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Life-Cycle Net Tax Rates and Intergenerational Redistribution: Evidence from Selected OECD Countries

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Abstract

Using LIS data, this paper provides empirical evidence of how past tax/transfer policies in UK, US and Sweden have shaped both the intrapersonal and the intergenerational redistributive profiles. Measuring intrapersonal effects is important in order to disentangle life cycle inequalities and redistribution due to a non-linear age-income profile; while the estimation of intergenerational shifts could provide a more correct way to infer whether temporary *static* deviations of annual tax burdens have corresponding entries in a life cycle perspective. To this purpose, a cohort analysis is used, by which different samples of people belonging to the same generations are followed over time. Results are shown that over the last thirty years conventional cross-section inequality overestimates the true interpersonal effect of taxes and transfers in all countries, and that the true inequality reducing power of taxes and transfers is generally declining. Further, evidence of generational deviations from a common life cycle profile has been found, of different intensity and direction in the three countries considered, signalling the presence of intergenerational redistribution and its link with the pattern of fundamental tax reforms enacted in the observed period.

JEL classification: H23, H31, I38.

Keywords: Redistribution; intrapersonal; intergenerational; life cycle; cohorts; LIS; microsimulation; UK; US; Sweden.

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Introduction

Applied works on tax reforms have generally focused on static aspects of the redistributive issue, mainly deriving the differential effects of tax changes on various groups of population in a given year. Accordingly, redistributive conclusions are drawn without distinguishing between *intrapersonal*, *interpersonal*, and, possibly, *intergenerational* redistribution.

For a given tax system, intrapersonal redistribution occurs when the life-cycle burden of taxes, as measured by the average tax rate, is some function of age. According to the life-cycle hypothesis, in the simplest case, individual income is a non-linear function of age, with a typical hump-shaped pattern. With an invariant progressive tax system, a similar pattern should be revealed by the average tax rate. In this case, over the life-cycle, lower average tax rates, when younger and older, may be viewed as self-financed by higher average tax rates while in the labour market.

Interpersonal redistribution occurs when, within a given generation and for a given tax system, different groups of population are subject to different life-cycle profiles of average tax rates at the same income levels, because either of differential tax reliefs linked to socio-demographic characteristics at the same income level (e.g.; number of children; employees and self-employed; disabled; etc.) or of different positions in the income distribution (e.g.; rich and poor people).[1]

Intergenerational redistribution, instead, may be interpreted as that redistribution induced, either intentionally or involuntarily, by tax policy changes over the life-cycle of each generation. In other terms, intergenerational redistribution may occur through shifting of a common life-cycle profile (either upward or downward) for different generations.

Redistribution is obviously linked with tax structures. With a proportional tax system (assumed constant over the life-cycle) there is no intrapersonal redistribution, because the share of income paid in taxes is independent of age. Therefore, when plotted against age, the average tax rate is a flat constant line at the proportional tax rate level. Also, there is no interpersonal redistribution, because average tax rates are constant with respect to income, both at different positions in the income scale and across demographic groups. Then, when plotted against the lifetime income of a given generation, the average tax rate is again a flat constant line at the corresponding level. Yet, there might be intergenerational effects if the level of the proportional rate has shifted either upward or downward over time and across generations. This means that, for each generation, when plotted against age, average tax rates may be constant flat lines at different levels of the proportional tax rates. These different levels allow the possibility that taxpayers belonging to different generations may pay different share of their income when they will pass through the same age. In this case, the possibility of intergenerational redistribution basically depends on discretionary tax policy changes. In a growing economy, real income

[1] Under the hypothesis that these status prevail over the entire life-cycle.

tends to increase from older to younger generations; but a fixed proportional tax rate, while subtracting growing absolute amount of taxes, leaves the share of income paid in taxes unchanged.

With progressive tax systems, taxes paid increase faster than income itself, i.e. average tax rates increase with income. According to the life-cycle hypothesis, one should expect the average tax rate to mimick the hump-shaped income profile. Then, a given progressive tax system would imply some degree of intrapersonal redistribution, which depends on the combination of tax progressivity and the age-income concavity over the life-cycle.[2] For an invariant tax system, this profile also gives the differential effect, for any taxpayer, of paying progressive rather than proportional taxes, providing the same revenue, at various ages. This should make clear the sense of intrapersonal redistribution, which is therefore ideally measured with respect to a proportional tax profile.

Within any generation, progressive tax systems may also generate interpersonal redistribution, if different average tax rates apply to different groups of population. Two people born in the same year may pay quite different average tax rates, in the life-cycle, if one of them is disabled; or if one lives in low taxed areas of the same country (e.g. rural areas) or if one is lifetime rich and the other is lifetime poor.

Finally, progressive tax systems may also produce intergenerational redistribution, in the same way as proportional tax systems do. Tax policy changes may affect the life-cycle level of average tax rates paid by taxpayers belonging to different generations at the same age. However, for a given generation relative to the others, and unlike proportional tax systems, the level of the average tax rate may also shift in absence of tax changes. If real income grows (e.g. by productivity changes), the average tax rate will generally increase faster in percentage terms; then, with a fixed progressive tax structure[3] we cannot ruled out the possibility that average tax rates will increase also in absence of tax policy changes.

Now, when estimating the redistributive effects with standard techniques, i.e. using annual data and treating them as separate cross-sections, the three aspects of redistribution are combined and therefore confused. In a given cross-section, the estimated relation between age and average tax rate does not take into account that some contribution to the hump-shaped profile arises from an intrapersonal effect.[4] In such cases, the degree of redistribution estimated among age classes cannot be interpreted as pure interpersonal redistribution, because that shape is affected by the degree of intrapersonal redistribution implicit in progressive tax systems over the

[2] If individual real income were stable over the life-cycle, a progressive (invariant and perfectly indexed) tax should subtract always the same fraction of income, i.e. for that individual the tax would be proportional in its effect, yet progressive for the society as a whole if income dispersion is sufficiently high. Therefore, progressive tax is necessary to have intrapersonal redistribution, but not sufficient in the case where the age-income profile is linear. Strict concavity of the age-income profile is required.

[3] Assumed to be perfectly indexed for inflation.

[4] For pioneering work on this aspect, related to inequality as measured by the Lorenz curve, see Paglin (1975).

life-cycle. Further, using one cross-section disregards that element of redistribution which is in fact intergenerational. Repeating the analysis using separate cross-sections does not solve the first problem, while exacerbating the second, because people at different ages in two successive cross-sections may in fact belong to the same generation.

The aim of this paper is to provide empirical evidence of the degree of intrapersonal, interpersonal and intergenerational redistribution implicit in the tax/transfer systems of three different countries (UK, US and Sweden) over a period covering the last thirty years, using not regular repeated cross-sections available at Luxembourg Income Study (LIS).

Measuring intrapersonal effects is important because personal differences in income linked to differences in age might not be relevant for equity of taxes and transfers. Equity might be best achieved by redistributing from *lifetime* rich to *lifetime* poor, and not by redistributing from *static* rich to *static* poor. Of particular interest is therefore to understand what part of the total redistributive effect of taxes and transfers may be imputed to intrapersonal life cycle effects.

In the same vein, claiming of any given generation regarding its own tax burden should not be carried out on *annual* basis; rather the estimation of generational shifts could provide a more correct way to infer whether temporary deviations of annual tax burdens between age groups have corresponding entries in a life cycle perspective.

To this purpose, a cohort analysis is used, by which people belonging to the same generation are followed over time. Cohort analysis tracks not the same individual over time (like in panel data) but a random sample of people grouped by year of birth. Sections 1 and 2 are concerned with general issues in estimating life-cycle variables and with a discussion of data, variables and cohort regression techniques.

Section 3, instead, will set the basis of discussion for all types of redistribution considered, providing evidence of what actual data can reveal in terms of cross-sectional age profiles of income, taxes and transfers. In Section 4, the proposed methodology for estimating life-cycle variables is applied to: income, taxes, transfers, average tax rates, average transfer rates and average net tax rates. Life-cycle patterns are derived, discussed and compared, in order to draw differences among countries of the height and the concavity of relative profiles against age. Further, results obtained in this section are of considerable importance for the content of Section 5, where the intrapersonal and interpersonal effects are decomposed for each country and for the various years considered. As will be explained in Section 5, intrapersonal effects are isolated by calculating inequality indices (Gini index) both before and after tax and transfers on the estimated life-cycle income distribution.

This methodology closely resembles the pioneering work of Paglin (1975), who, in a Lorenz-curve context, argued that inequality should be measured departing not from the equidistribution line, but from an income distribution in which all individuals in specified age groups receive equal incomes. This latter Lorenz curve should measure the accepted degree of inequality, i.e. the intrapersonal part of the total redistribution which depends on people being at different ages in the underlying income distribution. In Paglin (1975), the reference age-income distribution is built by assigning the conditional mean income to all individuals in the same age group and then ranking groups by mean incomes. Unlike Paglin, the innovative aspect of this paper is that reference life-cycle age-income profiles are estimated by a regression technique controlling for cohort effect. Gini indices are therefore calculated on these life-cycle distribution and intrapersonal effects isolated.

Finally, Section 6 will show how the common life-cycle profiles have been implicitly shifted over time by tax/transfers policies followed by the three countries analysed. Departures from the life-cycle profiles are again calculated through regression techniques, and conclusions over the relative burden/gain of each generation discussed and compared. Section 7 concludes.

1. Estimating life-cycle variables: general issues

In order to deal with life-cycle patterns and intergenerational redistribution, the estimation of life-cycle variables of interest is needed. There are different ways to achieve this aim within the framework of redistributive studies.

A relatively restricted range of works has made recourse to Dynamic Microsimulation Models (DMM), which track a single synthetic cohort of individuals born in a given year through time in a world which is exactly the same as it is at the time of birth.[5] With this kind of models, life of each cohort is simulated basing on probabilities that some demographic and other events occur (e.g., schooling, marriage, divorce, labour force participation, unemployment, disability, death, etc.). The main advantage of these models is that generational profiles are fully observed, as simulations are generally run for a sufficiently long number of years (e.g. 90 years) to have a complete picture of the behaviour of the simulated variables. The main shortcoming, instead, is the steady-state assumption on which these models are based. In the period of simulation, generations are only affected by probabilities that some events will occur, but the institutional, social and economic context is held constant.

A steady-state world is also at the base of *generational accounting* models, which indicate, in present value, the net amount that current and future generations have to pay to the government now and in the future.[6] In other terms, by comparing what a government is taking from the current generations and the difference between its projected consumption and its current net wealth, one can estimate the burden imposed on future generations. This method is particularly useful, for example, to

[5] Main references are: Falkingham and Hills (1995), Harding (1993), Wolfson (1988), Kennedy (1990), Baldini (1997), Wolfson (1990), Harding (1990), Hancock *et al.* (1992), Hain and Helberger (1986).

[6] See, for example, Auerbach *et al.* (1991) and Auerbach *et al.* (1992).

measure the future sustainability of current government fiscal policies (e.g. pensions). Also, alternative scenarios may be simulated and their implications for generational accounts analysed.

However, both approaches are forward-looking; i.e. they look in a simulated future in order to get meaningful information on lifetime variables or lifetime redistribution. For example, if the interest lies in knowing whether lifetime income distribution will be more equally distributed than the current one, *given existing economic conditions and government policies*, DMM may provide meaningful answers. Rather different is the question, addressed in this paper, of verifying what kind of life-cycle pattern of taxes and transfers has been shaped by *actual* past tax/transfer policies of various governments and, possibly, how this pattern differs among generations. To make this exercise operational, both dynamic microsimulation models and generational accounts lose much of their appeal, because they simulate a lifetime path in the future that, in our case, needs to be recovered by available data looking at the *past*.

The best theoretical way of inferring past behaviour would be to use panel data for a sufficiently long period of time, where changes of a specific variable may be meaningfully observed. Unfortunatately, panel data are uncommon and, when existing, they extend over limited periods, so that information on complete life-cycle profiles cannot generally be inferred.[7]

Yet, life-cycle patterns can be meaningfully identified by constructing cohorts on repeated cross-sections.[8] Cohorts are generally defined by year of birth of individuals; then, in any given year, observation on one generation may be obtained by averaging the variable of interest over the specific cohort. Therefore, cohorts are not the same individuals tracked over time, but a sample of individuals born in the same year who becomes older in any successive surveys. From this point of view, cohorts are a semi-aggregated structure, i.e. an intermediate level between the pure microdata and national aggregates.[9]

Cohort techniques are extremely useful when life-cycle variables are expected to behave differently across different generations; in this case, the cross-section age profile may diverge from the life-cycle profile. As argued by Shorrocks (1975), a single cross-section age-profile may not be a consistent estimator of the true life-cycle profile. Further, redistributive indices generally tend to be overestimated when measured on cross-sections rather than life-cycle distributions.

[7] An alternative to lack of panel data has been proposed by King and Dicks-Mireaux (1982) who estimate a cross-sectional age profile of earnings and correct it by using out-of-sample information to scale the common earnings profile. Note that DMM actually simulate a panel data when observing a given generation from a given point in time to the next, say, 90 years.
[8] Pioneering works in this direction are Shorrocks (1975) and Masson (1986). Theoretical reference for cohort analysis with repeated cross-sections is Deaton (1985).
[9] See Deaton (1997; 120).

However, non-trivial problems may be encountered when using cohort techniques. First of all, when the unit of analysis is the household , it is generally not possible to take up the problem of household dissolution over time (e.g., because of divorce and remarriage).[10] Further, older people, while forming an independent family, may decide to join the household headed by one of their children after a given age. In all these cases, households in a given survey may belong to other households in another survey. The simplest way to deal with this issue is to assume that households observed in the first survey are indissoluble, a negative solution to the general difficulty of monitoring changes in household formation from the observed data.

Second, a model and some assumptions are needed in order to estimate and decompose the age, cohort and time effects[11]; the first to construct the age profile; the second to identify differences in the position of the age profile belonging to each generation; the third to isolate the common shocks that shift all cohorts temporarily away from their profiles.[12]

In the most general form, cohort analysis may be performed as a result of a theoretical framework where agents maximise a life cycle utility function subject to an intertemporal budget constraint. This procedure is particularly useful when the dependent variable is a choice variable (e.g. consumption, savings, etc.).[13] In our case, however, the aim is less ambitious and lies in the descriptive context of generating life cycle profiles for some variables of interest which cannot be considered as choice variables (i.e. taxes and transfers). In this limited sense, our cohort analysis is heuristic in nature, lacking a structural model and being instrumental to the understanding of how actual past tax/transfer policies might have shaped the net tax burden across generations.[14]

To this purpose, cohort analysis is best performed by a regression technique. By this way, a life-cycle variable of interest may be estimated as a function of age, cohort and time. In the simplest case, all variables may be approximated by a set of dummies, especially when an *a priori* pattern is not recoverable. However, since assumptions about the relation of many life-cycle variables with age may be often

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[10] See, for example, Deaton and Paxson (1993; 8) arguing that averaging by the age of the household head has the inevitable effect of confounding genuine changes in stable households with changes both in household formation and in headship

[11] The three factors which are generally confused when measuring redistribution effects on a single cross-section.

[12] The first factor also represents the correct benchmark to measure inequality in single cross-sections. In fact, standard measures of inequality indices assume, as a benchmark,
(e.g.; the Gini index), where all incomes are equal and independent of age. More fruitfully, the inequality of a given income distribution should be measured net of the degree of inequality which is imputable to intrapersonal distribution over the life-cycle. See Section 4 below.

[13] Much work, for example, has concentrated on the pattern of saving rates across generations. See, recently, Gokhale et al. (1998) and Jappelli and Modigliani (1999).

[14] Yet, tax and transfers could have been analysed for their effects on life cycle consumption (saving) profiles within a theoretical consistent framework. However, the aim of this paper is not to analyse what is effect of taxes and transfers on consumption, rather that of measuring and comparing the implicit patterns of taxes and transfers on a life cycle perspective and for different generations. For a similar approach see, for example, Giles *et al.* (1998).

maintained, it may be reasonable to model age effects as polynomial of third or higher order.

In this general form, the estimated model may be expressed as:

$$\Lambda = \alpha + \beta A + \gamma C + \delta T + \varepsilon \qquad [1]$$

where Λ is the life-cycle variable of interest; A is a either a matrix of age dummies or a polynomial in age; C is either a matrix of cohort dummies or a polynomial in cohorts; T is, generally, a matrix of time dummies; ε is the usual error term; and α, β, γ and δ are coefficients to be estimated.

A third problem with cohort analysis is that each cohort is only observed for a limited period of time, because repeated cross-sections are not available for the whole life-cycle of a given generation, and the interval between successive cross-sections is generally more than one year and irregular.[15] This means that cohorts grow at different steps in the period observed. Further, in international comparisons, steps may also be differentiated among countries. However, standard techniques for decomposing age, cohort and year effects can still be used in the case where the number of surveys is limited and intervals between them are not regular.[16]

2. Data, variables and cohorts

2.1. Data

In order to implement model [1] in its various forms, recourse has been made to the Luxembourg Income Study (LIS) dataset, storing microdata on income and demographic variables for a wide number of OECD countries. Detailed description of LIS data are now available at the LIS website.[17] To the aim of the paper, household level variables have been used, as information on taxes and monetary transfers are only available at that level.[18] The countries chosen for the analysis are Sweden, UK and US, basically because of the satisfactory number of repeated cross-sections in the dataset.[19] However, this choice gives us the opportunity to compare the relative life-cycle burden of taxes (and transfers) on households in a country with an historical high level of taxation (Sweden) compared with a country whose personal income tax reform in the Eighties has been one of the most influential

[15] This is one of the main differential point with DMM, where each generation is observed on the entire life-cycle; rather, cohorts constructed on repeated cross-sections are generally observed only for a fraction of their life-cycle.

[16] See Deaton (1997; p.125).

[17] http://lissy.ceps.lu/variables.htm. Introduction to LIS data may be found in Smeeding *et al.* (1985). Technical documentation on single countries may be also downloaded from the web.

[18] But person level variables and limited child level variables are also available.

[19] For Sweden the following years are available: 1967, 1975, 1981, 1987, 1992 and 1995; for UK: 1969, 1974, 1979, 1986, 1991 and 1995; and for US: 1969, 1974, 1979, 1986, 1991 and 1994.

among industrialised countries in recent times (US); reform whose prescriptions, to some extent, have been embodied in UK income tax reforms in the Nineties.[20]

2.2. Variables

Before proceeding any further with the description of the cohort analysis, let us first explain the construction of variables. For the estimation of life-cycle income recourse has been made to ***total market income*** (MI):

$$MI = \underbrace{\underbrace{GW + SE}_{Earnings} + CP}_{FactorIncome} + PP + PUP \qquad [2]$$

where GW are gross wages; SE is self-employment income; CP is cash property income; PP are private pensions and PUP are public pensions.[21] As clear from equation [2], the sum of gross wages and self-employment income (which includes both farm and non-farm income) yields *earnings*; while *factor income* is obtained by adding cash property income (i.e. income from immovable properties) to earnings. Some explanation is deserved by the inclusion of both private and public pensions in the definition of market income. Estimating market incomes over the life-cycle needs to consider that incomes of elderly people are mostly represented by private and public pensions. On the one hand, leaving aside those incomes for that part of the population creates a life-cycle profile where, after retirement, incomes fall rapidly near zero. On the other hand, including all pensions (especially public pensions) in market incomes underestimate the subsidy (transfer) element implicit in many retirement schemes, where pensions are more generous than the actuarially equivalent sum of mandatory contribution paid by individuals (or households) while in the labour market. As the separation between the market and the transfer element of pensions paid is not recoverable from available data, the choice has been to include all pensions in the definition of market income. As a counterpart of this choice, transfers analysed do not include pensions.

Life-cycle taxes paid by households (TAX) should be ideally defined as:

$$TAX = IT + PT + MEC + MSEC + ODT + INDT \qquad [3]$$

where IT is the income tax; PT is the property tax; MEC are mandatory employee contribution; $MSEC$ are mandatory contributions for self-employed; ODT are other direct taxes; $INDT$ are indirect taxes.[22] However, for the case of taxes, LIS data are not completely satisfactory. For the countries analysed, the only tax which is always recorded is the income tax, as reported in table 2.1.

[20] Some details of these reforms are given in Appendix A.

[21] Capital income and other financial incomes (e.g. dividends) do not appear in LIS data.

[22] It is here implicitly assumed that direct and indirect taxes fall on households; while mandatory employer contribution (not included in [3]) fall on employers. In a life-cycle perspective this last assumption may be discussed; however, because of lacking data on LIS, equation [3] has been reduced, so that the problem of final incidence of mandatory contributions has been escaped.

Table 2.1 Surveys and type of taxes

Therefore, in order to avoid meaningless comparisons between life-cycle profiles containing different implicit burdens, we have been forced to confine the analysis to the income taxes and to delete from the analysis the first year of the US surveys (1969) which do not contain any information on taxes paid. In particular, one important item in the overall tax burden (indirect taxes) is not recorded in any surveys considered. The life-cycle analysis that will follow has therefore be narrowed to income taxes; as a consequence, the difference between income taxes paid and transfers received, as a measure of the life-cycle balance, should be interpreted as that part of transfers which is covered by income tax burden.

Life-cycle *social transfers* received by households (*TRA*) are instead defined as follows:

$$TRA = SP + AP + DP + SRB + CA + UB + MP + MW + OT + MTB + NCB \quad [4]$$

where *SP* stands for sick pay; *AP* for accident pay; *DP* for disability pay; *SRB* for social retirement benefits; *CA* for child or family allowances; *UB* for unemployment benefits; *MP* for maternity pay; *MW* for military/veteran/war benefits; *OT* for other social insurance benefits; *MTB* for means-tested cash benefits; *NCB* for near-cash benefits. Since the absence of one or more of these transfers across years cannot be precisely imputed to lack of recording, the total has been considered for all years and for all countries.

Average tax rates (ATR) and average transfer rates (ATRR) have finally been calculated as the ratio of taxes and transfers, as previously defined, on *gross* income. This latter aggregate may be broadly defined as the sum of market income and social transfers; in this sense, it is a *proxy* for the overall household income, over which both the burden of taxes and the benefit of transfers are measured. This choice is justified by two main reasons: the first is that transfers may be variously taxed at the household level and in different countries, so that a measure of total burden is more appropriately defined over the total potentially taxable income; the second, more practical, is that the ratio between transfers and market income caused those observations where transfers are a significant part of total income to have extremely high values, generating outliers and estimate imprecision.[23] Adding social transfers to market income necessarily makes the ratio between social transfers and gross income to range from zero and a hundred per cent. By this way, ATR is best interpreted as the share of income taxes on the overall income of households (including social transfers); while ATRR is best interpreted as the share of total income represented by social transfers. The balance between the two (ANTR) is therefore the net burden (benefit) paid (received) by each household as a percentage of its total income.

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[23] Other adjustments have been made to neutralise the influence of irregular observations: in general, negative entries for social transfers, gross incomes and average tax rates have been deleted from the analysis.

2.3. Constructing cohorts

Implementation of model [1] needs first constructing cohorts. For each of the three countries analysed, twelve cohorts have been defined according to the year of birth of the head of household. In particular, the oldest cohort (henceforth, cohort 1) includes all households whose head was born between 1910 and 1914; while all households with heads born between 1965 and 1969 fall in the youngest cohort (henceforth cohort 12).[24] By this way, in the case of UK, people born in 1910, whose age was 59 in 1969, will be observed at age 64 in 1974, 69 in 1979, and so on. Younger people, born in 1965, will be observed first in 1986 at age 21, then in 1991 at age 26 and finally in 1995 at age 30.

In order to get meaningful common life-cycle profiles of the variables of interest, for each country we have first defined a stacked dataset in which each observation is in fact a cohort-year pair, i.e. members of single generations (identified by the cohort) observed at a given year.

Table 2.2 Number of observations in each survey

To this purpose, and for a reason that will become clear later, the original surveys have been randomly sampled to keep the same number of observation in each year. Table 2.2 reports the original number of observations in each survey, while table 2.3 shows the average cell size for each cohort after adjusting the sample.

As can be seen from table 2.2, the original number of observation has been reduced in all countries, more sharply in Sweden and US where the imbalance among the number of observations in each survey is greater if compared with the relative stability of UK. The first step has been to adjust for outliers: for example, negative tax rates have been excluded, as well as average tax rates greater than 100 per cent. After this adjustment, the number of observations in each survey has been reduced to the lowest number among them. As a final result, we get six surveys in Sweden and UK each of which records 5375 and 6691 observations, respectively (see row Adj. in table 2.2), while for US we get five surveys with 12172 observations each.[25] In total, the data allow to construct 32250 single cohort-year observations for Sweden; 40146 for UK; and 60860 for US.[26]

Table 2.3 reports the average number of households in each cohort for both countries and surveys used. For example, in Sweden 1967, members of the fifth cohorts are 454; while in Sweden 1995 they are 306. If we make exception for some variations in cell size for youngest cohorts, that when first appearing in the survey are typically less likely to be head of households, significant variations in cell sizes

[24] Intermediate cohorts are formed at regular intervals of five years.

[25] On the one hand, the reason for this procedure is to avoid weighting one survey more than others; on the other hand, we used this criterion in order to implement a normalisation of time dummies to be discussed below.

[26] We refer here to a *single cohort-year observation* as an observation of a given household belonging to a specific cohort at a given year.

occurs only for the oldest cohort (cohort 1) in Sweden. In this case the sample may be incorrectly drawn, e.g. the range of years chosen to define this cohort (1910-1914) may be insufficient to contain all relevant cases in the survey.

Indeed, the sum of each row in table 2.3 does not match the adjusted total reported in table 2.2, because some observations for oldest people are not included in the first cohort. After experimenting that the exclusion of these observations may cause some bias to our estimations, the choice has been made to treat these observations as belonging to the oldest cohort.[27]

2.4. Model implementation and identification

The general model [1] can now be used for the various life-cycle estimation performed in this paper. Let us first consider the age-income profile. In this case equation [1] can be used as a descriptive device, relating life-cycle income with age, cohort and time variables. Having *a priori* judgement on how the age-income profile should be, age variables have been modelled as a polynomial of the fifth degree. While imposing structural assumptions, the degree of the polynomial reflects a sufficiently flexible functional form to capture the curvatures of the age-income profile. Cohort and time effects have been instead modelled as dummies.[28] Further, a set of demographic variables has been introduced to clear the age-income profile from specific demographic effects.

Table 2.3 Average cell size for each cohort

Before proceeding with the full specification of the model, it is necessary to deal with a well-known non-standard problem related to the use of time dummies and to the linear relationship among age, cohort and time.[29] For each observation, if one knows the date of the survey and the year of birth, one can easily infer the age.[30] Then, when cohort-year pairs of observed income are regressed on age, cohort (year of birth) and time, a perfect linear relationship will occur, since *cohort=year-age*. In these circumstances, age and cohort effects cannot be disentangled, unless additional identification assumptions are made.[31]

[27] This means that while not included in Table 3, those observations have been actually included in the econometric estimation in all countries; this method provides narrower confidence intervals of estimation compared with the case in which they were excluded.

[28] Other structural assumptions can be made: Deaton (1997; 124) states that cohort effects might even be adequately handled as linear; while Jappelli (1995) uses a cohort polynomial. Kapteyn *et al.* (1999) use proxies for productivity growth in order to overcome an identification problem to be discussed below.

[29] For a detailed treatment, see Deaton (1997).

[30] Or equivalently, the year in which household is sampled equals age plus year of birth.

[31] An example may help to clarify the problem. Defining the following matrices: cohorts by *C*, ages by *A*, years by *T*, and by v vectors of sequences $\{0,1,2,3,4,......\}$ whose length is equal to the number of columns of the matrices of cohorts, ages and years, it is possible to demonstrate that the following linear relation holds: $Cv_c = Av_a - Tv_t$. The point is best illustrated by a short example. Assume two years (1970 and 1971) and three cohorts (born in 1919, in 1920 and in 1921); also assume that all variables are expressed as dummy variables. Matrices of dummies will be:

In order to overcome this identification problem, one can note that, in the specific case, any time trend can be reinterpreted as trends in ages and cohorts. Following Deaton and Paxson (1994), one can therefore choose to attribute the time trend to age and cohorts and not to time. To perform this normalisation, year dummies must be orthogonal to a time trend and sum to zero. After the normalisation, all trends are attributed to age and cohorts; while time dummies will record only non-systematic influences or shocks.[32] As explained in Deaton and Paxson (1994) and Deaton (1997), this normalisation may be implemented as follows:

$$h_t = T_t - \left[(t-1)T_2 - (t-2)T_1\right] \qquad t = 3,\ldots S \qquad [5]$$

where h_t is the normalised time dummy at time t; T_t is the original time dummy in the same period; and S is the total number of surveys available. Note that the normalised set of time dummies starts from the third period.[33]
With these assumptions, model [1] for age-income profile assumes the following structure:

$$C = \begin{array}{cccc} Year-age & 49 & 50 & 51 \\ 70/49 & 1 & 0 & 0 \\ 70/50 & 0 & 1 & 0 \\ 70/51 & 0 & 0 & 1 \\ 71/50 & 1 & 0 & 0 \\ 71/51 & 0 & 1 & 0 \\ 71/52 & 0 & 0 & 1 \end{array} \qquad A = \begin{array}{ccccc} Year-age & 49 & 50 & 51 & 52 \\ 70/49 & 1 & 0 & 0 & 0 \\ 70/50 & 0 & 1 & 0 & 0 \\ 70/51 & 0 & 0 & 1 & 0 \\ 71/50 & 0 & 1 & 0 & 0 \\ 71/51 & 0 & 0 & 1 & 0 \\ 71/52 & 0 & 0 & 0 & 1 \end{array} \qquad T = \begin{array}{ccc} Year-age & 1970 & 1971 \\ 70/49 & 1 & 0 \\ 70/50 & 1 & 0 \\ 70/51 & 1 & 0 \\ 71/50 & 0 & 1 \\ 71/51 & 0 & 1 \\ 71/52 & 0 & 1 \end{array}$$

where the first column of each matrix is the year-age combination; columns of C are cohorts labelled as, say, *age in 1970*; columns of A are actual ages recorded in the dataset; columns of T are the available surveys. If one correspondingly defines: $v_c = \{0,1,2\}$; $v_a = \{0,1,2,3\}$; $v_t = \{0,1\}$ and pre-multiply each matrix by the corresponding sequence, one can get, in the same order, the following column vectors: $\{0,1,2,0,1,2\}$; $\{0,1,2,1,2,3\}$; $\{0,0,0,1,1,1\}$ which are evidently linked by the above linear relation.

[32] In the case of income, they may be productivity shocks; but also in the context of taxes and transfers, non-systematic changes may reflect the implementation of major tax/transfer reforms, which are appropriately modelled by time dummies capturing the common shift of tax/transfer profiles for all generations. This normalisation implies that these effects average out to zero in the long run, an assumption that may be debatable for taxes and transfers. However, as far as these instruments are used cyclically, this assumption may be quite reasonable. It must also be taken into account that the problem of identification illustrated for the case of dummy variables (or linear variables) is exacerbated for models with higher order interactions. As noted by Heckman and Robb (1985; 142), in a model with interactions terms of order k with j variables and one linear restriction among the variables of the $\binom{j+k-1}{k}$ coefficients, only $\binom{j+k-2}{k}$ combinations of the coefficients associated with terms of order k can be identified .

[33] An alternative normalisation procedure can be found in Kapteyn, Alessie and Lusardi (1999), where cohort dummies for the analysis of income and wealth are replaced by proxies for productivity, namely real GNP per capita when the head of household entered the labour market; and the changes in Social Security benefits to explain wealth behaviour.

$$
\begin{aligned}
Y = {} & \alpha+\beta_1 age+\beta_2 age^2+\beta_3 age^3+\beta_4 age^4+\beta_5 age^5+ \\
& \gamma_2 C_2+\gamma_3 C_3+\gamma_4 C_4+\gamma_5 C_5+\gamma_6 C_6+\gamma_7 C_7+\gamma_8 C_8+\gamma_9 C_9+\gamma_{10} C_{10}+\gamma_{11} C_{11}+\gamma_{12} C_{12}+ \\
& \delta_3 h_3+\delta_4 h_4+\delta_5 h_5+\delta_6 h_6+ \\
& \theta_1 FH+\theta_2 NC+\theta_3 EL+\theta_4 DH+\theta_5 DS+\theta_6 NE+\varepsilon
\end{aligned}
\qquad [6]
$$

where Y is real income expressed at 1995 prices for Sweden and UK and at 1994 prices for US; the various *age* variables are the polynomial in age; C_2 to C_{12} are cohort dummies, whose γ coefficients should identify the intensity of the shift imputable to each generation with respect to the common life-cycle profile; h_3 to h_6 are the normalised time dummies. A set of demographic variables has also been added to the basic model [1]: *household female headed* (FH) whose coefficient is expected to negatively contribute to life-cycle income; *number of children under age 18* (NC) with a likely negative entry; *high-degree educational level* (EL) which should show a positive relation with life-cycle income; *disability status of head of households and of spouse* (DH and DS) which should negatively contribute to life-cycle market income; and *number of earners* in the household (NE), whose coefficient should be positive, since life-cycle income is generally higher when there is more than one earner in the same household.[34] Equivalent income profiles are also estimated by adjusting incomes by the OECD equivalence scale.

The full specification of model [6] has then been adapted to estimate the life-cycle profile of all other variables included in the analysis (taxes, transfers, ATR, ATRR, ANTR, which replace income as dependent variables). In all these cases, dependent variables are related to (unobservable) lifetime income, of which cohort dummies may be used as proxies.

The only significant change, compared with model [6], possibly regards the sign of the coefficients of the demographic variables. The coefficient of FH (household female headed) is expected to be negative for taxes and positive for transfers. In general, all income tax systems provide tax reliefs for either single or single parent women, and transfers are more generous when the household is female headed. The coefficient of NC (children under age 18) is expected to have the same behaviour as above. Income tax systems provide either deductions or tax credits for this kind of demographic characteristic, and cash benefits are generally paid in the presence of children under a given level of income and age. The sign of the coefficient of EL (educational level) may instead be ambiguous. For taxes, one can expect that higher educational levels are associated with more taxes through the positive correlation between educational levels and incomes. However, a positive correlation may also occur between high incomes and the share of income perceived in forms other than fully taxable income (e.g. capital gains or exempt income, etc.) which are, as far as it is known, only very imperfectly recorded in LIS. Therefore, the sign may be expected to be positive, but a negative sign might also find its justifications. For transfers, an opposite line of reasoning holds, but in this case the income limits on

[34] Therefore, the benchmark case is a one-earner male headed household, with no children under age 18, not educated at the highest degree, with no disability, belonging to the oldest generation (cohort 1).

which cash subsidies generally depend should bias the sign towards a negative sign. Both disability status, *DH* and *DS*, would show a negative sign with taxes and positive signs for transfers. Finally, the coefficient of *NE* (more than one earner) might also have an ambiguous sign. On the one hand, with progressive tax rates, two earners splitting the same income of a single earner should paid lower taxes, at least in those cases where income splitting techniques do not apply. On the other hand, two-earner households may be, on average, richer than one-earner households, so that they could pay, on average, higher taxes. On the transfer side the second effect is likely to prevail; a negative sign is therefore expected.

3. Age related profiles: what actual data can say

The simplest way to examine the life-cycle behaviour of income from survey data is to plot incomes against age. What we can learn from the empirical observation is that incomes typically follow a hump-shaped profile, with an increasing profile from young ages to maturity, reflecting career dynamics and the return to education and experience, and a variable declining profile from maturity to retirement, mostly depending on the end of exploitation of the previous factors and on the higher degree of substitutability of non-skilled workers which prevents a significant growth of their wage levels over the life-cycle.[35]

In order to verify whether this hypothesis holds in our case, figure 3.1 reports the actual profile of market incomes calculated for selected surveys in each of the three countries analysed. As can be easily seen, the hump-shaped pattern is empirically recoverable from all pictures, even though there is much noise on the shape of the curvature, mostly depending on the interaction of age, cohort and time effects.

Figure 3.1 Cross-sectional age-income profiles, selected years

Real income growth is also somewhat visible in the three graphs, as the profiles shift upward when moving from early surveys to recent years. This shift is however more marked in UK, while for Sweden the difference between 1987 and 1995 real incomes is not as pronounced; quite surprisingly, in the US case, the three patterns are relatively more confused. This does not mean that productivity increases have not been recorded in US during the twenty years covered by the surveys, neither that GDP per capita has had a stable pattern. Data showed in figure 3.1 mainly record households earnings; to the extent that either productivity increases or GDP growth are not mirrored by earnings behaviour, the absence of shifting effect may still be consistent with a growing economy.[36]

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[35] See, for example, the typical age-wage relation proposed by Deaton and Muellbauer (1980; 312), where for non-manual workers the profile is generally increasing at decreasing rates until retirement; while for manual workers, the profile would show negative rate of changes well before the retirement age.

[36] This is an argument on which we will return below in the text, when cohort effects will be discussed.

Figure 3.2 shows the same information for real taxes and transfers. As expected, real taxes have a hump-shaped profile mirroring the income pattern; with progressive income tax rates, the real burden of taxes is indeed positively related to income growth.[37] Since the characteristic of a progressive income tax is that average tax rates increase with income, also the life-cycle shape of ATR is expected to increase until middle ages and then to steadily decline. Real transfers, instead, tends to have a stable pattern from young ages to retirement and a sharp increase after retirement.[38] The payment of transfers is in general negatively related to income levels, at least in those countries where selective (or means-tested) schemes are in place. Declining segments at young ages (when young people is subsidised before participating in the labour market or while having babies) and increasing segments near and after retirement (when health needs increase and pensions support schemes or other forms of subsidies are paid as complementary to public and/or private pensions) are therefore the consequence of the general structure of transfer payments. Average transfer rates should exhibit the same pattern: they should be higher at young ages, when transfers paid might be a substantial part of a small total income; have a negative peak approximately when income is at its maximum (which should imply to have transfers near their minimum); increase monotonically after the peak, when the growth of transfers might overcome the growth of income.

Figure 3.2 Cross-sectional age-tax/transfer profile

However, one of the point raised in the Introduction was that age profiles estimated using cross-sections data may give a wrong impression of what the true life-cycle age-income profile might be; further, if different generations systematically differ by tastes and productivity growth, a common life-cycle profile may be shifted either downward or upward.[39] To this purpose, figure 3.3 reports the same information as in figure 3.1 but disaggregated by cohorts (each identified by a different symbol). Figure 3.3 still reveals the aggregate hump-shaped pattern found in cross-section data, but the presence of more dynamic profiles belonging to some generations is also evident in all countries considered.

Figure 3.3 Cohort profiles of the age-income relationships, selected years

4. Age related profiles: life-cycle estimation

4.1. Estimated life-cycle patterns of income, taxes and transfers

Information obtained in the previous paragraph are concerned with actual incomes, taxes and transfers, i.e. with patterns emerging from actual data. Figures 4.1 to 4.3, instead, draw the results of model [6] for income, taxes and transfers for the three countries analysed, expressed in real values of the last year available. Smooth

[37] But taxes may also grow for pure monetary factors, like imperfect indexation of personal income tax parameters to inflation rates.
[38] Just to recall that in this case transfers do not include pensions.
[39] An example of this misleading possibility can be found in Deaton (1997; 343-344) for the case of Taiwan.

profiles, that are estimated controlling the age effect for cohort and time dummies, are of particular importance for obtaining information on the degree of intrapersonal redistribution. Indeed, life cycle income may be intended as the reference distribution for Lorenz curve-based inequality indices, such as Gini, once the degree of inequality due to different ages of people within the income distribution is accounted for. Analogously, life cycle distribution may be calculated for income net of taxes and for income net of taxes and transfers. In this sense, results obtained in this section form the basis of the discussion of intrapersonal redistribution reported in Section 5.

Figure 4.1 Life-cycle variables in UK
Figure 4.2 Life-cycle variables in Sweden
Figure 4.3 Life-cycle variables in US

Part a) of each figure shows the age-income profile, which is always typically hump-shaped; in order to show the importance of controlling for the cohort effects, for each country the same income profile has been also estimated treating all observations in the corresponding cross-sections as a single large sample, dropping cohort and time dummies (cross-sectional profile in the graphs). It can be seen that controlling for cohort dummies is particularly relevant in UK and US. In the first case, failure to include those variables in the estimation of the age profile causes the age-income profile to be overestimated at young ages and only slightly underestimated at older ages; while in US, overestimation occurs over the whole interval. In both cases, cohort-adjusted income declines less rapidly after the peak level. An opposite effect occurs in Sweden, where the cross-sectional profile underestimate at young ages and declines less rapidly after the peak income.

In each figure the life-cycle profiles of equivalent incomes are also reported. As can be easily seen, this profile is generally flatter in each country, giving some evidence that households smooth income over the life-cycle according to the specific demographic characteristics occurring during their life.

Life-cycle taxes and transfers are reported in part b) of the figures. The general shape of the profiles are again very similar; yet, there are some important differences among countries. real taxes and transfers, in the life-cycle, cross twice in UK and US, giving place, visually, to a bon-bon effect . The first crossing is around age 26-28; the second around 59-61. It means that, in real terms, income taxes paid by households headed by young people do not cover the real value of transfers received before age 26; in other terms, households are there net beneficiaries of the public support. After age 28, the real value of taxes becomes higher than the real value of transfers in all countries. At that age, incomes are increasing and taxes increase more or less up to the peak of the age-income profile, even though they start to decline two or three years before income reaches its peak. At age 60, households become everywhere net beneficiaries, for real amounts which appear substantially higher than before, as shown by the distance between the two life-cycle profiles. In terms of intrapersonal redistribution[40], the age interval between 28 and 60, where taxes paid

[40] This aspect will be discussed below.

are in excess of transfers received, should finance the deficit of taxes paid when younger and older in each country.

The bon-bon effect is not recoverable in Sweden, where there is evidence that households become net beneficiaries only after age 59. But for households headed by young people, while transfers are surely positive, they do not appear to overcome the real burden of taxes; in this sense, Swedish households in the labour market are always net payers. Further, the age-tax profile appears to be flatter compared with the corresponding estimation in UK, which may be due to the lower variance of the real burden of taxes over the life-cycle, which in turn may be due to the lower earning dispersion.[41]

For illustrative purposes only, one can calculate if the taxes paid in excess of benefits in mature ages compensate the excess of transfers at young and older ages, where available. In 1995 pounds, the present value at age 20 of the two flows is reported in Table 4.1, using two different discount rates, 5 and 10 per cent.

Table 4.1 The present value of real taxes and transfers

Table 4.1 illustrates that, at age 20, a Swedish household has a real burden of income taxes, over the life-cycle, equal to more than 43.000 pounds; while the same burden is one fourth for UK and one third for US. Switching to a 5 per cent discount rate makes the present value of US taxes equal to above 40 per cent of the Swedish benchmark; while the UK burden does not change dramatically, in relative terms. In all cases, with the exception of UK at 10 per cent discount rate, the sign of the net burden is positive, i.e. each household, at the beginning of its life , pays more in income taxes of what it gets in transfers. Finally, the particular relevance of the Swedish protection for elderly people can be appreciated by considering that the present value of transfers becomes equal to about 44 per cent of the present value of taxes, when both are discounted at 5 per cent, compared with a 30 per cent in the case of a 10 per cent rate. When future transfer flows are discounted less, the relative importance of protection after retirement becomes higher.[42]

4.2. Estimated life-cycle patterns of average tax rate

Previous results should give a clear picture of the pattern of income, taxes and transfers over the life-cycle, but just a rough impression of the intrapersonal redistributional effect caused by both taxes and transfers. In order to specifically deal with this problem, the life cycle analysis has been performed on three other variables, the average tax rate (ATR), the average transfer rate (ATRR) and the average net tax rate (ATRR) obtained as a difference between ATR and ATRR.

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[41] See, for example, Gottschalk and Smeeding (1997), where data reveals that the decile ratio of high to low earnings is in Sweden, in 1992, equal to 3.5; the corresponding figures for US (in 1991) is instead 5.7.

[42] It must be recalled that transfers do not include public pensions; further public expenditures in goods and services are not considered.

Table 4.2 reports the results for the average tax rate (ATR).[43] The constant coefficients reflect the mean estimated level, over the life-cycle, of the average tax rates in the three countries. As expected, while UK and US levels are rather comparable (12.74 and 10.57 points respectively), the mean level for Sweden is much higher (26.42 points), reflecting its high-tax attitude over the period considered.

Table 4.2 Regression results: average tax rates

In all cases the *age* variable at its first order enters the regressions with statistical significance and with the expected negative sign, which means that average tax rates are indeed negatively related with age. The relation is not linear, by assumption, and the degree of non-linearity is given by the significance, the signs and the sizes of the coefficient of the *age* variable at its higher orders. The curvature of the age-ATR profile given by the first order *age* variable appears slightly higher in UK and US, compared with Sweden; this might translate into a flatter profile of the life-cycle ATR in this latter country, i.e. age might have a greater potential in shaping ATRs in UK and US.

Figure 4.4 reports the implicit age-rates profiles for each country. As expected, the age-ATR profile is hump-shaped partially reflecting the life-cycle behaviour of its base (i.e. income).[44] More important, concavity of all profiles gives evidence that taxes have some *intrapersonal* redistributive effect.[45]

Figure 4.4 Life-cycle average rates: common profiles

As also expected, the height of the Swedish life-cycle profile is twice as much those of the other two countries for all ages, while the US profile is the lowest; as a percentage of *gross total income*, Swedish ATR climb above 25 per cent, compared with levels ranging from 10 to 12 per cent for UK and US. It means that in the last thirty years, a Swedish household, on average, has paid a much greater share of income tax on total income at every age.

With regard to the life cycle profile within each country, however, things do not differ very much. In UK, the highest ATR occurs around age 40, while in US there is evidence of a little delay (two-three years). Further, the two profiles differ more at young ages, with relatively higher differentials, compared with the corresponding

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[43] In Table 6.1 cohort dummies are dropped to focus on the life-cycle estimate of intrapersonal redistribution. Cohort effects will be considered in Section 7.

[44] It is again worth stressing that Figure 6.1 draws the common age-ATR profile, from which one can only infer intrapersonal redistribution and not the intergenerational profile, which deviates from the common profile by the magnitude of the cohort dummies.

[45] Were average tax rate were flatter against age, taxes would be proportional. It would mean that the reference life cycle income distribution before taxes, plotted as Lorenz curve, would remain unchanged after the application of taxes. As a consequence, the degree of intrapersonal redistribution due to taxes would be zero. Therefore, figure 4.1 provides a positive answer to the intuition that taxes have an intrapersonal effect. However, it does not quantify the intensity of this kind of redistribution on the overall redistributive effect of taxes (intrapersonal + interpersonal). Section 5 will deal with this latter issue.

pattern around the retirement age. This gives a first rough impression of the relative degree of intrapersonal redistribution, which seems to be correspondingly lower in Uk than in US. A slight anticipation of the peak occurs in Sweden, where it is achieved before age 40 and where ATRs decline less rapidly, compared with the other two countries, showing a flatter path at least until retirement age. In all cases, ATRs peak earlier than incomes, which means that real taxes start to decline before income is at its peak; and that the age interval where taxes increase faster than income is before age 40.

With regard to the specific effect of demographic variables, table 4.2 reports the values of the estimated coefficients. Results are again satisfactory, with the expected sign and a reasonable magnitude. For example, a female headed household (FH) pays from 2.7 (in US) to 3.7 (in Sweden) points less than the benchmark household; while households with high educational levels and with more than one earner generally bear relatively higher ATRs on the life-cycle. Further, of particular relevance, are the estimates of the values of tax expenditures related to the number of children and disability status, both for head of household and for the spouse. In Sweden, the constant ATR is indeed reduced by about 60 per cent when the head of household is disabled (15.9 percentage points), compared with about 45 per cent in both UK and US. A greater rate of protection, over the life-cycle, is instead provided by UK and US with regard to the disability status of the spouse. Further, children value is 4.7 points in Sweden, 4.2 points in US and 3.6 points in UK.

4.3. Estimated life-cycle patterns of average transfer rate

Table 4.3 reports the results of the regressions for average transfer rates, again dropping cohort dummies.

Table 4.3 Regression results: average transfer rates

Again, the constant coefficients reflect the average level of transfer rates over the life-cycle, with rather comparable values among countries, with an interval of 3.5 points between Sweden and US. The *age* variable enters the regressions with the correct positive sign, signalling that transfers, as a percentage of income, increase with age, even though growth is not linear, depending as before on the sign and the magnitude of the other coefficients of the polynomial. The intensity of the Swedish coefficient (1.15) also reveals that this growth is expected to be greater than in the other countries, i.e. the slope of the ATRR curve over the life-cycle should be higher for Sweden the more actual age approaches retirement age. This effect is somewhat expected: in Sweden, income, especially of elderly people, is strongly supported by public intervention; while US, among the three countries that with the lowest value of the age coefficient, has traditionally the greater share of social protection provided by private sector.

The middle graph of figure 4.4 reports the age-ATRR profiles, which supports the previous conjecture. Looking at the Swedish profile reveals that transfer rates are higher at young ages, fully comparable with those of UK and US at middle ages and significantly higher after retirement, where transfers represent a greater part of gross total income. For very old head of households, this rate approaches 90 per cent, about twice as much of the figures estimated for both UK and US, which show very similar patterns over the whole range. The Swedish profile is also the most concave, at younger ages, among the three, supporting previous findings on actual data (figure 4.2).

In general, the estimated patterns provide reasonable evidence of the behaviour of transfers over the life-cycle. All profiles have the expected inverse hump-shaped pattern: the share of transfers on gross income is low when younger and in the labour market, and increase rapidly when market income starts to decline according to the findings of the life-cycle theory. Transfers support gross incomes of the very young more in Sweden and less in US. Between age 38 and 50, the share of transfers on total income of all households falls to around 10 per cent. After retirement, the same share achieve its peak, due to both the increase of specific monetary transfers linked with age conditions and to the declining pattern of market income.

Finally, the role of demographic variables can again be inferred by the value of the coefficients reported in table 4.3. All variables enter the regressions with the right sign (except for *educational level* in UK) and the values are pretty comparable among countries. For example, for a female headed household, the share of transfers on total income is about 13.7 points above the average in UK; 8.75 points in US and 10.8 points in Sweden. Significant weight, on the life-cycle, is revealed by the disability status of the head of household: in this case, the share of transfers range from 26.6 points above the average in US to 46.8 points in Sweden. Children under age 18 also increase the share of income attributable to transfers in all countries; while the presence of two or more earners has a depressing effect on the same share, even though statistical significance is only 10 per cent in UK.

4.4. Estimated life-cycle patterns of average net tax rate

The natural end point of the discussion is to verify how income taxes and social transfers interact, i.e. to calculate an average net tax rate (ANTR) as the difference between ATR and ATRR. Results of the regressions are not shown, but they can be easily inferred by those reported in Tables 4.2 and 4.3. The constant coefficient is everywhere positive, with values of 14.1 in Sweden, 1.7 in US and 1.01 in UK. The *age* variable is instead negative, which means that one can expect the net tax rate to decline with age at a rate depending on the sign and the size of the *age* variable at its higher orders. In the specific case, net tax rate may also become negative at some point in the life-cycle, to the extent that, at a given age, the share of income received in transfers becomes higher than the share of taxes paid on the same base.

The bottom graph of figure 4.4 shows how and when this effect occurs in the various countries. The most important point is that, after retirement, taxpayers become net receivers in all countries.[46] This occurs around age 53 in US and UK

[46] Just to remember that they become net receiver with respect to the income tax only.

(which show a very close profile) and later (around age 57) in Sweden. At the same time, in Sweden, people until age 64 pay a higher net tax rate than the corresponding people in both UK and US; however, after that age, the Swedish net tax rate continue to fall much below the corresponding rate for the other two countries.

Life-cycle ANTRs of US and UK, instead, are very similar on the overall period, even though there is a partial evidence of multiple crossings of the two profiles, with higher levels for UK from young ages until age 40 and from age 68. While in the labour market, from age 40 to retirement, US households pay a higher net tax rate than in UK, but still less of Swedish households, who have the highest net tax rate profile, basically due to higher level of their average tax rate.

5. How much intrapersonal redistribution?

The most important result obtained insofar is that taxes and transfers have an intrapersonal redistributive effect, evidence of which is given by the curvatures of the corresponding life cycle profiles. Further, life cycle profiles of incomes, especially equivalent income, tend to be less dispersed than corresponding cross-sections profiles. However, evidence has not been provided of the relative weight of intrapersonal redistribution on the total redistributive effect of taxes and transfers.

This information is of particular importance for tax and transfer policies, not only for a positive analysis of their ex post effects, but also from a normative point of view. Personal differences in incomes linked to differences in age might not be relevant for the equity of taxes and transfers. Equity might be best achieved by redistributing from *lifetime* rich to *lifetime* poor, and not by redistributing from *static* rich to *static* poor. Were the income profile flatter against age, it would mean that age differences would not cause significant differences in income. In this case, the reference income distribution (i.e. the life cycle income profile) would be equivalent to the equidistribution line in the Lorenz curve analysis, and static inequality equivalent to lifetime inequality. Therefore, interpersonal inequality to be minimised may be less from a lifetime perspective; on the other hand, as progressive taxes and transfers correct also for intrapersonal distribution, the interpersonal aim is achieved to a less extent.

But then, what is the lifetime interpersonal power of taxes and transfers in the three countries analysed? And how much of the total redistributive effect can be imputed to intrapersonal shifting? The intuition behind the methodology used to disentangle these effects is the same elaborated by Paglin (1975), who argued that measuring inequality and redistribution departing from the equiproportional income distribution is of little meaning. He then suggested to measure inequality departing from a reference distribution in which all individuals in specified age groups receive equal incomes. This latter Lorenz curve should measure, at any given point in time, the accepted degree of inequality, i.e. the intrapersonal part of the income distribution depending on people being at different ages in the underlying income distribution. As defined, this part of the total inequality would disappear if measured over the lifetime distribution.

In Paglin (1975), the reference income distribution is built by assigning the conditional mean income to all individuals in the same age group and then ranking groups by mean incomes in a given cross-section. Unlike Paglin s method, the innovative aspect regarding the measurement of intrapersonal effects here used is represented by life cycle profiles estimated by regression techniques controlling for cohort and period effects. By this way, the potential information embodied in repeated cross-sections is used by estimating those profiles treating all available data as a large cross-section. By this way age groups are followed across different years and not for just one cross-section as in Paglin.

The meaning of the numbers illustrated below can be fruitfully studied by considering the Lorenz curve interpretation underlying the Gini indices. The difference between cross-sectional Gini measures the area included between the Lorenz curve of income before taxes and the Lorenz curve of income after taxes, i.e. both the intrapersonal and interpersonal redistribution. While, the difference between life cycle Gini measures the area included between the Lorenz curve of life cycle income before taxes and the Lorenz curve of life cycle income after taxes, i.e. it measures the intrapersonal part of the total redistributive effect.[47]

Results are reported in table 5.1 for all countries analysed. Numbers in the first panel are the Gini indices of life cycle equivalent incomes before taxes and transfers (pre t/t), after tax and before transfers (post tax) and after tax and transfers (post t/t). Corresponding cross-sectional Gini indices are instead showed in the second panel. The total redistributive effect of taxes and transfers, measured as the difference between cross-sectional Gini indices, is reported in the third panel. The fourth panel reports the intrapersonal part of the total redistributive effect, measured as the difference between life cycle Gini indices. Finally, the fifth panel measures, by difference, the interpersonal redistributive effects of taxes and transfers.

Some interesting results can be inferred from table 5.1. First, life cycle inequality before taxes and transfers is substantially lower than cross-sectional inequality measured by Gini indices for all countries and for all years considered.[48] This is quite a standard result, evidence of which has already been found in studies using Dynamic Microsimulation Models (DMM), where the ratio between life-cycle inequality and cross-sectional inequality generally ranges from 50 to 65 per cent.[49] In the specific case, the ratio between the Gini life cycle index and the conventional

[47] Paglin s analysis is indeed strictly related to the decomposition of Gini index proposed by Pyatt (1976). As the Gini index is in fact exactly decomposed in three parts, between group, within group and overlapping factor (at least in those cases where partial rankings of groups do not add up to total ranking), subtracting the intrapersonal (between groups) effect leaves the analyst with the sum of the other two effects (interpersonal and overlapping).
[48] Being estimated on a life cycle perspective, life cycle Gini are equal for all years, i.e. they measure inequality of the reference distribution that must be the same over the period.
[49] See, for example, Blinder (1974), Soltow (1974), Lillard (1977), Blomquist (1981), Harding (1986), Bjorklund (1993).

Gini ranges from 49.4 to 61.6 in UK, from 49.2 to 68.3 in Sweden and from 33.2 to 37.7 in US.[50]

Table 5.1 Intrapersonal and interpersonal redistribution

Second, conventional cross-sectional inequality tends generally to increase in all countries, achieving quite comparable levels in the last year available (0.425 in UK; 0.406 in US; 0.410 in Sweden after a period of relatively lower cross-sectional dispersion in earlier years). For UK, results are also in line with the common finding that sharp rises in inequality occurred only since 1977, with fastest rises in inequality occurring in the late 1980s.[51]
The increase of this dispersion is evident even considering both the conventional Gini after taxes and after taxes and transfers, as a partial consequence of the reduced conventional redistributive power of taxes in all countries considered (first row of the third panel).[52] At the same time, as evident from the third row of the third panel, transfers are likely to have affected underlying income distributions in a growing inequality reducing direction, but not enough to recover increased inequality in the distribution of the reference income. Indeed, the second row of the third panel shows the total conventional redistributive power of the two instruments together, which is generally increasing over time (more slowly in US) because of the compensatory action of transfers on the reduced power of taxes.

Third, of particular interest is the possibility that part of the total redistributive effect be intrapersonal. This possibility is caught by the difference between corresponding life cycle Gini indices, instead of cross-sectional ones. If intrapersonal redistribution occurs, it means that the reference life cycle income distribution is affected (either positively or negatively) by the combined action of taxes and transfers. In terms of Lorenz curve analysis, we should expect the reference income line to shift upward (towards the equidistribution line) with progressive taxes and transfers, i.e. life cycle income distribution becomes more equal after taxes and tranfers.

The fourth panel of table 5.1 reports the results. Positive values implies the presence of intrapersonal effects. For taxes, intrapersonal redistribution ranges from about 18.9 per cent to 37.2 per cent of the total redistributive effect in UK; from 29.7 to 40.3 per cent in US; and from 23.1 to more than 38 per cent in Sweden.[53] Therefore, a not negligible part of the total redistributive effect of income taxes measured in each cross-section is in fact an intrapersonal effect, i.e. income taxes reduce the inequality of the individual life cycle income paths. Were the income tax applied on the lifetime incomes, this part of the redistributional power of income taxes would

[50] Differences may arise by the relative homogeneity of the surveys used, testing of which is relatively difficult not directly controlling for LIS data.
[51] See, for example, Giles et al. (1998; 22).
[52] This power is measured as the difference between cross-sectional Gini indices.
[53] Fullerton and Rogers (1993), using a general equilibrium model, show that, in US, the personal income tax has a lower redistributive effect in the life cycle than in cross-section analysis. See especially, chapters 4 and 7. Entries in the fourth panel are identical for each year, because Gini life cycle estimates do not vary with cross-sections having been estimated over a stacked dataset controlling for cohort and time effects.

disappear, because it would be able to distinguish between *lifetime* rich and *lifetime* poor, instead of being applied on *annual* rich and *annual* poor without information on their corresponding place in the lifetime income distribution.

The presence of an intrapersonal effect of taxes means that their true interpersonal effect must be lower than the conventional redistributive effect. This is evident, for each country, in the first row of the fifth panel where some tracks of the main personal income tax reforms are also visible. For example, in UK interpersonal effects fall significantly in 1979, when the top marginal tax rate was lowered from 83 to 60 per cent. Further, in percentage of the initial Gini index, the interpersonal effect is almost constant until 1986, following a no change period that lasted until 1988. And no dramatic changes occurred in correspondence of the two and three-bracket income tax set in 1991 and 1993, respectively. In US, the pattern is almost the same, with the weight of the interpersonal effect on the initial Gini index decreasing over time, especially between 1979 and 1986, where two major tax reforms were enacted. Finally, also in Sweden there is quite a comparable effect with two steps, the first between 1981 and 1987 (from 5.8 to 3.0 per cent of the initial Gini) following a significant tax reform in 1982; the second between 1987 and 1992 (from 3.0 to 2.6 per cent) after the 1991 tax reform, implementing considerable tax reductions for large groups of population.

A similar line of reasoning can be held for the third row of the fourth panel reporting, for each country, the intrapersonal effect of transfers. As evident from the entries, the intrapersonal part of the total redistributive effect is greater than in the case of taxes, ranging from 56.9 to 83.7 in UK; from 74.9 to 87.3 in US and 31.2 to 78.9 in Sweden. Therefore, as somewhat expected, transfers reduce inequality of the individual life cycle income paths more than taxes do. This may partially be the consequence of the specific functioning of transfers, that, unlike taxes, target *annual* poor with explicit insurance and assistance purposes.

Also in this case, the interpersonal effect must be lower than the total redistributive effect. The third row of the fifth panel reports this result, evidencing a general tendency towards an increase of the weight of the interpersonal effect on the corresponding initial Gini index in all countries. The combined effect of taxes and transfers is also reported in the second row of the fifth panel.

6. Intergenerational shifting: how did past tax/transfer policies affect the common life cycle profiles?

Insofar, the analysis has been conducted having as a reference point the common life cycle income distribution against which both intrapersonal and interpersonal redistributive effects of taxes and transfers have been assessed.

In this section, attention will be paid to the shifts induced by actual tax/transfer policies over that common life cycle profile. In other words, evidence will be provided of the intergenerational shift of life cycle profiles belonging to different generations. By this way, information will be given on whether taxes and transfers have had (and are likely to have for present generations) any effect on the position of the common life cycle profile.

The analysis will start again from estimated generational patterns of income, taxes and transfers, in order to disentangle their movements on the pattern of average tax rates (ATRs), average transfer rates (ATTRs) and average net tax rates (ANTRs) for different generations. Shifting of these latter variables from the common profiles, induced by taxes and transfers, will mean that tax/transfers policies have had a generational effect.

6.1. Estimated generational shifting for income, taxes and transfers

Figures 6.1, 6.2 and 6.3 show the cohort profiles of income, taxes and transfers for each country, respectively, which gives evidence that the life cycle profile estimated in figure from 4.1 to 4.3 have different heights for different generations in all countries analysed.[54]

Figure 6.1 Incomes, taxes and transfers in UK: cohort profile
Figure 6.2 Incomes, taxes and transfers in US: cohort profile
Figure 6.3 Incomes, taxes and transfers in Sweden: cohort profile

For example, in the UK case (figure 6.1), there is evidence that real income has grown over time and that the youngest generations, on average, have higher age-income profiles, which might be attributed to productivity growth.[55] Deviations are evident also for the absolute amount of real taxes and transfers, more marked in the first case, where the shift of the real burden of taxes for youngest generations strongly mimicks the income shift. Evidence of significant generational shifts is less compelling in the case of real transfers, where middle generations would bear the lowest age-transfer profiles.

Evidence of significant generational shifts are less clear in the US (figure 6.2). Real income growth is more evident for generations nearer to the oldest, and in the observed period this growth occurs at declining rates. The growth of real taxes is more evident, especially for middle generations, but this may again partially be caused by increasing real incomes. Also for real transfers, there is evidence of an increasing life-cycle profile when moving from oldest to youngest generations, yet this generational differential is going to become more thin for very young households. This latter, on average, get the same life-cycle transfer profile of the oldest generation, even though they are asked to pay more in taxes. However, distributional implications cannot be drawn by looking at these absolute levels, because younger generations also perceive a higher life-cycle profile of incomes.

[54] Moving from right to the left one moves from older to younger generations.
[55] Productivity growth is here best understood as growth of average earnings (see below), because LIS data mainly records earnings in the income variable; therefore, any productivity increase that is not matched by an increase in earnings is likely to be not recoverable in LIS data.

A different pattern emerges from Sweden (figure 6.3). Here, real income profiles are lower for youngest generations, possibly reflecting the decline in real average earnings occurred during most of the period included in the analysis.[56] Partly as a consequence of this factor and partly as an effect of tax reforms here introduced, the cohort profile of real taxes also shows significant lower levels for youngest generations. More interesting, Sweden is the country where the pattern of the cohort effect on taxes deviates most from that on income, signalling that tax changes may have had a greater generational impact in terms of average tax rates. While the transfer profile gives evidence of a slightly higher life-cycle profile for younger generations, even though it occurs at declining rates and with small differences with respect to the benchmark.

More information on the generational shift can be obtained by looking at figure 6.4. Here, the X-axis reports the age of the cohort in 1990 and moves from older to younger cohorts when moving from left to right; the Y-axis reports the implicit annual growth rate of income, taxes and transfers of each generation compared with the oldest and resulting from regression estimates. Each age in the graph is calculated as the median age of the cohort.

Figure 6.4 Cohort effect: UK, US and Sweden

As can be easily seen, UK has a growing and generally positive profile of income, which means that real incomes of each next generation are higher than those of the oldest, but also that the distance between them is increasing as far as one moves to younger generations. For example, those born between 1960 and 1964 (age 28 in 1990), at a given age, benefits, on average, of a real income growth equivalent to 0.8 per cent per year compared with the benchmark cohort, those born between 1910 and 1914. This growth is reduced to 0.5 per cent per year for those born between 1935 and 1939 (age 53 in 1990). The complete set of underlying data are reported in Table 6.1.[57]

Table 6.1 Cohort effects in UK: implicit annual growth rates (%)

Also the real burden of taxes seems higher for younger generations, with a pattern closely following the growth of real incomes. The implicit annual growth of real taxes, for each generation, is indeed quite close to the growth of real income, with younger generations having a higher life-cycle profile of real taxes. The reduction of the life cycle profile of real transfers for those aged between 23 and 58 in 1990,

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[56]The Swedish economy has indeed performed rather poorly since the 1970s with a per capita GDP equal to 96 per cent of the OECD average in 1995, against a corresponding figure of 114 per cent in 1970. See Lundvik et al. (1999).

[57] It can be noted that for generations immediately after age 78 in 1990, the sign of the cohort effect in income is negative and that of transfers is positive. Those aged 73 and 68 in 1990 born in 1917 and in 1922 respectively, and the time they ideally entered the labour market approximately coincides with the Second World War period, which may explain a lower lifetime income profile and a relatively higher transfer profile.

instead, can be easily appreciated by looking at the negative entries of both figure 6.4 and table 6.1.

The middle graph of figure 6.4 and table 6.2 gives corresponding entries for US. For the youngest generation, the pattern of real income is about 0.9 per cent per year above the same pattern for the oldest generation; but it is 3.27 per cent in the case of those born between 1915 and 1919.[58] The shifting of real taxes is also evident, especially for middle generations (where the trend is slightly positive), but it again closely follows the pattern of income. In fact, the two generational patterns appear very similar, even though there is evidence, as typical of progressive income taxes, that the implicit annual growth of real taxes is slightly faster than the same growth of income.[59] Complete data are in table 6.2.

Table 6.2 Cohort effects in US: implicit annual growth rates (%)

Swedish peculiarities are evident in the third graph of figure 6.4 and in table 6.3. The declining pattern of tax changes is striking, as it is the narrow channel within which both real incomes and real taxes flow in the life-cycle of different generations. While real income do not increase when moving to youngest generations and real taxes decline, real transfers still show small upward shifts of the common age-transfer profile, even though they occur at declining rates. In redistributive terms, as it will be discussed in the next section, one can expect a non-increasing (or declining) generational profile of average tax rates (since taxes decline faster than income) and an increasing generational profile of average transfer rates.[60]

Table 6.3 Cohort effects in Sweden: implicit annual growth rates (%)

Finally, as an indirect tool of comparison with the estimated cohort effects in income, figure 6.5 reports the evolution of the index of real average earnings between 1970 and 1990 in the three countries. Marked increases occur only in UK, which is also the only country where the estimated cohort effect records an unambiguous increasing upward shift of the lifetime income profile for younger generations. In Sweden, where there is estimated evidence of negative cohort effects for the youngest generations, it is worth noting that the real index of average earnings has steadily declined from 1976 and 1983; and that in 1975 and 1976, the real index was at levels not anymore achieved in the period observed. Finally, for US, with the exception of the period 1981-83, the real index has had cyclical fluctuations, partially explaining why the estimated cohort effect for each generation does show declining implicit annual growth rates compared with the benchmark.[61]

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[58] Just to make clear that positive values associated with a negative trend on figure 5.7 does not mean that the variable is decreasing, but only that it is increasing at declining rates, compared with the benchmark.

[59] This may mean that one can expect a growth of the average tax rate among generations, a point that will be discussed later in Section 7.

[60] See below sections 6.2-6.4.

[61] As observed above, this does not mean that productivity increases did not occur in the analysed countries; but it may mean that productivity increases (proxied, for example, by the level of per capita GDP) and average earnings increases are not symmetric. Since LIS data record earnings and

Figure 6.5 Real index of average earnings, 1987=100.

6.2. Estimated generational shifting for average tax rates

The main conclusion of the previous section is that all cohorts are likely to experience either a downward or an upward shift of its own life cycle profile, and that shifting occur for income, taxes and transfers at various intensities, measured in absolute real levels. The aim of the next three sections, respectively, is to draw conclusions on the possibility that the share of taxes paid on income (average tax rate), the share of transfers received on income (average transfer rate) and the balance between the two (average net tax rate) have experienced similar shifting, therefore signalling the presence of intergenerational redistribution. For example, moving upward from the common life cycle profile of average net tax rate (ANTR) will mean that the specific cohort will bear, in its life, a higher net tax burden than the benchmark cohort.

Figure 6.6 shows the ATR estimates for all countries. For UK, evidence is shown that the generations immediately next to the oldest and the youngest ones have a sensible upward shift of their ATR life-cycle profile; while, for middle generations this shift is still positive but substantially lower. This effect may be better appreciated recalling figure 6.4, where the cohort effect of real taxes and real income was plotted. In UK, for each generation next to the three oldest ones, real income tends to grow faster than real taxes; therefore, average tax rates are expected to follow a declining pattern, across generations and relative to the benchmark. For younger generations, the reverse is true, giving place to the increasing path observed in figure 6.6. This result is particularly important, as the formal structure of the personal income tax has been profoundly lightened between early 1970s and 1990s, but no significant effect on the average tax rate occurs for youngest generations.

Figure 6.6 Average tax rates by cohorts

Intergenerational shifting of ATRs are less evident in the case of US, if we made exception for a little jump between the oldest and the next to oldest generation. The life-cycle profiles appear indeed rather homogeneous, with some evidence of an increasing pattern for middle generations and a slightly positive growth for the youngest one. The cohort effect already analysed in figure 6.4 shows how middle generations might bear some disadvantages from US tax policies. From the cohort aged 68 in 1990 to the cohort aged 43 in the same year, real taxes grow faster than real earnings; it means that average tax rates increase, compared to the benchmark. But from the cohort aged 43 in 1990 to the cohort aged 28, real taxes growth at almost the same rate than income.

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only imperfectly other income sources, this may partially explain why even in presence of possible productivity shifts among generations (or increases of the level of per capita GDP), one can find some evidence of negative cohort effects if the main measured income source is earnings.

Unlike the US case, in the Swedish case intergenerational effects appear stronger. Compared with the benchmark, positive shifts of significant magnitudes occurred for both oldest and middle generations. As already reported in figure 6.4, the pattern of cohort dummies for taxes is positive, yet declining, between those aged 43 in 1990 and those aged 73 in the same year. For younger generations, instead, the pattern of cohort dummies is random around zero, meaning that the direction of redistribution is here from oldest to youngest generations. Therefore, for the Swedish case, the effect is almost the opposite of that occurring in UK; there, youngest generations are financing low ATR profiles of middle and to some extent oldest generations; in Sweden, youngest generations are instead financed by all other generations; while in US, households in middle generations are in fact slightly financing all others.

The overall compared cohort effect affecting all rates is finally reported in figure 6.7, where, implicitly, the link between ATRs and major tax reforms occurred in each country may be better appreciated. As before, for each cohort, only the median age is considered on the horizontal axis; while the vertical axis shows the shift imputable to each generation compared with the common ATR profile, measured in percentage points. A curve lying on the positive quadrant means that the median age of the generation considered is experiencing a higher ATR life-cycle profile (compared with the benchmark); the reverse is true for those parts of the curve lying on the negative quadrant.

Figure 6.7 Pattern of cohort dummies of average rates, all countries

For the UK case, there is some evidence of a (weak) positive U-shaped pattern of cohort dummies, meaning that both mature and particularly youngest generations are paying, on their life-cycle, more than what the oldest generations did pay. For example, the highest shift is shown by those households whose head was born between 1960 and 1964 (median age 28 in 1990); while for the youngest generations (age 23 in 1990) the shift is still positive but lower, possibly as a consequence of the significant changes of the income tax structure realised between 1988 and 1990 (reduction to two brackets and replacement of joint taxation with individual taxation).[62] For middle generations, for example those aged 53 in 1990, the positive shift is instead quite low. As can also be easily seen from figure 6.6, at age 36 , for example, belonging to younger generations means to have a ATR profile of about two points higher than those implicit for middle generations while at the same age. All these considerations may give partial evidence that both younger and older generations (possibly with the exception of the oldest one) have actually redistributed to middle generations, whose profile does not deviate very much from the benchmark.

Not very different patterns emerge for US, where from age 28 to age 43 in 1990 the average tax rate is almost constant (or slightly decreasing). This is particularly important to infer some possible intergenerational effects caused by one major US

[62] Time dummy for 1995 gives further support to this hypothesis, signalling a downward common average shift of ATR equal to 0.357, which may of course be unequally distributed among different generations.

tax reforms, that implemented between 1981 and 1986. While there is evidence of a common downward shift, on average and in 1986, of about 1 percentage point for all cohorts[63], this reform is likely to have favoured most younger generations, i.e. those who accessed the labour market at the time of the reform, but not as strongly as one could expect.

For Sweden, the most relevant point is the declining path of the upward shifting of ATR with a random pattern around zero of the cohort effect for younger generations. A possible explanation of this effect may be the implementation of two tax reforms licensed in 1982 and 1991. In particular, the 1991 reform provided for a reduction of the marginal tax rates of about 25 percentage points, on average; and the estimated time dummy for 1992, the first year in which the reform had effect, enters the regression with a value of 2.51.[64]

6.3. Estimated generational shifting for average transfer rates

Figure 6.8 shows analogous information for the average transfer rate (ATRR) in each country; the same does the middle graph of figure 6.7, where the pattern of the corresponding cohort dummies is reported. Consider first the UK case: figure 6.8 illustrates that the cohort effect is stronger for the next to oldest generations (second and third cohort) and remains almost constant, with the exception of the youngest generation (those aged 23 in 1990) whose shift is however not statistically significant. This result is in line with the common impression that the UK welfare state is a system that, in quantitative terms, has maintained intact its role even in periods characterised by strong commitments against taxation and government expenditures.[65]

Figure 6.8 Average transfer rates by cohorts

The general U-shape of the level of cohort dummies highlight that middle generations did not benefit of a significant deviation of their life-cycle ATRR, compared with the benchmark. But the relative high level profile for younger generations comes, as illustrated in the previous section, at the price of a higher profile of average tax rates, too.

Of some interest, therefore, will be to analyse below what kind of pattern average *net* tax rates will exhibit. Before moving to this evidence, however, figures 6.8 and 6.7 allows us to appreciate that generational shifting is almost monotonic in US; after an

[63] This is the value of the coefficient of the 1986 time dummy. Most of the reduction in taxes, at least those potentially relevant for households, occurred in 1981, but no survey is available for that year; further, the possible reduction of life-cycle profile induced by that reform has been partially compensated by next increases in 1991 and 1994, years for which time dummies are both positive and statistically significant. To this purpose, if one looks at the youngest cohort (aged 23 in 1990) who was not in the labour market at the time of the 1981 reform, there is a small evidence of an increasing shift, compared with the previous generations.

[64] Between 1970 and 1980, direct taxes share of GDP was roughly constant; while it begun to decrease after tax reforms, especially after 1990.

[65] See, for example, Cardarelli and Sefton (1999).

initial increase, compared to the baseline, the level of transfer shifting is positive but declining until the cohort aged 38 in 1990 and becomes negative for the three youngest generations. It means that as moving to younger generations the share of income represented by government transfers tends to decline in the life-cycle. An opposite trend occurs in Sweden, where the ATRR profile is shifted upward for middle and younger generations, even though in this latter case the trend is reversed. Figure 6.8 illustrates this effect and figure 6.7 shows that the pattern of cohort dummies for ATRR follows an opposite trend compared with the corresponding pattern of ATR. This is mainly the effect of transfer payments having more than doubled between 1970 and 1995 (from 11 to 25 per cent of GDP) as a result of a number of costly reforms.[66]

6.4. Estimated generational shifting for average net tax rates

At this point, of some importance is to analyse the combined result of the two life-cycle profiles, ATR and ATRR, and to draw generational differences of the average net tax rate (ANTR) profile. Figure 6.9 reports this information for the three countries; while figure 6.7, as the bottom graph, shows the pattern of the cohort dummies.

Figure 6.9 Average net tax rates by cohorts

Starting again with the UK case, a downward shift of the ANTR profile is evident for very old and the youngest generation (aged 23 in 1990); while for middle generations the pattern does not deviate very much from the baseline. This information may be further appreciated looking at figure 6.7, where the pattern of cohort dummies for UK follows a reversed U-shaped pattern, with lower levels for the second and third cohort and a pronounced downward shift for the very young. As easily inferred from figure 6.6 and 6.8, this may be explained as follows: oldest generations benefit of a shift of ATRR higher than the positive shift of their ATR; net tax rates therefore record a negative shift. For middle generations (from those aged 63 in 1990 to those aged 48) the deviations from the baseline almost compensate, and the same is true also for some young generations (e.g. those aged 33 in 1990). For the youngest generation, instead, the positive shift in transfers is more pronounced than the corresponding positive shift in taxes; it follows the negative shift in ANTR reported in figure 6.7.

In US, figure 6.9 shows that the generational effects are again monotonic; the shift is negative for oldest generations and positive for youngest ones, but with an increasing intensity as far as one moves from older to younger cohorts. Looking again at figure 6.7, this effect is easily observable; also easy is to understand that the result is determined by a negative trend of cohort dummies for ATRR and a positive

[66]For instance, maternity assistance programmes were introduced; parents were entitled to parental leave with 80 per cent of labour income for 360 days; further, welfare programmes were, and still are, often offered without means-testing.

trend of cohort dummies for ATR. For every generation, then, the net shift is widening, with more taxes paid on income and less share of transfers received.

Finally, analogous information can be recorded for Sweden, where the pattern of cohort dummies follows an opposite trend, compared with both UK and US. In Sweden, net tax rates are higher for older generations; while middle and younger generations benefit of a negative shift of their ANTR profile. Particularly relevant, in this case is the reduction of the burden of income taxes at the beginning of Nineties.

Figure 6.7 gives also a picture of the direction of the intergenerational redistribution occurred in the three countries. Even though there is no evidence of large shifts from the common profiles, the direction of redistribution is different and may give some useful insights for commenting and assessing future public policies. In US, younger generations are in fact redistributing to oldest by means of a higher ANTR profile; in Sweden, the reverse is true: oldest generations, who paid more in taxes and had less in transfers, have financed lower net tax rate for younger and middle generations; finally, in UK, middle generations appear to finance lower ANTR levels of both older and younger generations.

A direct comparison of the relative net burden of each generation in the three countries analysed, may be finally appreciated by looking at figure 6.10, where, for each cohort, we have superimposed the ANTR profile prevailing in each country.

Figure 6.10 ANTRs by generations.

Younger generations are (net) taxed more in Sweden; while for middle and older generations the Swedish ANTR is below those of UK and US. These two latter profiles are in fact very similar, across generations, with some evidence of positive differential for US, especially for middle generations (cohorts 5, 6 and 7). To simplify matters, the different degrees of intergenerational redistribution suggest that to maximise income, assuming that the same pattern will replicate in the future, one would be in UK when younger, again in UK while working, and in Sweden at older ages. There is no particular convenience to be in US at any age, which is second best choice when younger and the worst choice when middle aged and after retirement.

7. Conclusions

The aim of the paper has been to provide empirical evidence of the degree of intrapersonal, interpersonal and intergenerational redistribution implicit in the tax/transfer systems of three OECD countries (UK, US and Sweden) over a period covering the last thirty years, using LIS data.

The first important result has been to derive complete life-cycle profiles of many variables drawing on actual data, rather than on simulated scenarios as those of either Dynamic Microsimulation Models or generational accounting methods. For real income the characteristic hump-shaped profile has been found, reflecting income differences linked with age across each individual life-cycle income paths.

The hump, however, significantly flattens in all countries when considering equivalent incomes. This implies that part of the variability in real income over the life-cycle may be explained by different household sizes and compositions. If equivalent incomes were chosen as the proper basis for welfare, it might be suggested that intertemporal allocation of resources by households generates a flat level of well-being. Further, for real taxes and transfers, a peculiar effect has been derived for UK and US, here defined as the *bon-bon effect*: when observing the life cycle distributions of these two variables, there are age intervals at younger and older ages where transfers received are in excess of taxes paid, while the opposite holds during most of the working age. A similar effect does not occur in Sweden.

In all cases, however, a non linear relation between income, taxes, transfers and age supports the idea that policy instruments have an intrapersonal as well as interpersonal effect. This finding has been also supported by deriving the life cycle profile of average tax rates, average transfer rates and the balance between the two. The following main points emerge.

First, conventional redistributive power of taxes and transfers overestimates their true interpersonal effect. This is of particular importance as tax and transfer policies, targeting *annual* poor and rich, may fail to reduce interpersonal inequalities in a life cycle perspective in favour of smoothing differences in individual life cycle income paths. Therefore, whether tax/transfer policies are effective in achieving equity cannot be judged without disentangling the intrapersonal part of the total redistributive effect, which we found to have comparable ranges for both taxes and transfers, even though slightly wider in the case of Sweden.

Second, as a consequence, the life cycle interpersonal inequality reducing power of taxes and transfers is lower than that measured by the conventional cross-section analyses. Further, particularly for the case of taxes, it has been shown that this power, in percentage of the initial Gini index, decreases in all countries in recent years following a trend to strongly reform personal income tax systems. An opposite movement has instead been recorded for transfers, even though the intrapersonal part of their total redistributive effect is generally greater than in the case of taxes. It might be speculated that recent attitudes towards lowering income taxes and strongly selecting beneficiaries for monetary transfers, could have improved the interpersonal power of this latter tool, while worsening the corresponding pattern of the former.

Third, evidence has been found of generational shifts from estimated common life cycle profiles. The basic conclusion is that these shifts do not follow the same direction in the three countries considered. Even though levels of average tax rates and average transfers rates are generally higher in Sweden, redistribution here occurs from oldest to youngest generations, as a result of a significant decrease of taxes and a slight increase of transfers for these cohorts, compared with the benchmark. Different trends, instead, occur in UK and US. In the first case, there is a weak evidence that middle generations have borne a higher net tax burden, compared with oldest and youngest cohorts; in the second case, instead, the direction of redistribution is from youngest to oldest generations, as a result of a negative trend of average transfer rates and a positive shift of the corresponding average tax rates.

Fourth, a visual impact of the comparative tax/transfer treatment of different generations (figure 6.10) has revealed that in past tax/transfer policies, Sweden performed better with respect to oldest generations, while UK did better with youngest and middle generations.

Even though results have been obtained by considering only income taxes and including only monetary transfers (e.g. health and education benefits are not part of the analysis), we think that these conclusions may give useful insights to the policy-maker in order to disentangle all kind of redistribution issues implicit in tax/transfer policies over time and what kind of equity achievements are pursued. Further, concern has been expressed that tax/transfer policies cause different generations to follow different average net tax rate profiles in their life cycle. This is of particular importance, because claiming of any given generation regarding its own net tax burden should not be carried out on *annual* basis (i.e. on a cross-section basis). The generational shifts here estimated provides in fact a more correct way to infer whether temporary deviations of *annual* tax burdens between age groups have corresponding entries in a life cycle perspective.

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Appendix A *Basic changes of the personal income tax in the selected countries*

The countries analysed are Sweden, United Kingdom and United States. The choice of these countries partially reflects the aim of estimating life cycle tax-transfer rates and integenerational redistribution in countries where significant tax reforms have been implemented in the last fifteen years.

In US, two of the most important changes of income taxes occurred in 1980s during Reagan Administration. In 1981, the Economic Recovery Tax Act (ERTA) was implemented with the explicit aim of cutting marginal tax rates and indexing the income tax for inflation. The top marginal tax rate was lowered from 70 to 50 per cent, while tax rates in all other brackets were cut by 23 percent over a period of three years.[67] In 1986, the Tax Reform Act (TRA) was instead mainly designed to close tax shelters and tax preferences heavily used by richer people. At the same time, the top marginal tax rate was cut from 50 to 28 percent in order to achieve neutrality in the level of total tax revenue and distribution of tax burden. In 1990, however, the top marginal tax rate has been increased to 31 percent and successively increased to 39.6 percent in 1993 in order to face budget deficit.

In Sweden, taxes on marginal earnings have been very high throughout 1970s and 1980s, leading to significant tax reforms in 1982 and in 1991; despite the first reform, the share of personal income tax on GDP has continued to increase, achieving about 55 percent in 1987. The 1982 reform mandated reductions in marginal tax rates from 74 per cent to 50 percent in 1985 for nearly all full-time employees, trying to match negative redistributional effects limiting some tax reliefs for richer people.[68] The tax reform of 1991 had a different character, as it moved away from the principle of global income tax to a *dual income tax* by introducing separate schedules for earned income and capital income[69]. The combination of the new central government tax with the local income tax provided a reduction of the marginal tax rates between 24 and 27 percentage points for large groups of population, with a central government top rate set at 20 percent[70]. Nevertheless these significant changes, their redistributional effects have been found almost neutral or not unambiguously rankable compared with the pre-reforms income distribution.[71]

In the United Kingdom, for many years a distinctive feature has been that of applying very wide basic rate band, which meant that many taxpayers faced the same marginal tax rate.[72] Reductions of marginal tax rates have mainly occurred during Conservative governments; in the 1979 Budget, the top marginal tax rate was cut from 83 to 60 percent. No changes were made until 1988, when the income tax was

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[67] See Slemrod and Bakija (1996; p.28). The structure of marginal tax rates was reduced from fourteen marginal tax rates to only two statutory rates (15 and 28 percent). For an analysis of the unsatisfactory aspects of the reform see also Shoven (1990).
[68] See, for example, Hansson and Stuart (1990).
[69] Discussion on the dual income tax system can be found in Sœrensen (1994).
[70] See, for example, Agell, Englund and Södersten (1996).
[71] See Björklund *et al.* (1995) and Aronsson and Palme (1998).
[72] See Dilnot and Kay (1990).

set with two rates: a basic rate of 25 percent and a single higher rate of 40 percent which was actually paid only by 5 per cent of the population. The number of brackets was then increased in 1993, with the introduction of a basic 20 percent tax rate for the first £2.000 of taxable income, while in 1990 joint taxation of husband and wife was replaced by individual taxation. The intermediate rate of 25 percent has finally been lowered to 23 percent.[73]

[73] For a more detailed survey of the changes see Giles and Johnson (1994) and McCrae (1997).

Table 2.1 Surveys and type of taxes in the LIS datasets

Sweden		UK		US	
1967	IT, PT	1969	IT	1969	No taxes
1975	IT, MSEC	1974	IT	1974	IT, MEC, MSEC
1981	IT, PT, MSEC	1979	IT, MEC, MSEC	1979	IT,PT,MEC,MSEC
1987	IT	1986	IT, PT, MEC, MSEC	1986	IT, MEC, MSEC
1992	IT, PT	1991	IT, PT, MEC, MSEC, OD	1991	IT, MEC, MSEC
1995	IT, PT	1995	IT, PT, MEC, MSEC, OD	1994	IT,PT,MEC,MSEC

For symbols, see text.

Source: LIS surveys, various years.

Table 2.2 Number of observations in LIS surveys

Sweden		UK		US	
1967	5.921	**1969**	7.005		
1975	10.306	**1974**	6.695	**1974**	12.328
1981	9.625	**1979**	6.777	**1979**	15.928
1987	9.530	**1986**	7.178	**1986**	12.600
1992	12.484	**1991**	7.056	**1991**	16.052
1995	16.260	**1995**	6.797	**1994**	66.014
Total	64.126	**Total**	41.508	**Total**	122.922
Adj.	5.375	**Adj.**	6.691	**Adj.**	12.172
Total	32.250	**Total**	40.146	**Total**	60.860

Source: Author's own calculations from LIS

Table 2.3 Average cell size for each cohort (number of observations)

Sweden	1	2	3	4	5	6	7	8	9	10	11	12
1967	504	533	514	403	454	448	507	435	27			
1975	425	492	596	565	552	634	737	627	303	101		
1981	181	426	587	553	520	583	678	713	464	263	130	
1987	134	179	375	441	472	474	599	645	539	513	432	451
1992	64	121	241	414	453	441	595	671	576	514	430	447
1995	282	362	333	266	306	329	437	498	501	445	434	445

US	1	2	3	4	5	6	7	8	9	10	11	12
1974	932	942	1.143	1.091	1.003	972	1.230	1.388	1.039	136		
1979	760	794	891	946	852	918	1.170	1.410	1.569	1.164	175	
1986	597	727	840	821	812	850	1.081	1.311	1.481	1.485	1.081	295
1991	437	596	748	762	719	832	1.042	1.305	1.358	1.451	1.374	894
1994	397	468	668	686	664	719	872	1.179	1.260	1.490	1.447	1.175

UK	1	2	3	4	5	6	7	8	9	10	11	12
1969	635	597	686	629	597	618	504	281	9			
1974	607	549	629	551	558	598	611	632	280	19		
1979	601	464	624	508	501	555	587	710	655	287	30	
1986	478	491	629	482	472	501	582	676	643	630	456	122
1991	378	410	550	499	490	516	498	595	635	634	633	488
1995	234	324	483	493	471	492	471	660	622	655	735	602

Source: Author's own calculations from LIS

Table 4.1 The present value of real taxes and transfers (*)

Discounting rate (%)	10		5	
	Tax	Tra	Tax	Tra
UK	10.522	10.668	25.338	22.233
US	15.414	9.210	39.635	23.863
Sweden	43.540	13.819	92.928	40.621

(*) values at prices 1995, converted in pounds at average exchange rates 1995.

Source: Author's own calculations from LIS

Table 4.2 Regression results: average tax rates

	UK	US	Sweden
Constant	12,74	10,57	26,42
Age	-0,163	-0,127	-0,0983
Age2	-0,009	-0,0087	-0,0065
Age3	0,08033	0,04009	-0,1416
Age4	0,00293	0,00162	-0,0024
Age5	*0,000027*	0,000079	-0,00018
FH	-2,98	-2,72	-3,70
EL	0,22	2,23	
DH	-5,97	-4,69	-15,90
DS	-3,19	-2,00	-3,99
NC	-3,57	-4,20	-4,71
NE	2,89	2,87	4,53

Italic entries: not significant at 5 per cent level.

Coefficients of age3, age4 and age5 multiplied by 1000.

Source: Author's own calculations from LIS

Table 4.3 **Regression results: average transfer rate**

	UK	US	Sweden
Constant	11,74	8,83	12,35
Age	0,900	0,73	1,15
Age2	0,0414	0,0515	0,0862
Age3	-0,5191	-0,03455	-0,2936
Age4	0,02482	-0,0323	-0,0456
Age5	0,00005	-0,00011	-0,00025
FH	13,74	8,76	10,83
EL	10,73	-6,36	n.a.
DH	30,39	26,64	46,82
DS	16,04	5,09	8,06
NC	9,84	8,88	7,67
NE	*-19,19*	*-11,66*	*-10,31*

Italic entries: not significant at 5 per cent level.

Coefficients of age3, age4 and age5 multiplied by 1000.

Source: Author's own calculations from LIS

Table 5.1 - Intrapersonal and interpersonal redistribution

UK	1969	1974	1979	1986	1991	1995
Gini Life-cycle						
- EI pre t/t	0,21024	0,21024	0,21024	0,21024	0,21024	0,21024
- EI post tax	0,20745	0,20745	0,20745	0,20745	0,20745	0,20745
- EI post t/t	0,10709	0,10709	0,10709	0,10709	0,10709	0,10709
Gini cross-section						
- EI pre t/t	0,34504	0,34115	0,37115	0,41853	0,42174	0,42539
- EI post tax	0,33155	0,32640	0,36367	0,41007	0,41171	0,41591
- EI post t/t	0,21125	0,20647	0,22154	0,23381	0,25998	0,25612
Redistribution						
- Taxes	0,01349	0,01475	0,00748	0,00846	0,01003	0,00948
- Taxes + Transfers	0,13379	0,13468	0,14961	0,18472	0,16176	0,16926
- Transfers	0,12030	0,11993	0,14213	0,17625	0,15173	0,15979
Intrapersonal						
- Taxes	0,00279	0,00279	0,00279	0,00279	0,00279	0,00279
- Taxes + Transfers	0,10314	0,10314	0,10314	0,10314	0,10314	0,10314
- Transfers	0,10035	0,10035	0,10035	0,10035	0,10035	0,10035
Interpersonal lifetime						
- Taxes	0,01070	0,01196	0,00470	0,00568	0,00724	0,00669
- Taxes + Transfers	0,03064	0,03154	0,04647	0,08158	0,05862	0,06612
- Transfers	0,01994	0,01958	0,04178	0,07590	0,05138	0,05943

USA	1974	1979	1986	1991	1994
Gini Life-cycle					
- EI pre t/t	0,13471	0,13471	0,13471	0,13471	0,13471
- EI post tax	0,12628	0,12628	0,12628	0,12628	0,12628
- EI post t/t	0,07274	0,07274	0,07274	0,07274	0,07274
Gini cross-section					
- EI pre t/t	0,35705	0,36937	0,38240	0,38960	0,40600
- EI post tax	0,33615	0,34097	0,35780	0,36624	0,38212
- EI post t/t	0,27481	0,27939	0,29538	0,29674	0,31069
Redistribution					
- Taxes	0,02090	0,02840	0,02459	0,02337	0,02388
- Taxes + Transfers	0,08224	0,08998	0,08701	0,09286	0,09531
- Transfers	0,06134	0,06158	0,06242	0,06950	0,07143
Intrapersonal					
- Taxes	0,00843	0,00843	0,00843	0,00843	0,00843
- Taxes + Transfers	0,06197	0,06197	0,06197	0,06197	0,06197
- Transfers	0,05354	0,05354	0,05354	0,05354	0,05354
Interpersonal lifetime					
- Taxes	0,01247	0,01997	0,01616	0,01493	0,01544
- Taxes + Transfers	0,02027	0,02801	0,02504	0,03089	0,03334
- Transfers	0,00780	0,00804	0,00888	0,01596	0,01790

Sweden	1967	1975	1981	1987	1992	1995
Gini Life-cycle						
- EI pre t/t	0,20277	0,20277	0,20277	0,20277	0,20277	0,20277
- EI post tax	0,19650	0,19650	0,19650	0,19650	0,19650	0,19650
- EI post t/t	0,13286	0,13286	0,13286	0,13286	0,13286	0,13286
Gini cross-section						
- EI pre t/t	0,30009	0,29666	0,34819	0,35027	0,41191	0,41050
- EI post tax	0,27597	0,26952	0,321686	0,33330	0,39465	0,39384
- EI post t/t	0,19529	0,18496	0,19345	0,21636	0,20512	0,19043
Redistribution						
- Taxes	0,02412	0,02714	0,02651	0,01696	0,01726	0,01666
- Taxes + Transfers	0,10480	0,11170	0,15474	0,13391	0,20680	0,22007
- Transfers	0,08067	0,08456	0,12824	0,11694	0,18954	0,20341
Intrapersonal						
- Taxes	0,00627	0,00627	0,00627	0,00627	0,00627	0,00627
- Taxes + Transfers	0,06992	0,06992	0,06992	0,06992	0,06992	0,06992
- Transfers	0,06364	0,06364	0,06364	0,06364	0,06364	0,06364
Interpersonal lifetime						
- Taxes	0,01785	0,02086	0,02023	0,01069	0,01098	0,01038
- Taxes + Transfers	0,03488	0,04178	0,08482	0,06399	0,13688	0,15015
- Transfers	0,01703	0,02092	0,06459	0,05330	0,12589	0,13977

Source: Author's own calculations from LIS

Table 6.1 Cohort effects in UK: implicit annual growth rates (%
Benchmark: age 78 in 1990.

Age in 1990	Income	Taxes	Transfers
73	-0,498	-0,479	0,374
68	-0,63	-1,042	0,909
63	0,312	-0,19	0,129
58	0,467	0,099	-1,198
53	0,544	0,245	-0,884
48	0,845	0,895	-0,966
43	0,945	0,98	-0,86
38	0,847	1,034	-0,756
33	0,705	0,857	-0,315
28	0,808	0,962	-0,676
23	0,644	0,77	-0,169

Source: Author's own calculations from LIS

Table 6.2 Cohort effects in US: implicit annual growth rates (%

Benchmark: age 78 in 1990.

Age in 1990	Income	Taxes	Transfers
73	3,271	4,856	2,527
68	1,823	2,085	4,471
63	1,803	1,938	2,704
58	1,793	2,115	0,593
53	1,784	2,276	0,441
48	1,558	1,984	0,867
43	1,316	1,662	0,763
38	1,125	1,371	0,468
33	1,058	1,202	0,288
28	0,955	1,129	0,067
23	0,890	1,063	-0,001

Italic entries: not significant at 5 per cent level.

Source: Author's own calculations from LIS

Table 6.3 Cohort effects in Sweden: implicit annual growth rates (%)

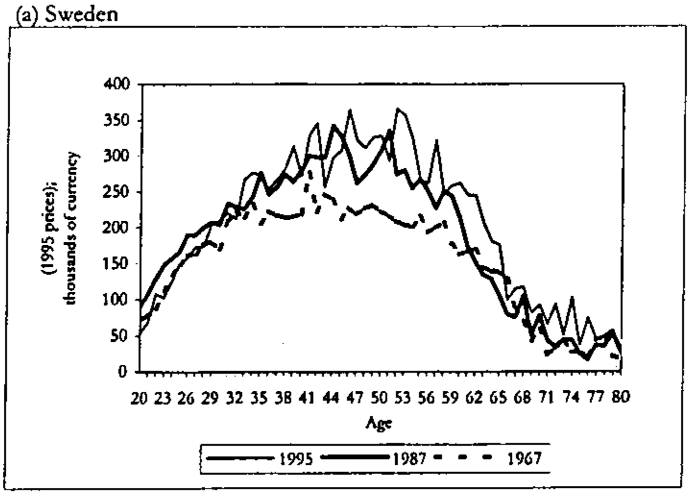
Age in 1990	Income	Taxes	Transfers
73	1,484	8,745	0,351
68	0,51	6,375	0,275
63	-0,101	3,683	0,215
58	*0,171*	1,419	0,145
53	*0,052*	0,535	0,122
48	*0,009*	0,267	0,117
43	-0,28	-0,31	0,117
38	-0,567	-0,823	0,124
33	-0,461	-0,56	0,128
28	-0,344	-0,097	0,123
23	-0,155	-0,112	0,1

Italic entries: not significant at 5 per cent level.

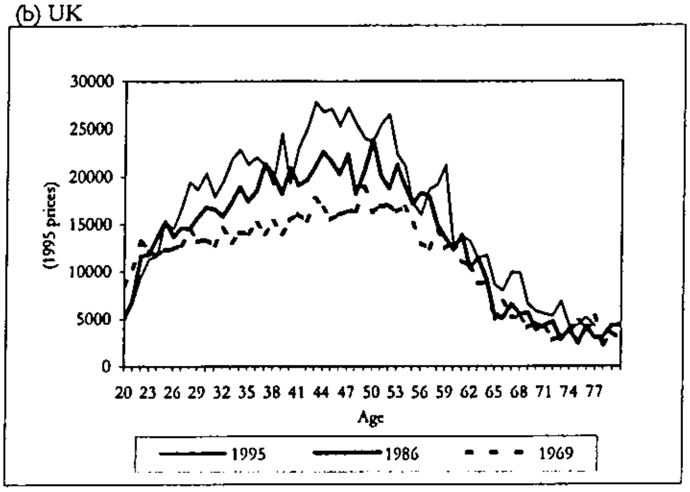
Source: Author's own calculations from LIS

Figure 3.1 - Cross-sectional age income profile

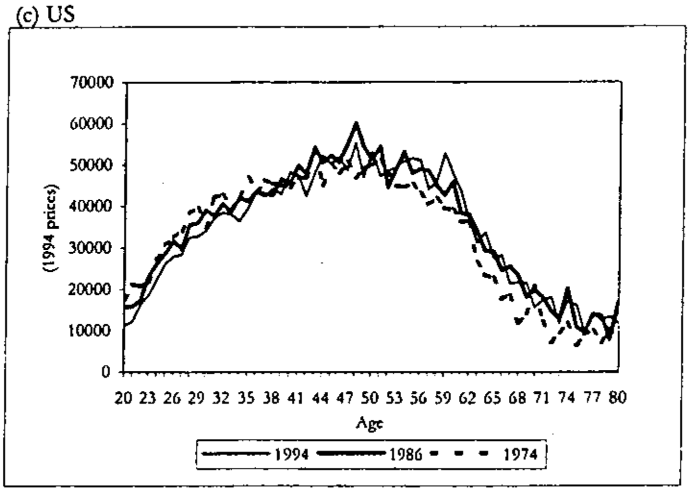
(a) Sweden



(b) UK



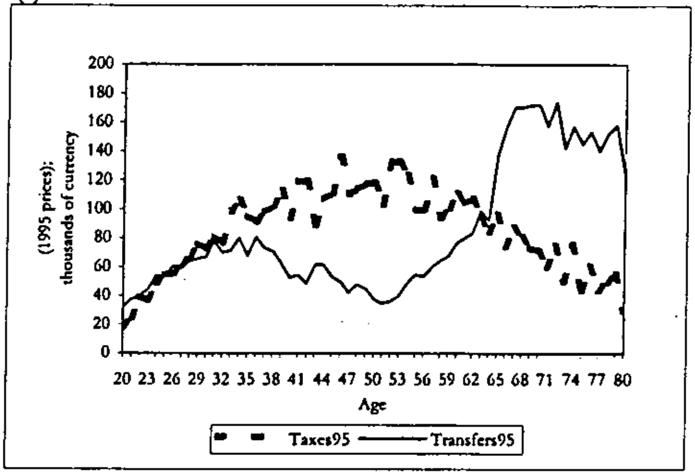
(c) US



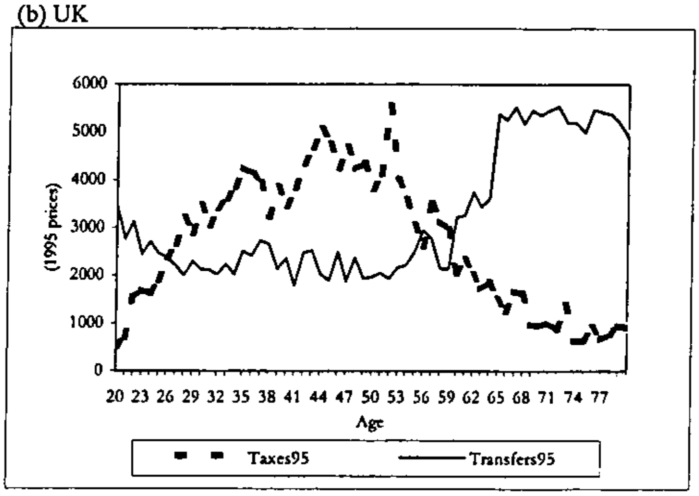
Source: Author's own calculations from LIS

Figure 3.2 - Cross-sectional age-tax/transfer profile

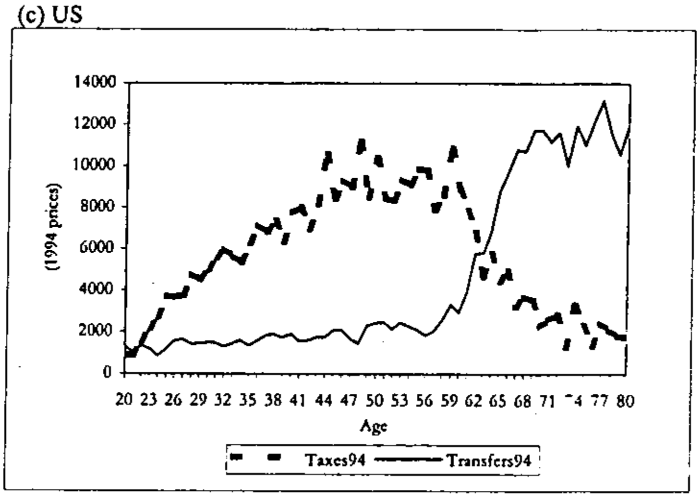
(a) Sweden



(b) UK



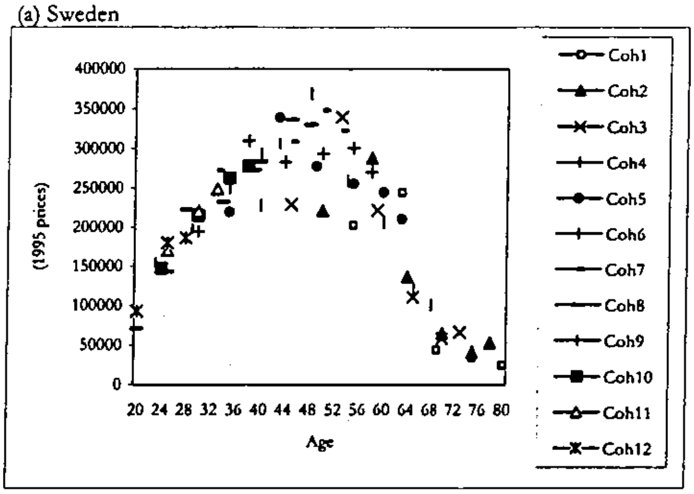
(c) US



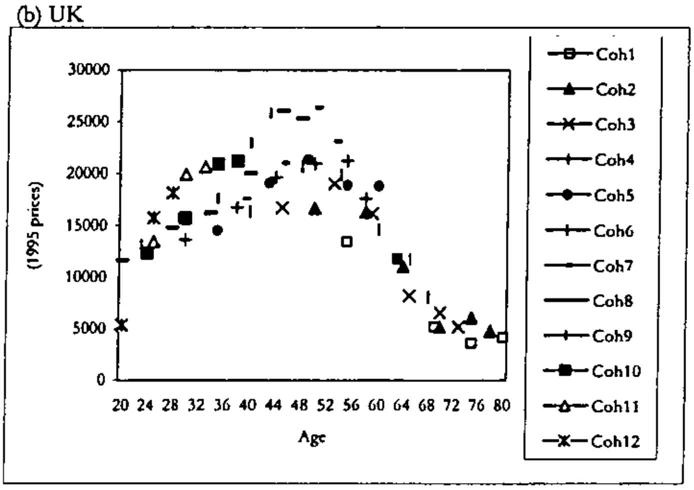
Source: Author's own calculations from LIS

Figure 3.3 - Age-income profile, by cohorts

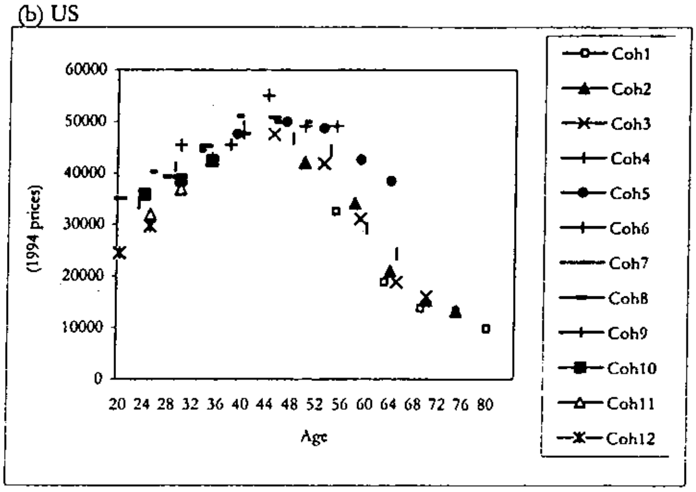
(a) Sweden



(b) UK



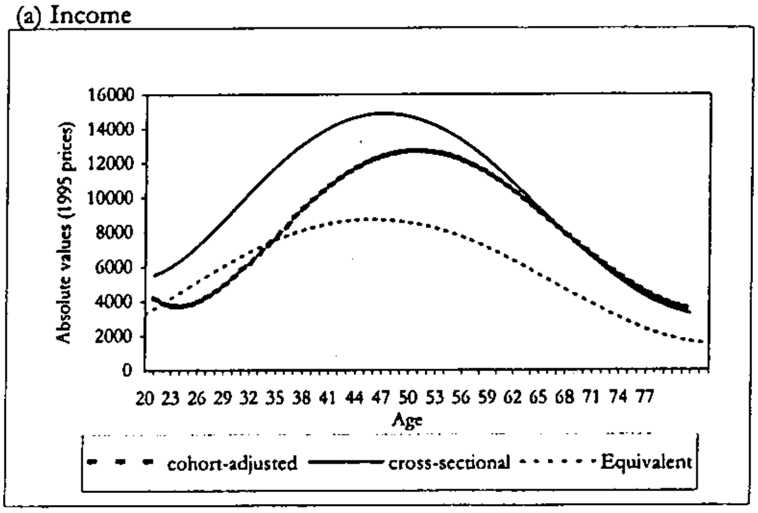
(b) US



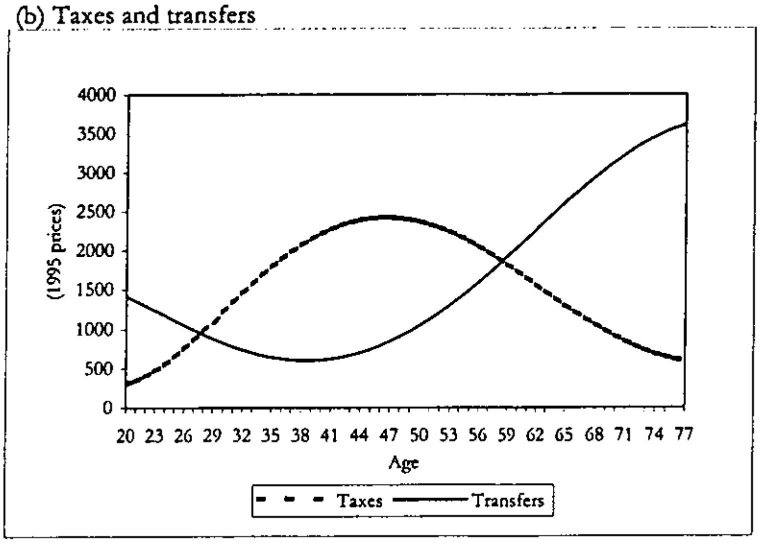
Source: Author's own calculations from LIS

Figure 4.1 - Life-cycle variables in UK

(a) Income



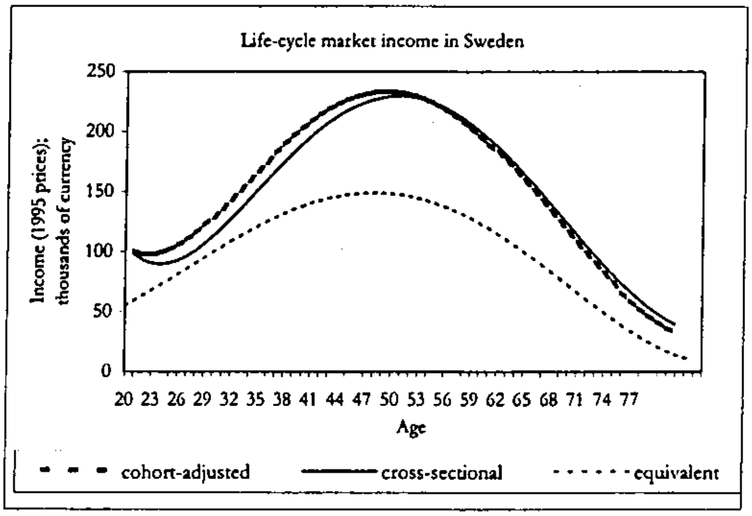
(b) Taxes and transfers



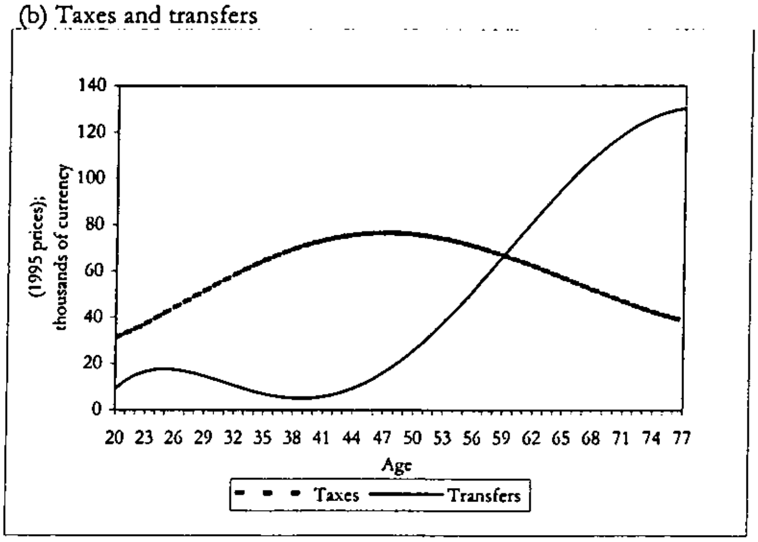
Source: Author's own calculations from LIS

Figure 4.2 - Life-cycle variables in Sweden

(a) Income



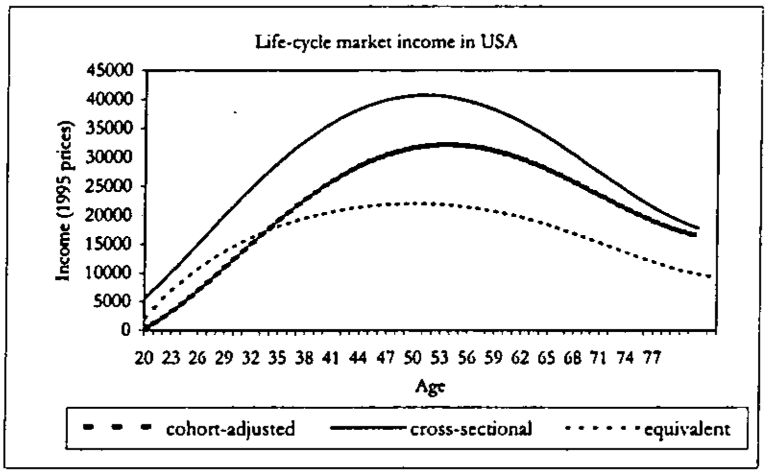
(b) Taxes and transfers



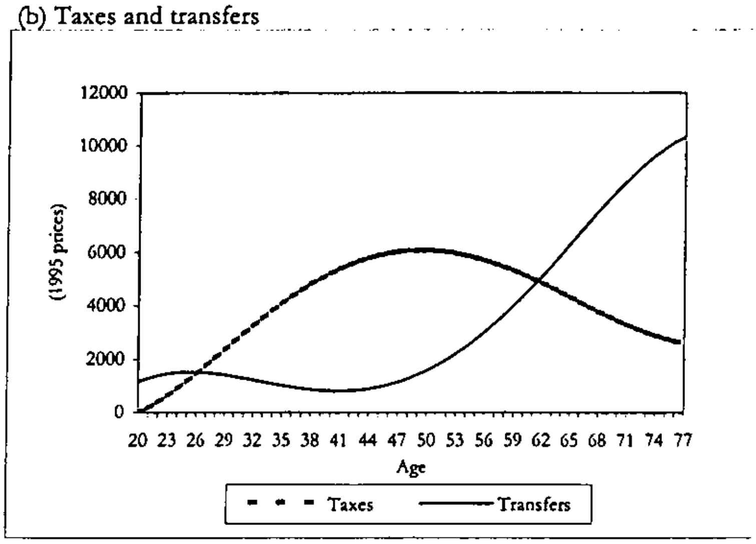
Source: Author's own calculations from LIS

Figure 4.3 - Life-cycle variables in US

(a) Income



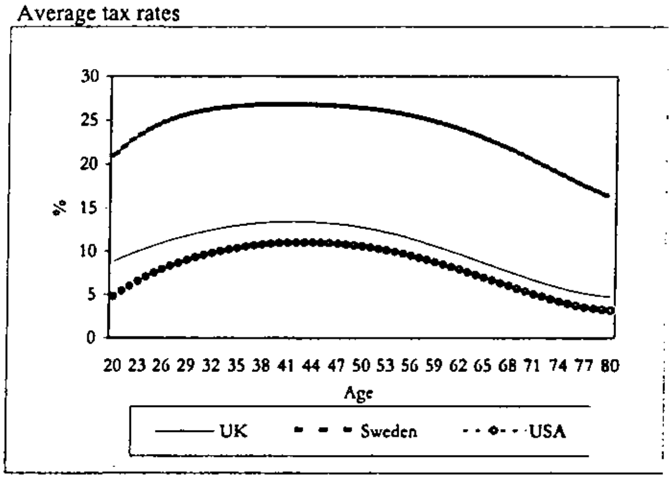
(b) Taxes and transfers



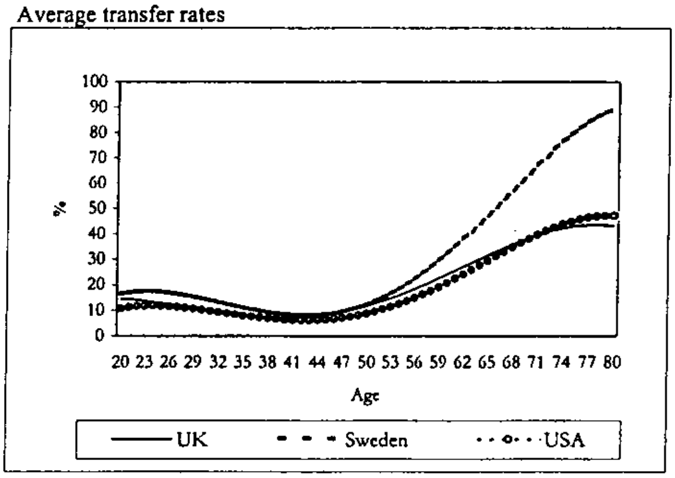
Source: Author's own calculations from LIS

Figure 4.4 - Life-cycle average rates

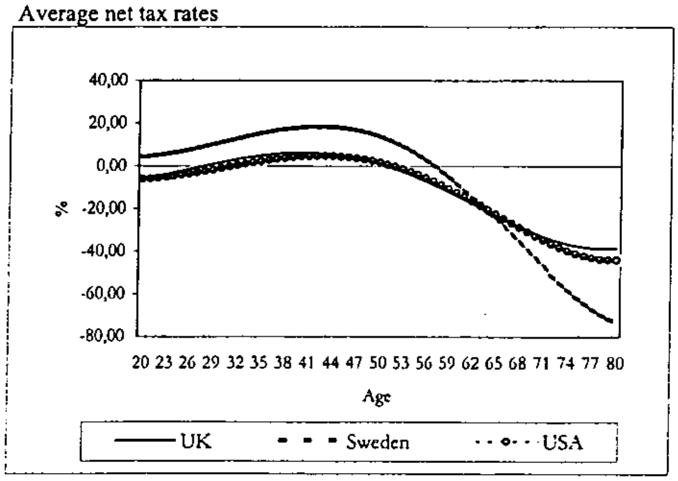
Average tax rates



Average transfer rates



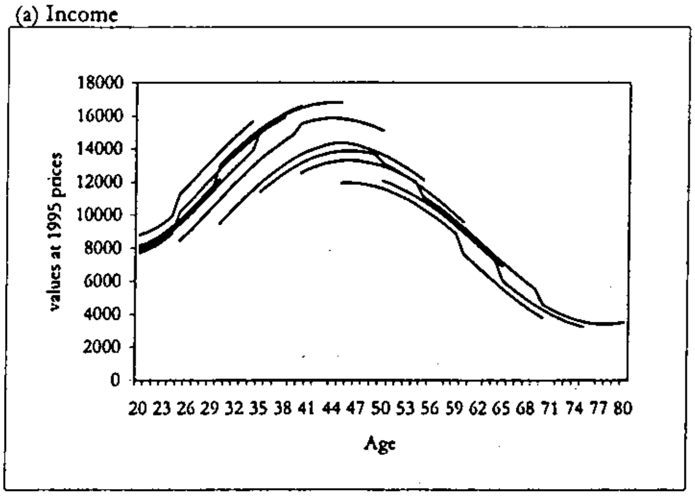
Average net tax rates



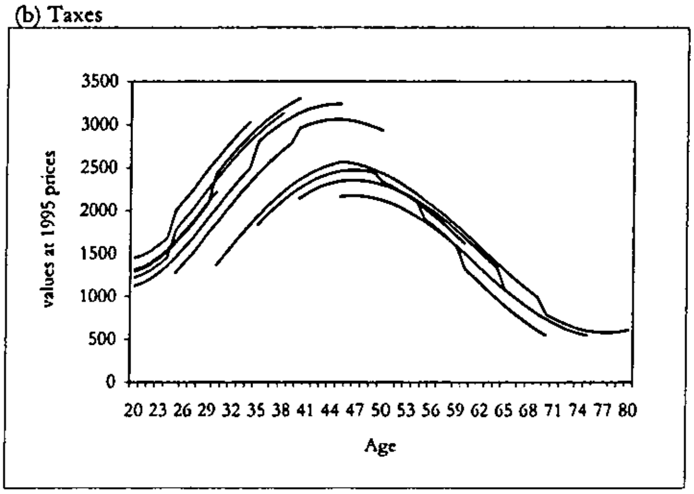
Source: Author's own calculations from LIS

Figure 6.1 - Cohort profiles, UK

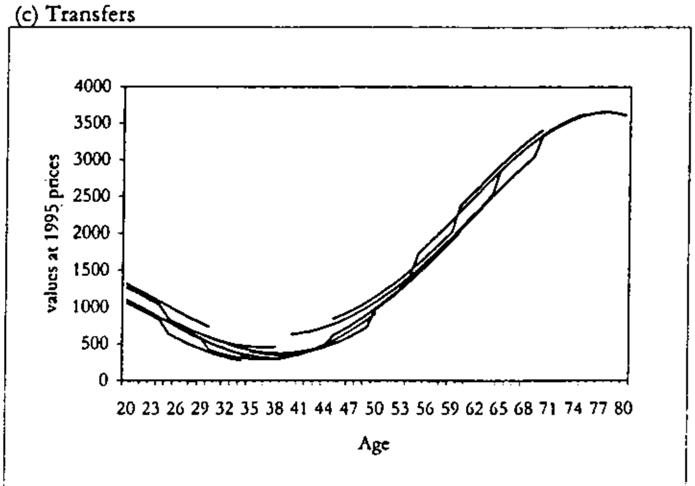
(a) Income



(b) Taxes



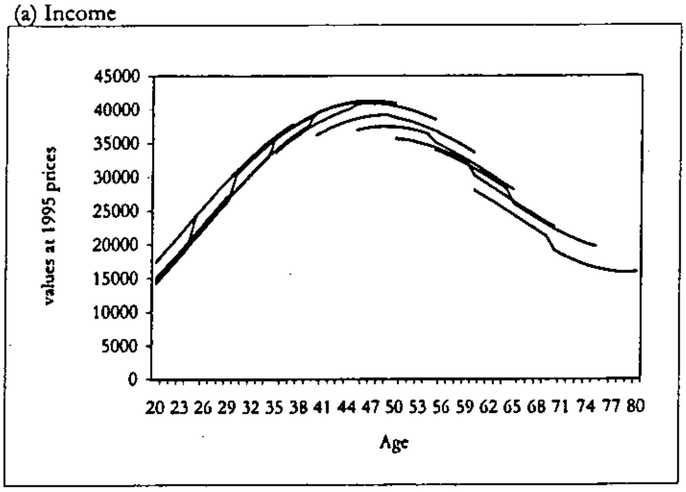
(c) Transfers



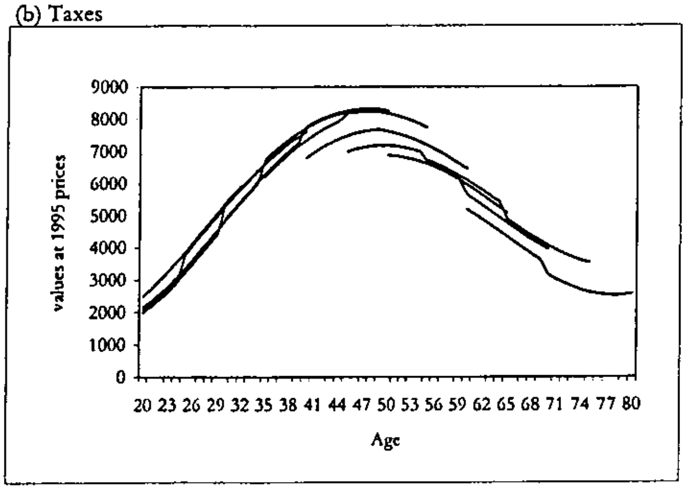
Source: Author's own calculations from LIS

Figure 6.2 - Cohort profiles, US

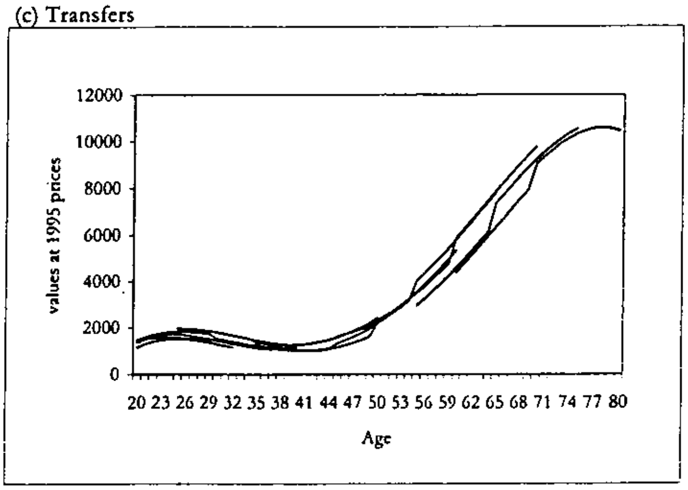
(a) Income



(b) Taxes



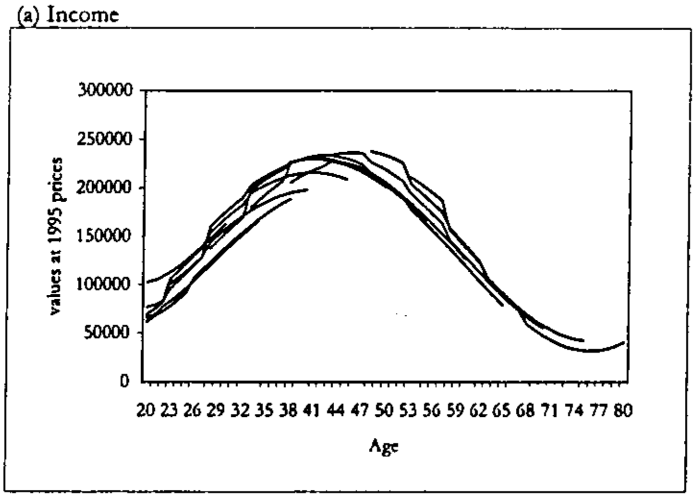
(c) Transfers



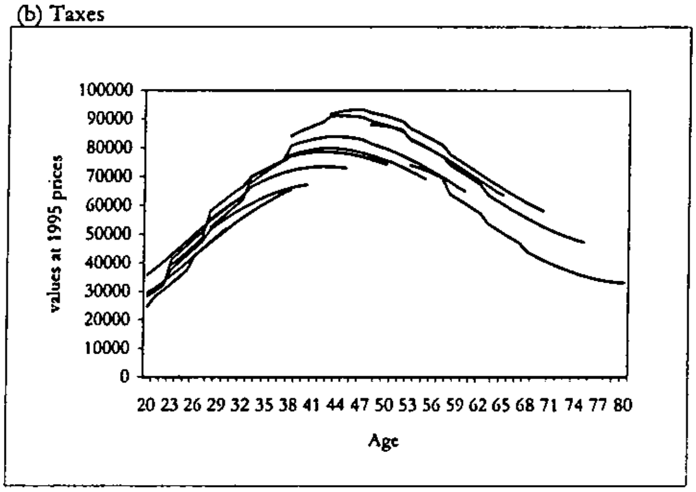
Source: Author's own calculations from LIS

Figure 6.3 - Cohort profiles, Sweden

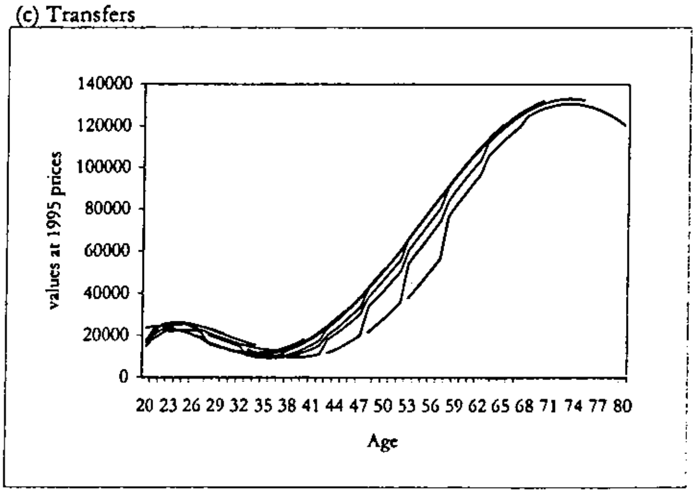
(a) Income



(b) Taxes



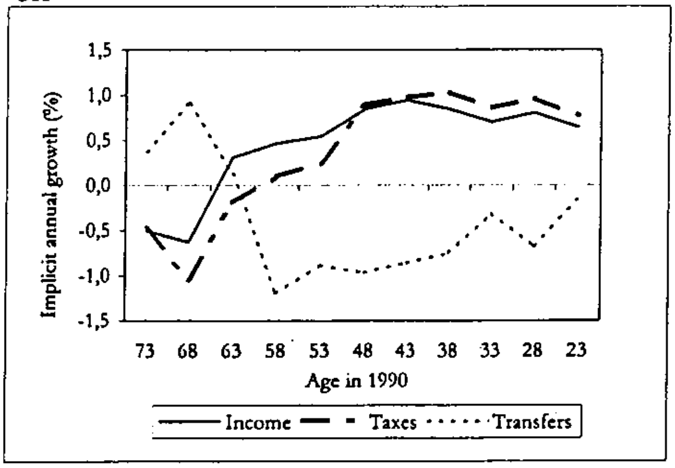
(c) Transfers



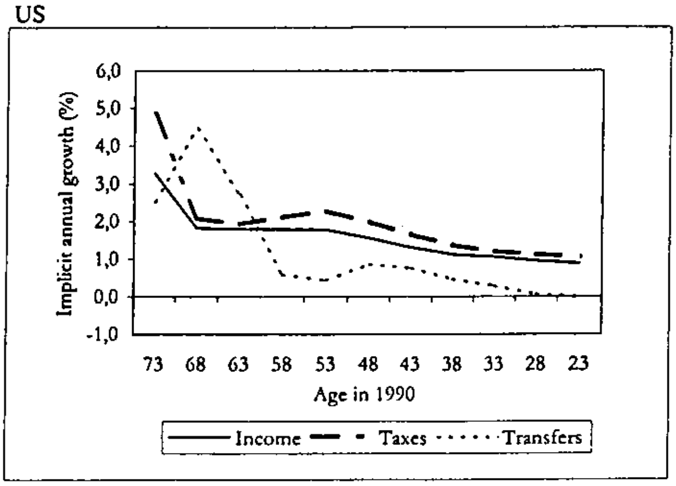
Source: Author's own calculations from LIS

Figure 6.4 - Cohort effects

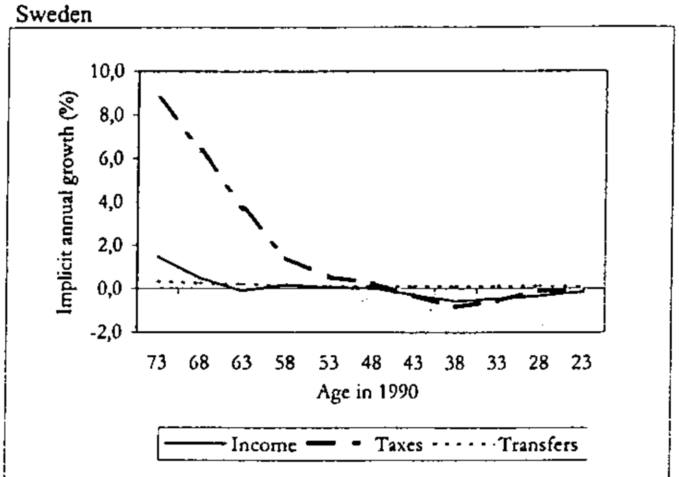
UK



US

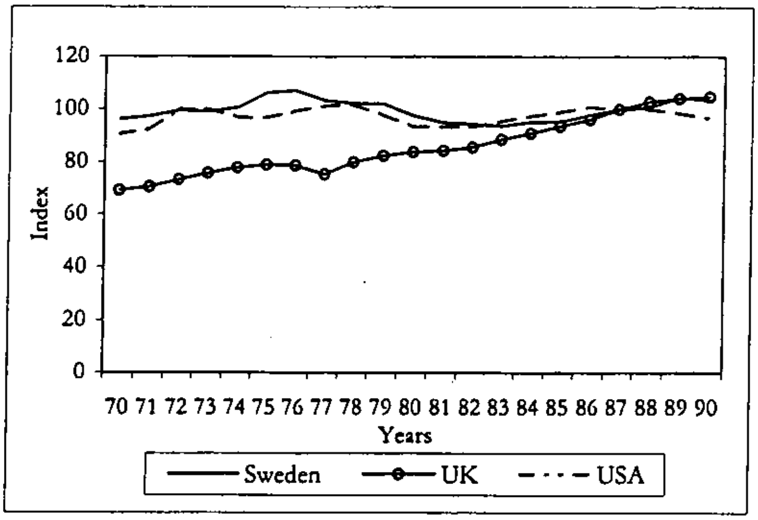


Sweden



Source: Author's own calculations from LIS

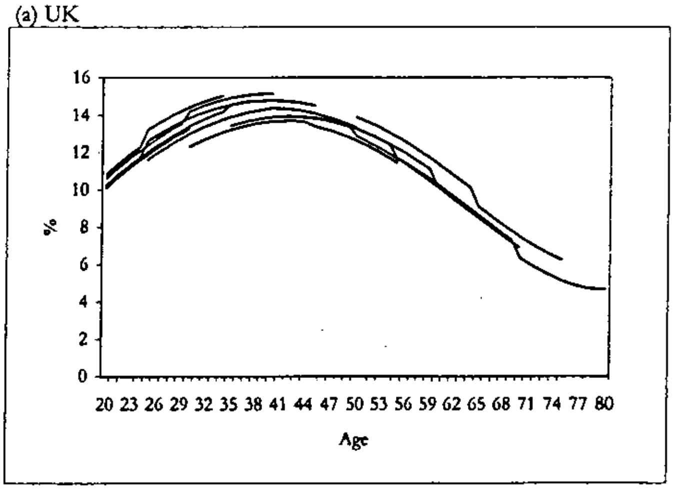
Figure 6.5 - Real index of average earnings, 1987=100



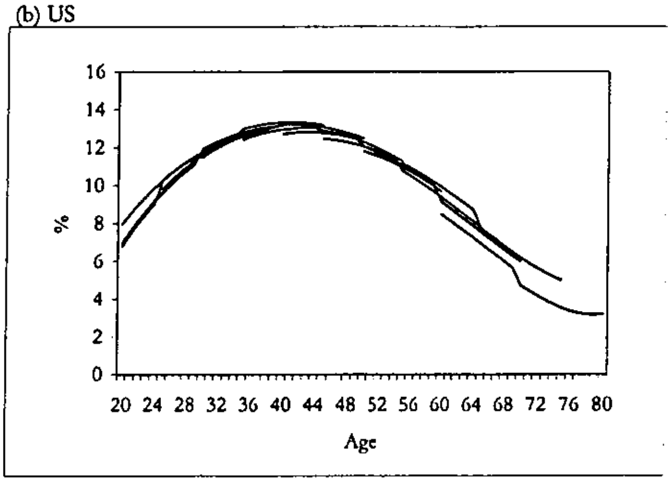
Source: World Tables, 1994

Figure 6.6 - Average tax rates by cohorts

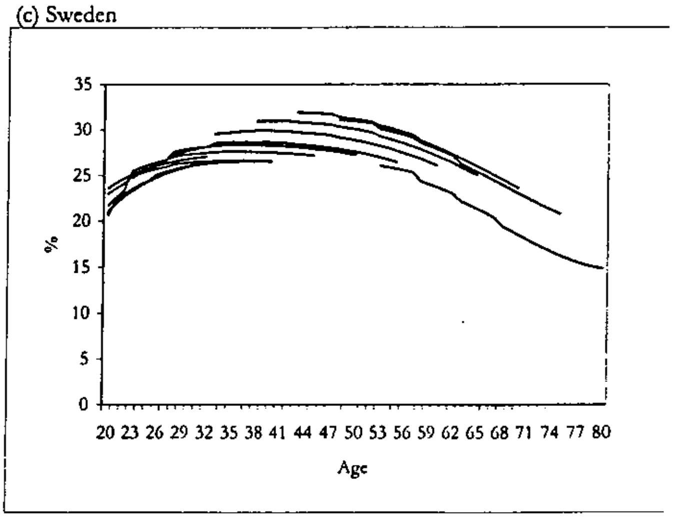
(a) UK



(b) US



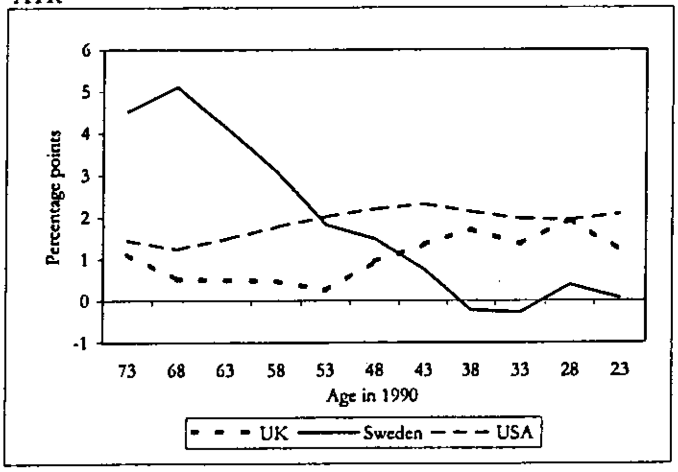
(c) Sweden



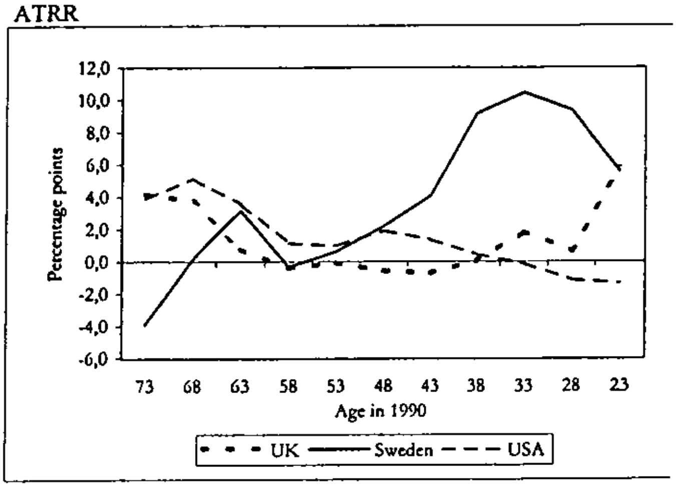
Source: Author's own calculations from LIS

Figure 6.7 - Pattern of cohort dummies

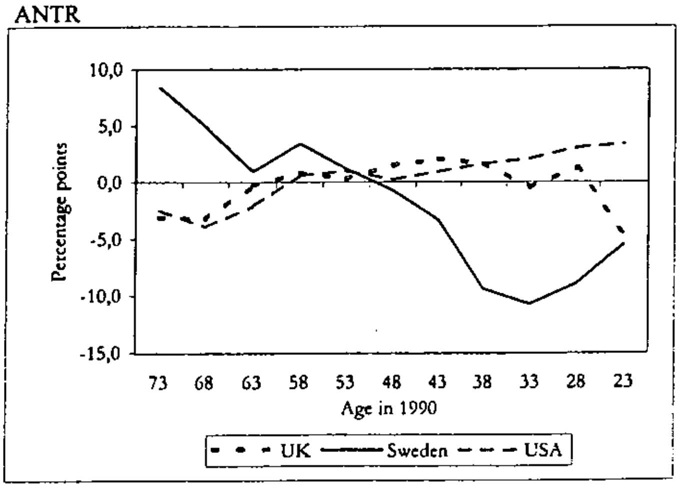
ATR



ATRR



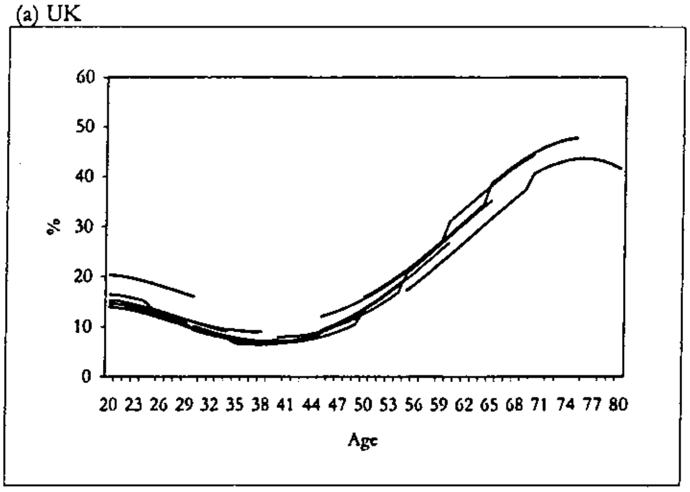
ANTR



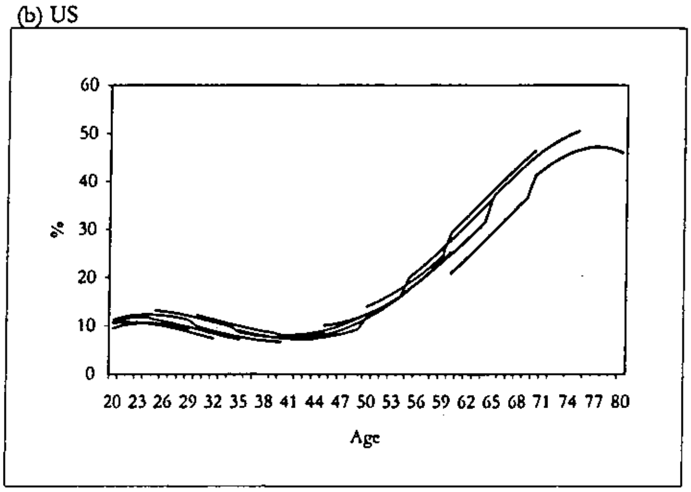
Source: Author's own calculations from LIS

Figure 6.8 - Average transfer rates by cohorts

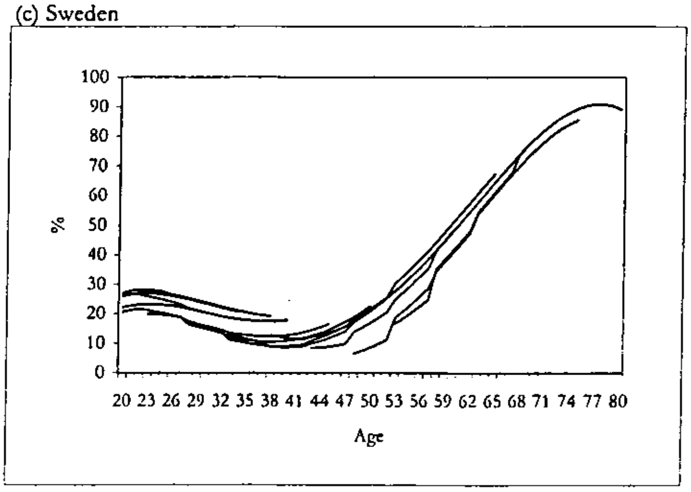
(a) UK



(b) US



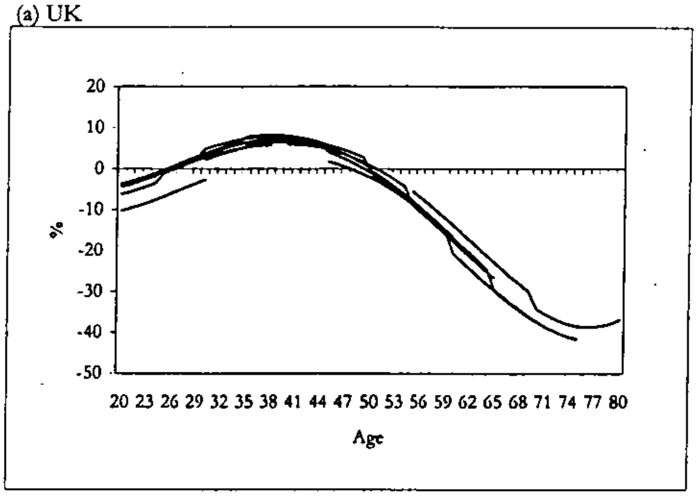
(c) Sweden



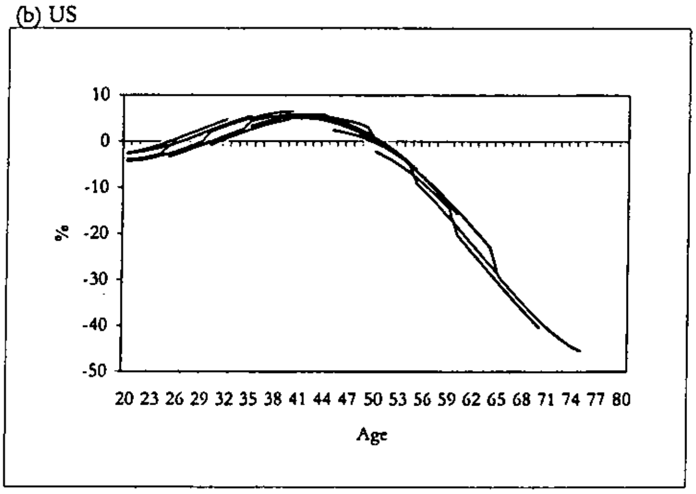
Source: Author's own calculations from LIS

Figure 6.9 - Average net tax rates by cohorts

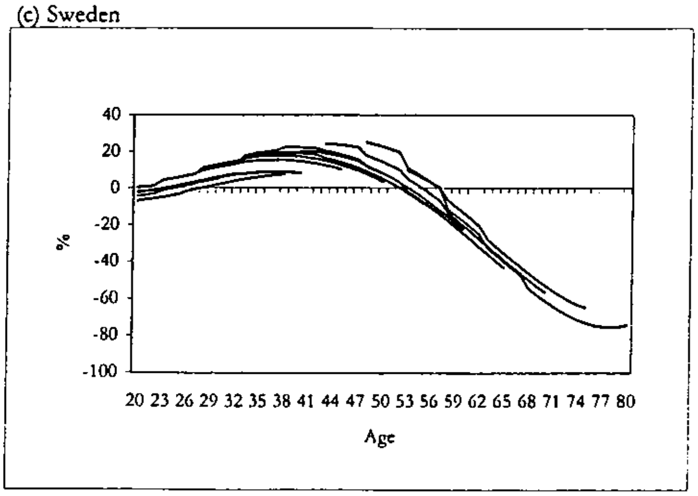
(a) UK



(b) US

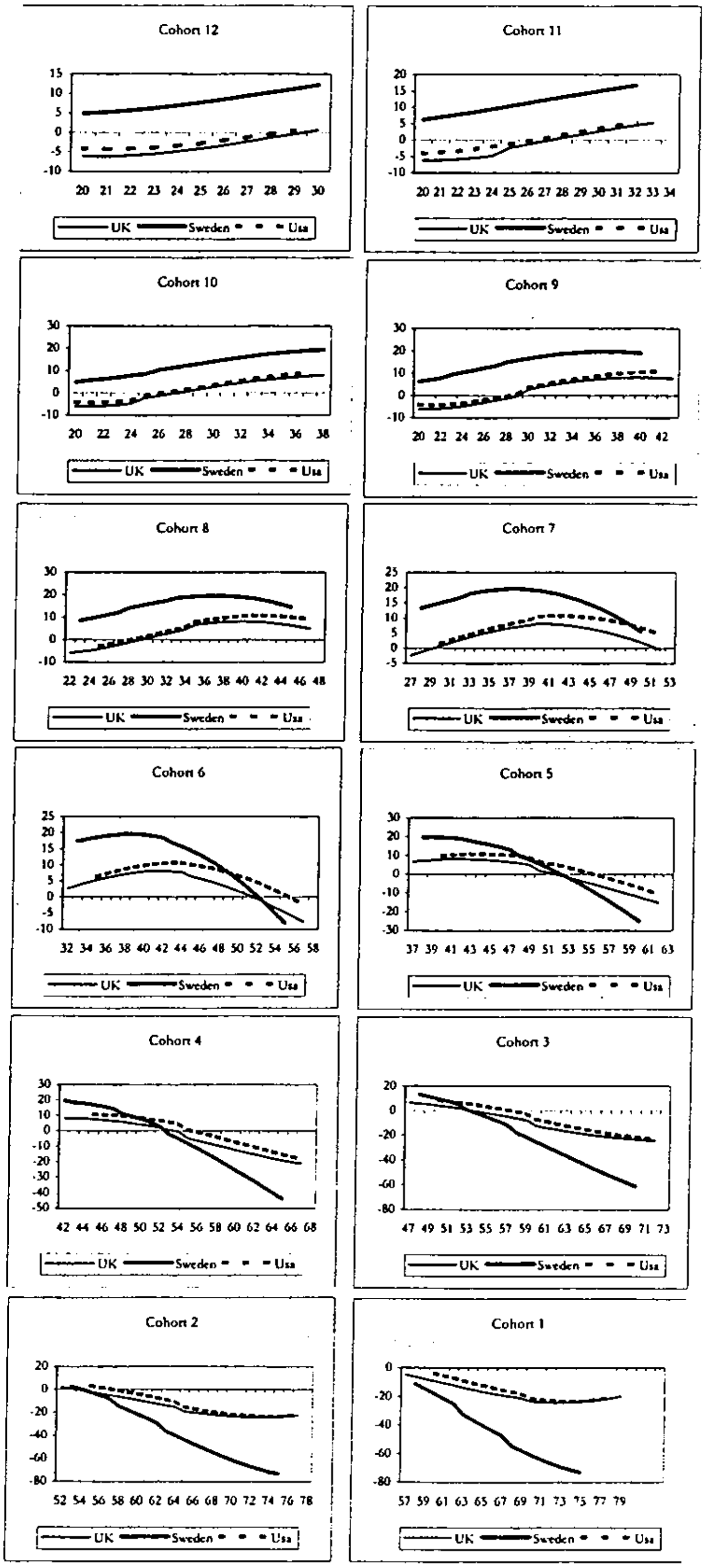


(c) Sweden



Source: Author's own calculations from LIS

Figure 6.10 - ANTRs by generations



Source: Author's own calculations from LIS