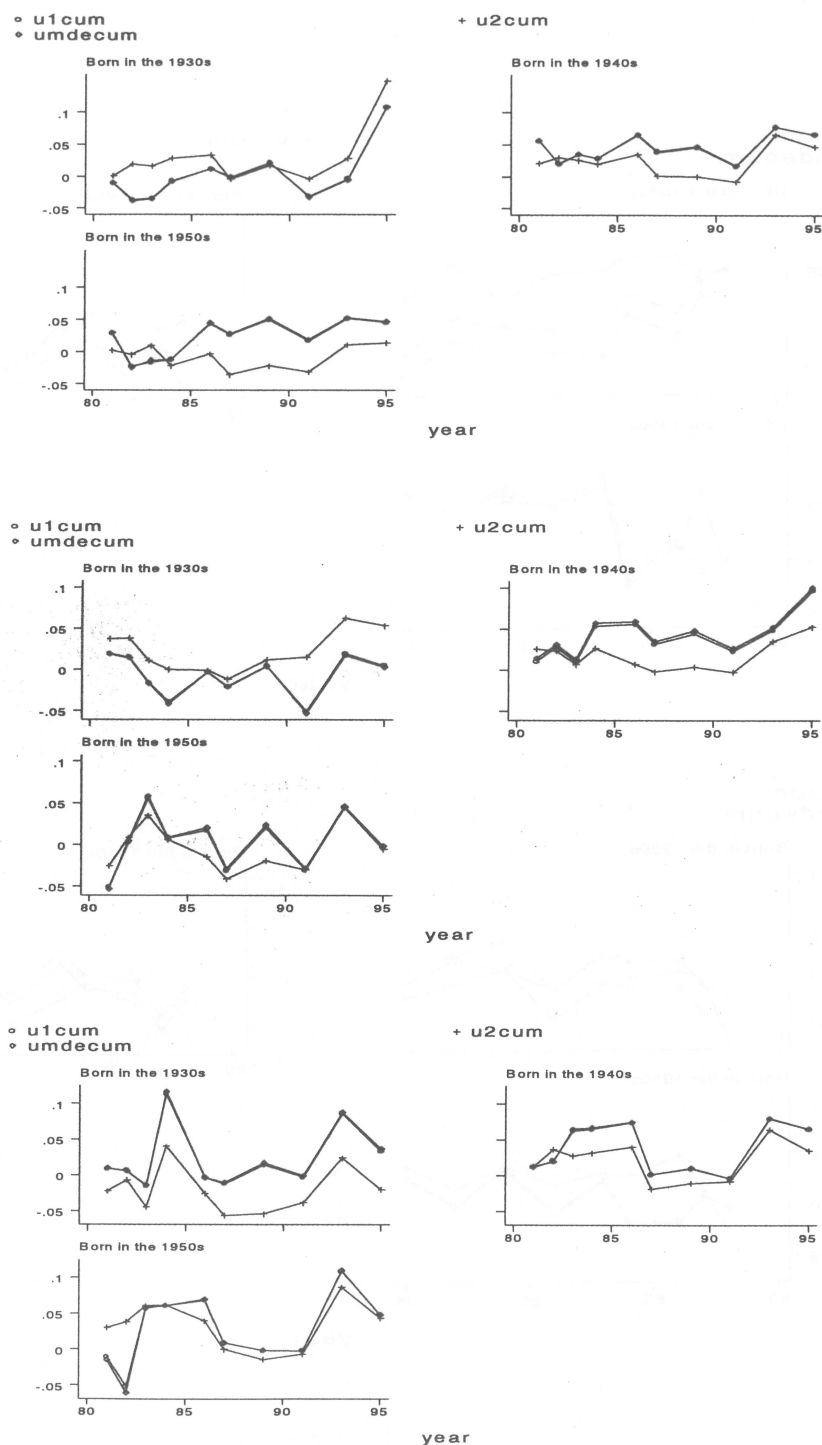


Figure 15: Cumulative changes in the variances of the transitory shocks. Estimates based on variances alone (u1cum), on variance of income and covariance (u2cum), and MDE (umdecum). SHIW data, by birth cohort and geographical area. Top: northern regions, centre: central regions, bottom: southern regions.

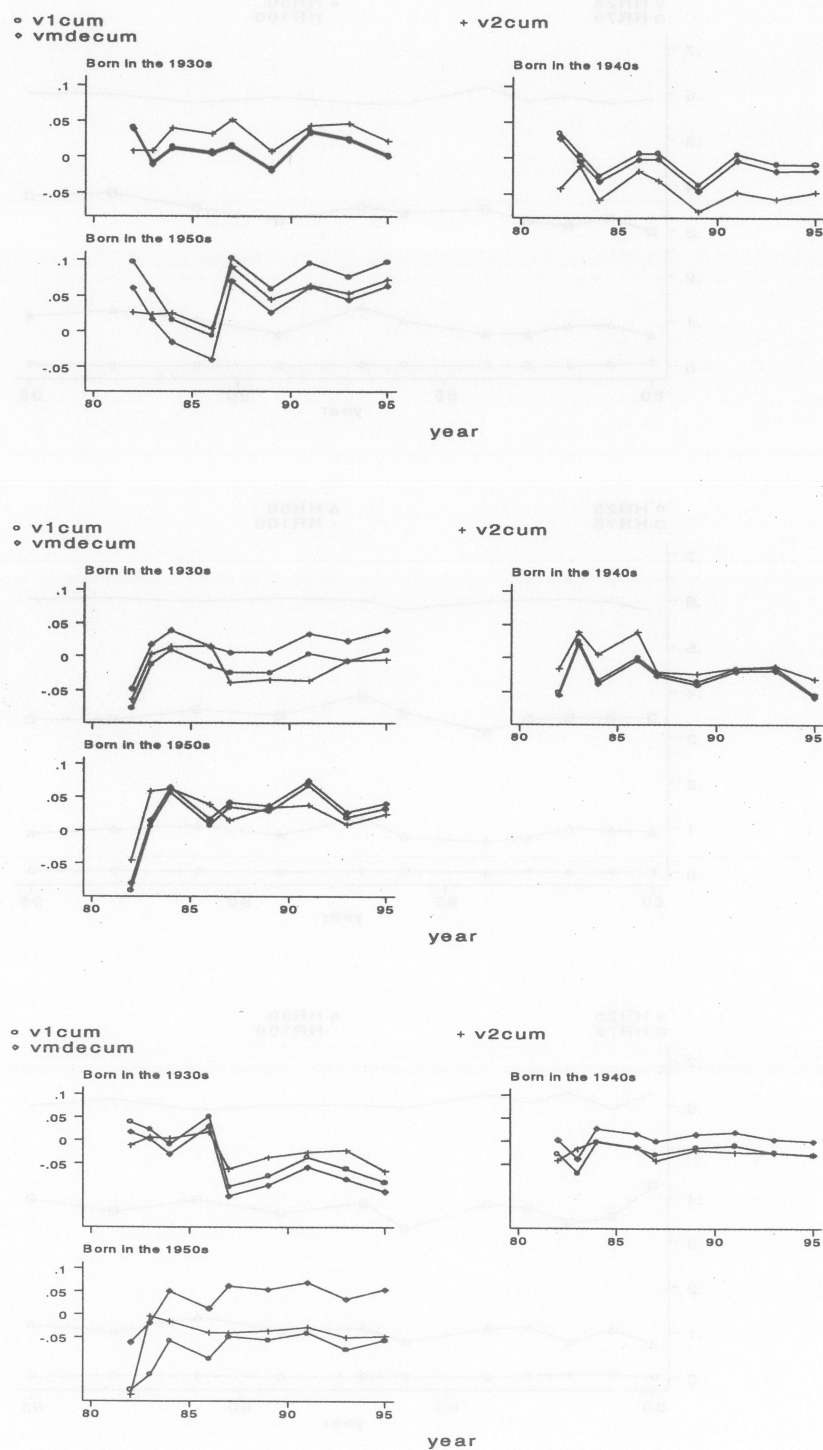


Figure 16: Cumulative changes in the variances of the permanent shocks. Estimates based on variance of consumption (v1cum), on covariance between income and consumption (v2cum), and MDE (vmdecum). SHIW data, by birth cohort and geographical area. Top: northern regions, centre: central regions, bottom: southern regions.

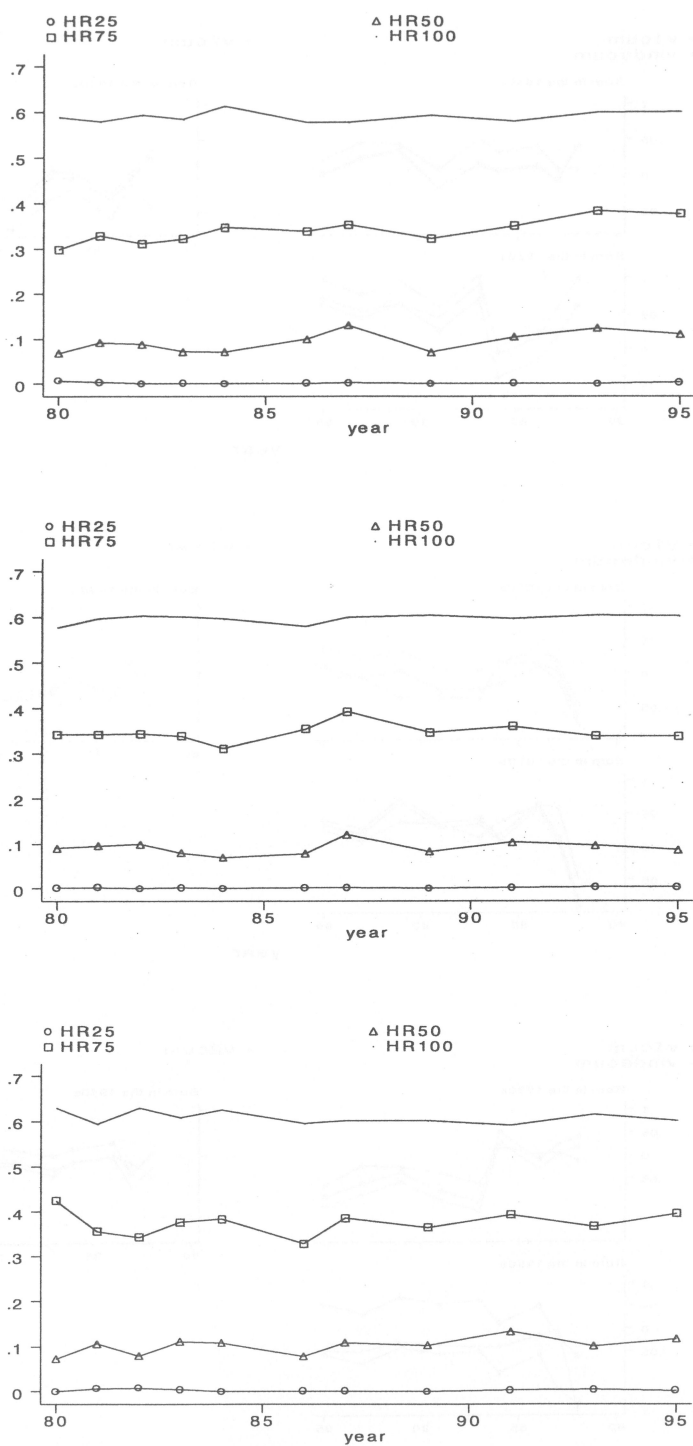


Figure 17: Headcount ratios from consumption for four different poverty lines. HR25, HR50 and HR75 refer to poverty lines equal to 25%, 50% and 75% of mean consumption, respectively, and HR100 to mean consumption. The values of the poverty lines are displayed in Table 13. SHIW data, by birth cohort. Top: born in the 1930s, centre: born in the 1940s, bottom: born in the 1950s.

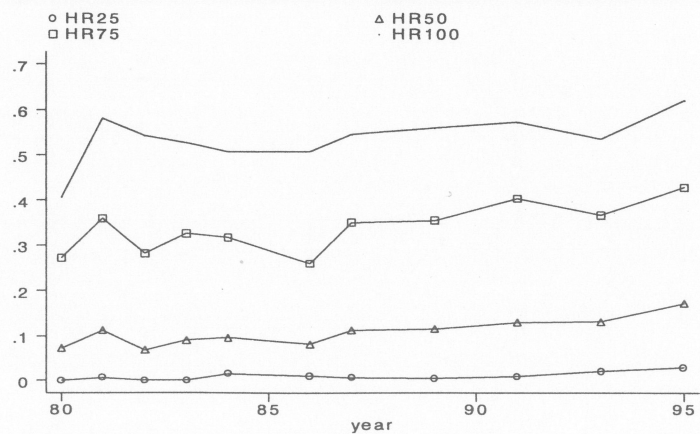
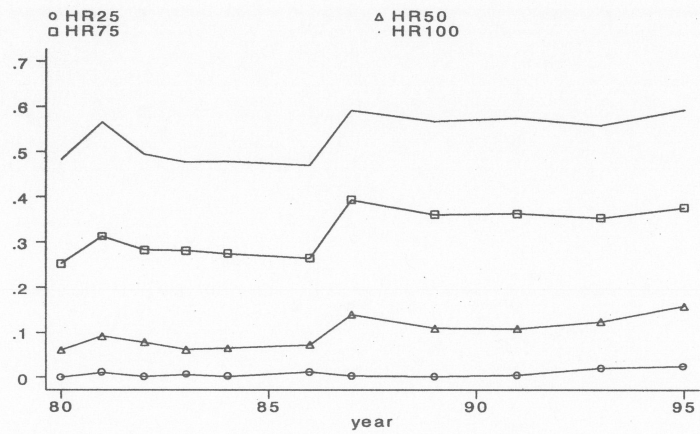
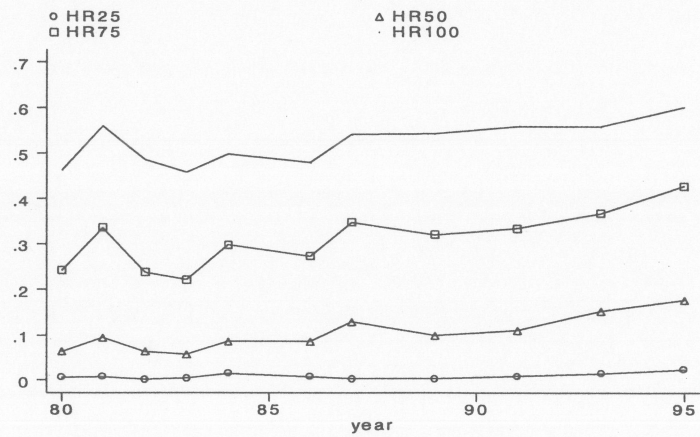


Figure 18: Headcount ratios from income for four different poverty lines (as defined in Figure 17). SHIW data, by birth cohort. Top: born in the 1930s, centre: born in the 1940s, bottom: born in the 1950s.



Figure 16. The four series from 1950 to 1960 are shown in Figure 16. The top series is the 1950 series, the bottom series is the 1960 series, the middle series is the 1955 series, and the series in the middle is the 1955 series.