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Poverty and Permanent Income: A Methodology for Cross-Section Data

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ABSTRACT. – If the set of households which are income poor does not fully overlap with the set of the consumption poor, it could well be that income and consumption expenditure convey different information regarding an unobserved variable on the basis of which families allocate their resources intertemporally. This paper presents a methodology for predicting the unobserved permanent incomes of households using multiple welfare indicators typically available in cross-section data.

Pauvreté et revenue permanent : une méthodologie pour les données en coupes transversales

RÉSUMÉ. – Si l'ensemble des familles pauvres selon le critère du revenu ne coïncide pas avec l'ensemble des pauvres selon la consommation, il se pourrait que ces deux indicateurs contiennent de l'information complémentaire en rapport à une variable selon laquelle les ménages allouent leur consommation au niveau intertemporel. Nous élaborons une méthodologie pour estimer les revenus permanents des ménages sur la base d'indicateurs de bien-être typiquement disponibles dans les enquêtes de dépenses transversales.

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1 Introduction

Whether an economy is growing or stagnating, the extent of poverty and its incidence ought to remain causes for concern for a government at all times. The days when growth was believed to provide a miracle solution for poverty alleviation are now gone and, as a result, policy makers and researchers alike have increasingly been drawing a distinction between *transient* and *chronic* poverty.

The identification of the long-term poor, at a given moment in time, needless to say raises some conceptual problems related to the measurement of resources. Cross-section data, the environment discussed in the present paper, provide a single measurement on a household's income and consumption expenditure, together with other demographic and socio-economic information, on the basis of which a researcher is to attempt to draw lessons about the extent and incidence of chronic poverty. A common practice in the area consists in defining a benchmark concept of resources (typically household income or consumption), and to examine, in the light of this concept, the incidence and depth of poverty. In many European countries for instance, poverty is defined in relation to an insufficient level of income. Families whose resources fall below a fraction of median income (often 50% of the middle income level) are counted as being poor.

Though appealing for its practical relevance, such an approach however does not fully address the question as to what is to be done in practice when a family is reported to cross the poverty line in, say, the income space but falls below the critical threshold in the consumption space (or vice versa). Our approach in this paper therefore will be to a formulate an economic model for the joint distribution of income and consumption in the cross-section, and to predict permanent income using correlates of this variable. There is a need to address the above question: on the basis of cross-section data, GLEWWE and VAN DER GAAG [1990], MERCADER–PRATS [1998] and MEYER and SULLIVAN [2003] all observe that alternative welfare indicators identify different populations as being in poverty, and that the choice of resources concept does matter indeed[1]. CHAUDHURI and RAVAILLON [1994] arrive at similar conclusions on the basis of multiple measurements on the household's income and consumption expenditure.

Drawing on MUSGROVE [1979] and MUELLBAUER [1983] among others, ABUL NAGA and BURGESS [1997] adopt a MIMIC model for income and consumption, for which they propose various predictors of household permanent income. This is the starting point of our paper. However, we note several limitations of this approach, and provide a more flexible set-up in the light of both economic theory considerations and statistical tests. A general limitation of any approach derived independently of a behavioural model is that it does not make explicit the assumptions about how households smooth consumption and the reasons why they save; in other words, how economic theory assumptions are turned into statistical identifying restrictions. To clarify these issues, the present paper therefore adopts a certainty equivalence intertemporal model of consumption and discusses the assumptions required in order to identify its empirical counterpart in the cross-section.

1. This same point about the limitations of using single welfare indicators to identify the deprived is equally well documented in the social policy literature. See for instance MCGREGOR and BOROOAH [1992] and WHELAN et al. [2001].

There are several reasons why such a discussion proves necessary. Firstly, this guides us towards formulating appropriate specification tests of identifying assumptions. Secondly, from the intertemporal model it comes out that the consumption function is cohort specific. Thus, the framework of Abul Naga and Burgess [1997] essentially requires families to adopt an infinite time horizon. With finite life horizons, there is therefore a need to estimate separate models for the various cohorts which a cross-section covers. And this brings us to our last point, namely how to construct the cross-section distribution of household permanent incomes. There, we find it necessary to distinguish an approach which estimates a unique model for the cross-section, from one which estimates separate models for the various cohorts, and constructs cohort specific predictors of permanent income. We also propose a test for the validity of the cross-sectional model. Essentially, the test evaluates the hypothesis that parameter estimates are equal across cohorts. This provides the practitioner with some guidance as to when the formulation of a unique model for the cross-section may be subject to a problem of aggregation bias.

It may be necessary at this stage to locate our methodology within the growing literature on multidimensional poverty. This school contains two broad approaches: the welfarist and deprivations approaches. The first of these (e.g. Bourguignon and Chakravarty, [2003]) uses a social valuation function to aggregate each family's shortfalls from commodity specific poverty lines. In the multiple deprivations approach (initiated by Townsend, [1979]), one *counts* the various shortfalls of a given family from critical thresholds of consumption of key commodities, and aggregates these into a deprivation *score*. In recent developments encompassing subjective poverty considerations (Hagenaars, [1991]) critical levels of consumption were obtained via opinion surveys, or were defined in relation to the consumption patterns of narrowly defined reference groups (for instance, age groups, populations pertaining to various geographic areas etc.)[2].

In our approach poverty is defined in relation to an insufficient level of permanent income. Because permanent income is not observed, we predict this variable using household consumption expenditure, disposable income and other socio-economic variables. In short, our perspective on poverty is unidimensional, but because of data limitations, it is made operational via a multidimensional approach.

The plan of the paper is the following. Section 2 considers an economic model of the intertemporal allocation of consumption subject to labour income uncertainty. The purpose of this section is to make explicit the assumptions under which the econometric framework (section 3) for the joint modelling of income and consumption expenditure is derived. In section 4 we use data from a Swiss living standards survey to illustrate the relevance of the proposed methodology for identifying the long term poor. We examine to what extent the methods can be useful for resolving some conflicting evidence regarding the incidence of poverty derived from income and consumption-based definitions of resources. More generally, we provide illustrative examples of how one may go about constructing the entire distribution of household permanent income and how the framework may be used to undertake ordinal comparisons of levels of living across geographic regions. Section 5 concludes the paper.

2. For an application of these concepts to the measurement of poverty in the context of France, see for instance Cardoso and Gardes [1996].

2 Consumption, Income and Permanent Income

LOLLIVIER and VERGER [1999] inform us that the task of reconstructing household permanent income is indeed complex[3]. With only data on current income and consumption expenditure available, in principle one would need to reconstruct the past, and simulate future realizations of these variables. This would require the researcher to model labour market participation decisions, the earnings process of each working adult, as well as the timing of retirement. Knowledge of the labour market is not enough: one must also model the effect of macro variables (such as the business cycle) on workers' perception of future income growth, and hence, the accumulation of assets.

This complete task list could somewhat be weakened when richer data sources are available to the researcher. Theories of intertemporal allocation provide a link between present consumption decisions and one's perception of future income flows. Thus, in principle one could attempt to model permanent income on the basis of repeated measurements on family level income and expenditures. The problem however is that in France, Switzerland and many other countries, longitudinal earnings surveys do not report household consumption. Similarly cross-section consumption surveys do not provide repeated measurements on income[4].

The certainty equivalence model, with its limitations (see below), however provides some information on household permanent income, which may be recovered from cross-section data. Our starting point is to note that, from the typical cross-section family expenditure survey, the data analyst observes information on disposable income and consumption expenditure for the present period t, while the forward looking family plans its consumption over its remaining life span $(c_{it}, ..., c_{iT})$ using information on its lifetime wealth, which the data analyst does not observe. Our purpose here is to measure levels of living and poverty using a dynamic income concept based on lifetime wealth.

Define A_{it} as period t assets, e_{it} as labour income, θ_{it} as a taste shifter, r as the rate of interest and ρ as a discount rate. In what follows we treat r as a constant and we assume that the only source of uncertainty pertains to labour income. Let $E_t(.)$ denote the expectations operator and $V(.)$ a maximum value function. Assuming preferences are time-separable, we may write the following dynamic programme in order to solve the current period t consumption problem,

$$\max_{c_{it}} v(c_{it} - \theta_{it}) + \frac{1}{1+\rho} E_t\left[V(A_{it+1})\right] \quad (1)$$

3. A direct measurement of household permanent income could be made available if the researcher were to observe the complete life-movies of individuals' earnings. For this reason, studies based on direct measurements of permanent income (for instance BLOMQUIST, [1981] and BJÖRKLUND, [1993]) are rare exceptions rather than the rule today.

4. One possible solution to this data problem is to combine information from expenditure and earnings surveys in order to predict, or simulate missing information (eg. GOURINCHAS and PARKER, [2002]). Yet another alternative, is to model average group behavior, as opposed to family level data, using repeated cross-sections on income and expenditure (see for instance BLUNDELL and PRESTON, [1998] and ROSATTI, [2001]).

The objective (1) is maximized subject to two types of constraints. Firstly, if the credit market is perfect, so that borrowing and lending are subject to the same rate of interest, the law of motion for assets is written as

(2) $$A_{it+1} = (1+r)\,(A_{it} + e_{it} - c_{it})$$

Secondly, choices must satisfy an intertemporal budget constraint, linking consumption decisions to total lifetime resources:

(3) $$\sum_{k=0}^{T-t} \frac{c_{it+k}}{(1+r)^k} = A_{it} + \sum_{k=0}^{T-t} \frac{e_{it+k}}{(1+r)^k}$$

Let $\lambda\,(c_{it} - \theta_{it})$ denote the marginal utility of instantaneous consumption and assume that $r = \rho$. The first order condition characterizing the evolution of the marginal utility of consumption, the Euler equation, gives the martingale property

(4) $$\lambda(c_{it} - \theta_{it}) = E_t\left[\lambda(c_{it+1} - \theta_{it+1})\right]$$

We are interested in characterizing the solution to the above equation within the confines of the permanent income model, where preferences are characterized by quadratic utility and the only source of uncertainty pertains to future realizations of labour income. Under such circumstances, the marginal utility function λ (.) becomes linear, so that it is possible to write (4) explicitly as

(5) $$c_{it} - \theta_{it} = E_t(c_{it+1}) - \theta_{it+1}$$

Likewise, k periods ahead, rearranging terms we obtain the relation

(6) $$E_t(c_{it+k}) = c_{it} - \theta_{it} + \theta_{it+k}$$

If we use (6) to take expectations at time t over the life-cycle budget constraint (3), we obtain the period t consumption function. This is written as

(7) $$c_{it} = \alpha_i(r) + \varphi_t(r) \cdot \left(A_{it} + \sum_{k=0}^{T-t} \frac{E_t(e_{it+k})}{(1+r)^k} \right)$$

where

(8a) $$\alpha_i(r) \doteq \frac{\sum_{k=0}^{T-t}(1+r)^{-k}(\theta_{it} - \theta_{it+k})}{\sum_{k=0}^{T-t}(1+r)^{-k}}$$

(8b) $$\varphi_t(r) \doteq \frac{r}{(1+r) - (1+r)^{-(T-t)}}$$

α_i is the family specific intercept term, and $\varphi_t(r)$ is the marginal propensity to consume out of (expected) lifetime wealth $A_{it} + \sum_{k=0}^{T-t}(1+r)^{-k} E_t(e_{it+k})$. From the above discussion, several points deserve mentioning. Firstly, it may be noted that

- The consumption function of the quadratic utility model is linear in resources[5]. Secondly,
- Because the model is dynamic (as opposed to being a one period problem), lifetime wealth is what defines resources, rather than disposable income, the latter often being adopted as a standard to evaluate poverty and well-being in cross-section data. Thirdly,
- While in a static model the consumption function would apply to the entire cross-section, here the appropriate unit of analysis is the cohort, since the marginal propensity to spend out of lifetime wealth will vary over the life cycle. Finally, note that in (7),
- It is only the expected value of lifetime wealth that affects consumption, so that consumption (and hence saving) is insensitive to perceived changes in future earnings risk.

This last result arises because the marginal utility function λ (.) is linear in the present context, whereas the existence of a precautionary saving motive would require a positive second derivative for λ (.). This is a major limitation of the certainty equivalence assumption underlying the permanent income hypothesis. The introduction of a precautionary saving motive in the present framework would require knowledge in relation to a family's exposure to earnings risk; and thus modelling of the underlying earnings process. As discussed earlier, cross-section surveys do not provide the required information (typically repeated measurements on earnings) for undertaking such an exercise.

3 An Empirical Framework

Our purpose in this section is to make the transition from a theoretical model of intertemporal allocation based on the certainty equivalence assumption, to an empirical model on the basis of which we can extract information on household permanent income. In sub-section 3.1 we specify our empirical model along the lines of earlier work in the applied welfare literature on the joint modelling of household income and consumption[6]. In sub-section 3.2 we present the three predictors of permanent income which will be used in our applications section below.

5. Alternatively, assume all future earnings e_{it} are known with certainty. Then, suppressing the expectations operator in (4), the class of additive preference structures which yields consumption functions linear in resources consists of the generalized constant elasticity of substitution form (comprising quadratic and iso-elastic utility) and additive exponential utility (cf. Pollak and Wales, [1992 pp. 36-42]).
6. See for instance Musgrove, [1979]; Muellbauer, [1983]; Miles, [1997]; Blundell and Preston, [1998] and others.

3.1 **Modelling Household Income and Consumption**

A natural starting point for the discussion that follows is to begin first with a clarification of what is exactly meant by permanent income. In line with the recent formulations of the Permanent Income Hypothesis [PIH], we shall define permanent income here as the annuity value of lifetime wealth (Deaton, [1992; ch. 3]). For a family with a life span of $T - t$ periods, we may use the right-hand side of the lifetime budget constraint to define permanent income as the quantity

$$\eta_{it} \doteq \frac{r}{(1+r)-(1+r)^{-(T-t)}}\left(A_{it}+\sum_{k=0}^{T-t}(1+r)^{-k}E_t(e_{it+k})\right) \quad (9)$$

A cross-section will typically comprise families from different birth cohorts. Because these will have different life spans, as such, life-time wealth (a stock variable) is not appropriate for measuring levels of living in a cross-section. Permanent income, in the sense of (9) is however a more appropriate welfare standard for such purposes. Also, as discussed in section 2 above, the functions $\alpha_i(r)$ and $\varphi_t(r)$ will typically be cohort specific[7]. For this reason then, our discussion here is centered around the cross-sectional relation between income, consumption and permanent income *within* a given cohort[8].

Suppressing therefore the time subscript in the left hand side of (9), we begin with a standard decomposition of household disposable income m_i into permanent and transitory components:

$$m_i = \eta_i + u_{im} \quad (10')$$

Note that under the PIH the transitory income component governs savings. In turn, the rainy day equation of Campbell [1987] allows us to relate u_{im} to the parameters of the earnings process. For instance, if we define disposable income as the sum of e_{it} and $\varphi_t(r) A_{it}$, then it follows that $u_{im} = e_{it} - \varphi_t(r)\sum_{k=0}^{T-t}(1+r)^{-k}E_t(e_{it+k})$[9].

For our empirical work however, we shall generalize (10′) to the form

$$m_i = \eta_i + \delta'_m D_{im} + u_{im} \quad (10)$$

where D_{im} is a set of demographic control variables assumed to influence the income process. Household demographics here are introduced to allow for the fact that the

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7. In practice another reason why the functions α_i and φ_t of the consumption function (7) may be cohort specific has to do with long run movements in the rate of interest r.
8. In early contributions to the literature (eg. Musgrove, [1979]), it was assumed that the remaining life span $T - t$ was infinite. Authors then did not have to draw a distinction between cohort and cross-section in modelling life-cycle consumption.
9. To solve for u_{im} more explicitly, we need to formulate an earnings process. If for instance $E_t(e_{it+k}) = e_{it}$ for all k, then it may be verified that $u_{im} = 0$. If on the other hand the first difference in earnings is an $MA(1)$ process:

$$e_{it+1} - e_{it} = \xi_{it+1} + \varpi\xi_{it}$$

so that $E_t(e_{it+k}) = e_{it} + \varpi\xi_{it}$ for all $k > 0$, then we obtain $u_{im} = -\varphi_t(r)\sum_{k=1}^{T-t}(1+r)^{-k}\varpi\xi_{it}$, etc.

income process may vary according to the age structure and size of a given household. Also, for a given level of pre-tax income, after-tax income will be shaped by the subsistence needs of the family, and hence its demographic composition. In what follows, it is assumed that $E\,(u_{im} \mid \eta_i, D_{im}) = 0$. This assumption is discussed further in Appendix 1 of the paper.

Our next equation, in accordance with section 2, states that consumption c_i is linear in life-cycle resources. If we approximate the household specific intercept term α_i of (8a) by a function of household demographic variables $\delta_c' D_{ic}$, and we express the second right hand side term of (7) as a function of η using (9), we obtain

$$c_i = \eta_i + \delta_c' D_{ic} + u_{ic} \qquad (11')$$

where we assume the disturbance u_{ic} to be uncorrelated with all other right hand side variables. The disturbance u_{ic} could arise because of errors of measurement in consumption data. Another interpretation is that u_{ic} is a transitory component of consumption, pertaining to accidental factors unrelated to income changes, such as illness.

In what follows however, we shall generalize (11′) to a form

$$c_i = \beta_c \eta_i + \delta_c' D_{ic} + u_{ic} \qquad (11)$$

to allow for the property that the marginal propensity to consume out of permanent income need not equal unity. There are several reasons why we may expect β_c to be smaller than unity. Firstly, if there exists a bequest motive, and such a good is a luxury, then β_c will typically be smaller than one (MUSGROVE, [1979]). Secondly, credit market imperfections in various forms may result in β_c to be different from one by forcing the consumer to depart from the optimum allocation rule (4). Thirdly, when consumption is sensitive to uninsurable earnings risk, the existence of a precautionary saving motive may also result in a marginal propensity to consume out of permanent income to be smaller than unity[10].

The empirical model also specifies an equation for the determinants of permanent income η_i:

$$\eta_i = \gamma' Z_i + \varepsilon_i \qquad (12)$$

That is, permanent income is made to depend on a set of observable characteristics of the household, Z, with unobserved determinants summarized by the disturbance term ε. As will be discussed in the first appendix to the paper, Z variables perform the role of instruments in the identification of (10–11).

The list of Z variables that have been proposed in the literature typically include human capital and physical capital (i.e. the stock of productive assets). Human capital is measured using the educational attainment of working age household members. Productive assets, typically available in relation to agricultural households,

10. Buffer stock saving behaviour for instance induces consumers to maintain a constant permanent income to wealth ratio (cf. BROWNING and LUSARDI, [1996] for a discussion). Unexpected rises in permanent income induce the consumer to save (rather than to consume more) in order to maintain a constant permanent income to wealth ratio.

are proxied using ownership dummies for productive durables as well as measures of cultivable land owned by the household. The common theme around the justification of the two types of instruments is the presumed existence of a production function for life-cycle wealth. In the economics of the family literature, permanent income is assumed to be produced using education and genetic endowments as inputs (BEHRMAN, [1997]). In the literature on agricultural household models, it is physical capital, land and labour inputs which are used in the production of wealth (SINGH, SQUIRE and STRAUSS, [1986]).

The model is completed by specifying the covariance structure for the disturbances of [10-12]:

(13a) $$E(u_{im} \mid \eta_i, D_{im}) = 0$$

(13b) $$E(u_{ic} \mid \eta_i, D_{ic}) = 0$$

(13c) $$E(u_{ic} u_{im}) = 0$$

(13d) $$E(u_{ic} \mid Z_i) = E(u_{im} \mid Z_i) = E(\varepsilon_i \mid Z_i) = 0$$

Under the above assumptions, the vectors γ and δ_m are identified from a least squares regression of m on Z and D_m. If $\hat{m}$ denotes the projection of m on Z and D_m, then β_c and δ_c can be identified via a regression of c on $\hat{m}$ and D_c. For an exhaustive account of the various approaches to the estimation of [10-13], the reader is referred to JÖRESKOG and GOLDBERGER [1975]. Appendix 1 discusses potential specification biases of the empirical model in relation to these assumptions.

3.2 Prediction of Permanent Income

The reduced form for our empirical model is obtained by substituting (12) for η in (10-11). Define $Y_i \doteq [m_i, c_i]'$, $\beta \doteq [1, \beta_c]'$ and $U_i' \doteq [u_{im}, u_{ic}]'$. Likewise define $\delta' \doteq \begin{bmatrix} \delta_m' & 0 \\ 0 & \delta_c' \end{bmatrix}$ and $D_i \doteq \begin{bmatrix} D_{im} \\ D_{ic} \end{bmatrix}$. We may then express the reduced form in vector notation as follows:

(14) $$Y_i = \beta\gamma' Z_i + \delta' D_i + \beta\varepsilon_i + U_i$$

Given data Y_i and Z_i we wish to predict the permanent income η_i of family i. ABUL NAGA and BURGESS [1997] derive three predictors of permanent income. These may be seen as members of more general classes of predictors presented here. To make the notation less cumbersome, below we shall drop the subscript i.

In what follows, a predictor η^+ of η is said to be unbiased if the condition $E[\eta^+ \mid Z] = E[\eta \mid Z]$ is satisfied; in other words, η^+ is unbiased if it is centered around the mean of the random variable η. Our first predictor is the regression of η on Z

(15) $$\widehat{\eta_Z} \doteq E(\eta \mid Z) = \gamma' Z$$

which exhibits the property that $\widehat{\eta_{Z}}$ is centered around the mean of η.

Consider next predicting η using Y variables, that is household income and expenditure. We define a class of predictors C_Y

$$C_Y \doteq \left\{ \widehat{\eta_Y} = b'\left(Y - \delta' D\right) \mid b'\beta = 1 \right\} \tag{16}$$

with the property that members of the class C_Y provide unbiased predictions of η[11].

More generally, we may define predictors of permanent income which are based on Y and Z variables. Define $W \doteq \begin{bmatrix} Y \\ Z \end{bmatrix}$. Predictors chosen in the class C_W:

$$C_W \doteq \left\{ \widehat{\eta_W} = \tau \widehat{\eta_Y} + (1-\tau)\widehat{\eta_Z} \right\} \quad 0 < \tau < 1 \tag{17}$$

will also be centered around $\gamma' Z$, the mean of the unobservable η. As a result, the three predictors will satisfy the property $E\left[\widehat{\eta_Y} \mid Z\right] = E\left[\widehat{\eta_Z} \mid Z\right] = E\left[\widehat{\eta_W} \mid Z\right]$. Conditional on Z, the three predictors have therefore the same mean (but different mean-square errors). The informational superiority of $\widehat{\eta_W}$ over $\widehat{\eta_Z}$ and $\widehat{\eta_Y}$ may be noted by observing that members of the class C_W exhaust the information available about η by pooling the information contained in $\widehat{\eta_Z}$ and $\widehat{\eta_Y}$.

4 Applications

There is a need to draw a distinction between a poverty concept based on a short run definition of resources (viz. annual income or consumption expenditure) and one based on a long run concept such as permanent income. We illustrate our methodology below using Swiss household data taken from the *Enquête sur le Revenu et la Consommation* of 1998[12]. We have a sample of 7948 families, where the household head is between 18 and 65 years of age. We have split the data into four groups, hereafter termed *cohorts*, according to the age of the household head (see Table 1).

Our purpose in this section is threefold. Firstly, in sub-section 4.1 we illustrate the proposed approach by examining the extent of overlap in the set of families

11. To see that this is the case, note that using the constraint $b'\beta = 1$, we have from (14) $b'(Y - \delta' D) = \gamma' Z + \varepsilon + b' U$. Taking expectations, we see that the class C_Y defines unbiased predictors in the sense that $E\left[\widehat{\eta_Y} \mid Z\right] = E\left[b'\left(\beta\gamma' Z + \beta\varepsilon + U\right) \mid Z\right] = \gamma' Z = E\left[\eta \mid Z\right]$, where the last equality follows from (15).
12. See Office Fédéral de la Statistique (1999) for a description of the survey.

TABLE 1
Summary statistics

	Cohort			
Statistic	**18-29**	**30-39**	**40-49**	**50-65**
ave INC	66.69	79.03	85.97	83.45
s.d. INC	39.53	43.84	53.04	56.86
ave CONS	52.83	68.25	77.64	74.48
s.d. CONS	33.51	47.35	42.95	48.42

Notes: 1. INC and CONS are respectively household annual disposable income and consumption expenditure measured in thousands of Swiss francs.
2. ave is the sample mean and s.d. the standard deviation.

identified as being in poverty using income, expenditure and a permanent income definition of resources. In sub-section 4.2 we examine how sensitive the ordinal ranking of income distributions is to the definition of resources. For this specific purpose we split the data (within a given cohort) into two geographic areas of Switzerland, which are assumed to be the subject of poverty comparisons.

In sub-section 4.3 we further dwell on the problem of constructing the cross-section distribution of permanent incomes. There we distinguish an approach based on pooling the predictions of permanent income from the four separate cohort estimates and one from estimating a single income and consumption model for the entire cross-section. It turns out that the distinction is important: the assumptions required to estimate a unique model for the cross-section are rejected on the basis of our statistical tests. The estimations of the empirical model [10–12] and constructions of related predictors of permanent income for the four cohorts are presented in Appendix 2 of the paper.

We begin by splitting the data into four cohorts according to the age of the main income earner in the household. These contain respectively family heads under age 30 (1275 observations), between the age of 30 and 39 (2545 observations), between 40 and 49 years of age (1965 observations) and a residual group for those between age 50 and 65 (2163 observations), totaling 7948 data points. Table 1 presents summary statistics for the level and dispersion of income and consumption by cohort. There are several patterns here worth mentioning. Firstly, average income and consumption rise as we move from the youngest age cohort to older ones. The peak for both variables is at the (40–49) age group; which is followed by a moderate decline for the oldest cohort considered here. Secondly, the dispersions in income and consumption largely follow an increasing pattern as we move from the youngest to the oldest age cohort.

Similar patterns have been documented elsewhere in the literature (see for instance DEATON and PAXSON, [1994] and BLUNDELL and PRESTON, [1998]). One lesson which features commonly in these and other studies, is that comparisons of inequality and well-being between cross-sections cannot be immediately interpreted in terms of differences in social justice. Because earnings follow an inverted *U* pattern over the life-cycle, the young will typically have lower levels of income than the elderly. Likewise, the accumulation of assets will also be age-dependent. From the Martingale property, the variance of consumption also rises over time as a result of the aggregation of innovations. Likewise, there exist periods of rapid economic growth and others of economic downturn. The present level of consumption and income of the various cohorts may thus reflect these generation effects.

In sub-sections 4.1 and 4.2 we shall therefore examine distributions of income, consumption and permanent income within cohorts. In sub-section 4.3, when we come to examine the cross-section distribution, we shall therefore keep in mind that demography and the history of economic activity play an important role together with government policy in shaping the overall distribution.

4.1 Identifying the Poor

Suppose we were interested in examining how sensitive the definition of resources is in identifying the poor population. Currently used definitions of resources include household income and expenditure. More recently, however, researchers have been interested in examining the extent to which money definitions of resources correlate with deprivation measures as well as conditions of economic strain (see for instance WHELAN et al. [2001]). Our purpose here is to examine the extent of agreement about the poor population between income, expenditure and permanent income.

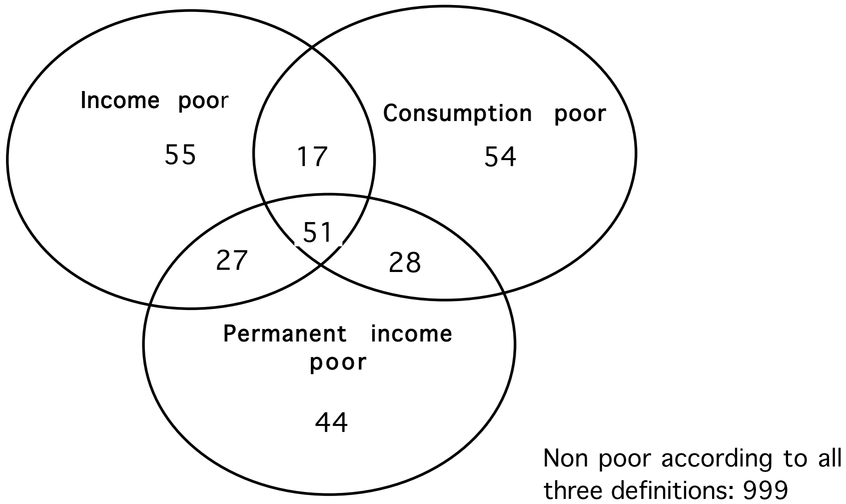
For this purpose, we consider predictors belonging to the C_Y class (obtained as weighted combinations of income and expenditure) and examine poverty in the youngest age cohort. Because subsistence needs vary with the demographic profile of the family, from here on, we normalize the income and consumption data by the square-root of household size. Our permanent income measure η_Y^* (cf. equation 20 of Appendix 2) now being a linear combination of needs adjusted income and expenditure is also comparable across families of different sizes. Following Conférence Suisse des Institutions d'Action Sociale (2000), we may take the level of expenditure per adult required to meet subsistence needs to be CHF 23'700. Accordingly, this would entail that amongst the 1275 households under age 30, 150 families would be identified as being poor. Denote this expenditure poverty line as s_c. Likewise let s_m and s_η respectively denote the income and permanent income poverty lines. Suppose we were to fix the income poverty line as well as the permanent income poverty line so that an identical number of families are poor also according to these two definitions. This would amount to setting s_m at CHF 27'070 and s_η at CHF 21'730.

The consumption poor define the set $C_p = \{i : c_i \leq s_c\}$. For the income poor we have the set $M_p = \{i : m_i \leq s_m\}$, and for the permanent income poor $ETA_P = \{i : \eta_i \leq s_\eta\}$, where η_i is the level of resources attributed to family i by the predictor η_Y^*. The main argument that motivates the now growing literature on multi-attribute poverty concepts is the fact that the extent of agreement between the income and consumption definitions of poverty, that is the intersection $M_p \cap C_p$ is very thin. Hence, a multi-attribute approach was argued to be attractive if it fostered a larger agreement with either of C_p and M_p than the existing overlap between the income and consumption definitions.

In Figure 1 we use a Venn diagram to examine the extent of agreement between the income, consumption and permanent income definitions of poverty. Recall that each definition entails 150 families as being in poverty. As shown in the diagram, $C_p \cap M_p$ has 68 observations. From these income, expenditure and perma-

FIGURE 1

Income, consumption and permanent income poverty: Venn diagram



Notes: 1. First cohort, comprising 1275 families under the age of 30.
2. Income and expenditure normalized by the square root of household size.
3. Permanent income index calculated using weights as given in the first column of Table A2.
4. Poverty line set such that each definition entails 150 poor families.

nent income jointly identify 51 families as being in poverty. There are 27 families identified as being poor using the income and permanent income definitions but non-poor using the consumption definition (the intersection $(M_p \cap ETA_p) \setminus C_p$ in figure 1). Similarly, the set $(C_p \cap ETA_p) \setminus M_p$ has 28 members.

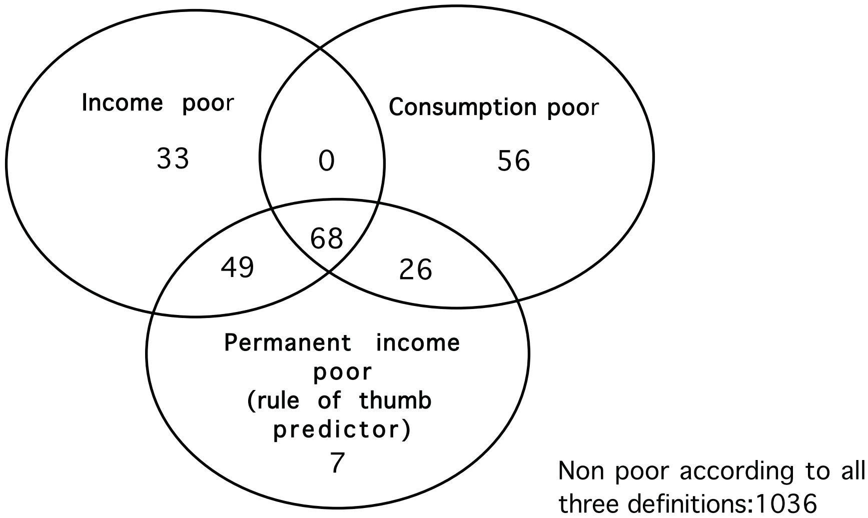
On the basis of these findings, we could now argue that the permanent income approach is indeed of practical relevance since all in all it converges more with the income and consumption definitions than the latter pair in identifying the poor. That is, $M_p \cap ETA_p$ has 78 families, $C_p \cap ETA_p$ has 79 observations, whereas $M_p \cap C_p$ has 68 members. Instead however, we prefer to argue that the permanent income approach is useful because it allows to identify 44 families in the state of poverty, which do not fall in the union of M_p and C_p.

One way to develop this point further could consist in comparing the permanent income approach to some related multidimensional approach which does not rely on an underlying model of intertemporal optimization, and which is not derived from an empirically estimated model. Let us then construct a rule of thumb predictor of permanent income which assigns equal weight to income and consumption: $\breve{\eta}_i \doteq 0.5c_i + 0.5m_i$. We define a poverty line $s_{\breve{\eta}}$ such that 150 families belong to the set $RTHUMB_p = \{i : \breve{\eta}_i \leq s_{\breve{\eta}}\}$ underlying our benchmark multidimensional index.

In Figure 2 we produce a Venn diagram of the three sets C_p, M_p and $RTHUMB_p$. It is to be noted now that the 68 families of the set $C_p \cap M_p$ also belong to the set $RTHUMB_p$. As such, there are no families which belong to $C_p \cap M_p$ but not to $RTHUMB_p$. In Figure 2, the set $RTHUMB_p \setminus (C_p \cup M_p)$ only contains 7 families, and 1036 families are non-poor according to the three definitions. In Figure 1 on

FIGURE 2

Income, consumption and permanent income poverty: Venn diagram for a rule of thumb predictor of permanent income



Notes: 1. First cohort, comprising 1275 families under the age of 30.
2. Income and expenditure normalized by the square root of household size.
3. Rule of thumb predictor assigns equal weight to income and consumption.
4. Poverty line set such that each definition entails 150 poor families.

the other hand, $ETA_p \setminus (C_p \cup M_p)$ has 44 families, and 999 families are non-poor according to either of the C_p, M_p and ETA_p definitions.

If one is primarily interested in working with a multidimensional approach which fosters agreement between the C_p and M_p definitions, then a rule of thumb index giving equal weight to income and consumption outperforms the permanent income approach. If one seeks a complementary perspective on poverty to the income and consumption definitions, then the (undoubtedly more cumbersome) approach developed here does the job better.

4.2 **Ordinal Ranking of Distributions**

The application above identified the poor using income, consumption and the predictor η_Y^*, for given predetermined poverty lines applied to each definition. A study of poverty however does not just stop at counting the poor. Another concern is to determine the range of poverty lines, such that one population has less poverty than another one. For our conclusions to be general, we need to know if our results are specific to a given poverty measure, or if alternatively they will be qualitatively similar provided we use any inequality-sensitive measure of poverty in order to compare the populations. Finally, we know from Figures 1 and 2 that the way we define resources may also affect our conclusions about the incidence of poverty.

In this sub-section, we illustrate these various concerns assuming that two regions of Switzerland are subject to poverty comparisons. For our findings to be robust to the choice of poverty measure and range of poverty lines, we compare the distributions from an *ordinal* perspective. Finally, to illustrate how the ordering of distributions is sensitive to the definition of resources, each poverty comparison is undertaken from the perspective of the distribution of income, consumption expenditure, and permanent income.

Let A and B denote the two regions of interest, with underlying distributions F^A and F^B. From an ordinal perspective, an examination of the first cumulant of the probability distribution function, the poverty deficit curve $\Phi(s) = \int_0^s F(t)dt$, provides all the information required to order two distributions in terms of poverty. Foster and Shorrocks [1988] show that if for all $s < s^+$, $\Phi^A(s) \leq \Phi^B(s)$, any inequality sensitive poverty measure will rank F^A as having less poverty than F^B, for all poverty lines ranging from zero to s^+.

In what follows, we take region A to consist of Zurich, Mittelland, Central and North Western Switzerland. Region A therefore constitutes the core of Swiss economic activity. Region B contains the more peripheral economic areas, namely the Lemanic Arch, Ticino and Oriental Switzerland. We begin with a detailed examination of the second cohort, with household heads aged between 30 and 39. With these definitions in mind, in Table 2 we report the consumption deficit curve ordinates for the two regions of interest in Switzerland. There are ten deciles corresponding to the expenditure thresholds reported in the first column of the table. Thus, the consumption level corresponding to the 10% poorest household of the combined sample is Q_{10} = 23’560 Swiss francs, the order statistic corresponding to the bottom 20% consumption level is Q_{20} = 27’470 etc. The next two columns, labeled *CONSA* and *CONSB* give the value for the poverty deficit curve, $\Phi(s)$, at the expenditure threshold s. Finally, in the last column, under the heading *TEST*, we conduct the Anderson [1996] test of second order stochastic dominance, where the null hypothesis is one of equality of the two deficit curves.

As comes out from Table 2, the consumption deficit curve pertaining to region A is everywhere below that for region B, suggesting, that for all poverty lines,

Table 2
Cohort 30-39: consumption deficit curves

s	CONSA	CONSB	TEST
23.557	1.106	1.246	-1.000
27.472	1.674	1.851	-0.956
30.814	2.506	2.690	-0.816
34.421	3.753	3.967	-0.784
37.763	5.210	5.518	-0.971
41.787	7.349	7.805	-1.231
46.393	10.242	10.900	-1.544
53.130	15.152	16.095	-1.888
64.793	24.908	26.166	-2.104
1’013.800	921.228	932.890	-1.941

Notes: 1. CONSA and CONSB denote consumption expenditure in geographic regions A and B.
2. TEST is the Anderson test of second order stochastic dominance.

poverty is unambiguously lower in region *A*. Furthermore, the Anderson test indicates that differences between the deficit curves are statistically significant at the 90% level for the top three deciles. In Table 3, we repeat the above exercise, with resources now defined in terms of household income. The deficit curve pertaining to region *A* is now above that of region *B*, for all poverty lines ranging from zero to CHF 43'890, suggesting now that poverty is unambiguously higher in region *A* up to the above stated income threshold.

Given these conflicting results pertaining to the poverty ordering of the two regions, we proceed further by comparing the two regions in terms of the permanent income concept. To make use of the entire range of variables available on each family, we predict permanent income using the predictor η^*_W, of the C_W class (cf. equation 21 of Appendix 2). Deficit curves calculated from this definition of resources are reported in Table 4. The overall conclusion is qualitatively similar to that obtained when comparing the two regions in terms of consumption expenditure. Namely, we find that $\Phi^A(s) \leq \Phi^B(s)$ for all values of s. The differences in deficit curves are however statistically significant everywhere in the results of Table 4.

One may be tempted to conclude on the basis of these findings that when income and consumption expenditure rank two regions differently in terms of poverty, a permanent income concept will replicate the ordering obtained from the consumption definition. In order to assess the validity of this conjecture, we repeat the above exercise for the remaining three cohorts. The results of the poverty comparisons are summarized in Table 5. For the youngest age cohort, $CONSB \succ CONSA$, for all $s \leq Q_{20}$, signifies that using the consumption definition, and for the bottom two deciles, *B* is the preferred region in terms of the poverty criterion; in other words, *B* has *less* poverty than *A* in this restricted range of the consumption distribution. Using the income concept, we find that $INCB \prec INCA$. That is, for all deciles, region *A* has unambiguously lower levels of income poverty than region *B*. Unlike

TABLE 3
Cohort 30-39: income deficit curves

s	INCA	INCB	TEST
25.894	1.368	1.216	0.986
30.633	2.104	1.901	0.973
34.910	3.163	2.979	0.703
39.038	4.566	4.465	0.322
43.891	6.706	6.692	0.037
49.704	9.842	9.950	-0.232
56.349	14.070	14.360	-0.531
65.688	20.953	21.484	-0.814
81.733	34.400	35.314	-1.153
331.036	269.657	273.696	-1.971

Notes: 1. INCA and INCB denote income in geographic regions A and B.
2. TEST is the Anderson test of second order stochastic dominance.

TABLE 4
Cohort 30-39: permanent income deficit curves

s	WPREDA	WPREDB	TEST
36.526	1.615	2.032	-1.924
39.662	2.026	2.562	-2.121
42.238	2.600	3.276	-2.395
44.497	3.327	4.131	-2.612
46.915	4.349	5.285	-2.795
50.182	6.053	7.176	-3.019
53.369	8.042	9.329	-3.169
57.954	11.386	12.862	-3.289
66.267	18.284	20.096	-3.552
193.223	137.690	141.891	-3.812

Notes: 1. WPREDA and WPREDB denote permanent income in geographic regions A and B.
2. TEST is the Anderson test of second order stochastic dominance.

TABLE 5
Poverty orderings and the definition of resources

Cohort			
18-29	**30-39**	**40-49**	**50-65**
CONSB $\succ$ CONSA $0 \leq s \leq Q_{20}$	CONSB $\prec$ CONSA	CONSB $\succ$ CONSA	CONSB $\prec$ CONSA
INCB $\prec$ INCA	INCB $\succ$ INCA $0 \leq s \leq Q_{50}$	INCB $\succ$ INCA $0 \leq s \leq Q_{40}$	INCB $\prec$ INCA
WPREDB $\prec$ WPREDA	WPREDB $\prec$ WPREDA	WPREDB $\succ$ WPREDA $0 \leq s \leq Q_{60}$	WPREDB $\prec$ WPREDA

Notes: 1. CONS is household consumption, INC is income and WPRED is permanent income.
2. XB $\succ$ XA ($0 \leq s \leq Q_p$) indicates that the distribution of XB has less poverty than that of XA from the first and up to the p-th percentile.

in the case of the 30-39 age cohort encountered earlier, this time however, the permanent income definition of resources ranks the two regions in terms of poverty in the same manner as the income definition.

For the third age cohort, consumption ranks region *B* as the better off region. For the permanent income definition, poverty is lower in region *B* for all poverty lines covering the bottom six deciles. Using the income definition we would also conclude that *B* has less poverty, up to the fourth income decile, after which the deficit curves of the two regions cross. For the oldest age group, the three definitions agree that for all poverty lines region *A* exhibits less poverty than region *B*.

It is therefore necessary to keep in mind that the ordinal ranking of distributions may at times be reversed depending on whether income or consumption is used to define household resources. The permanent income definition in some instances may preserve the ordinal ranking obtained from the consumption definition, just as it may not. Finally, as illustrated in the example of the oldest age cohort, there are instances where all three definitions will rank two distributions identically in terms of poverty.

4.3 **From Cohorts to Cross-Section**

As discussed earlier, changes in the cross-section distribution often reflect factors such as the overall change in the demographic composition of the population, which have little to do with the fairness, or equalization of opportunities underlying the functioning of an economy at a point in time. There are also some inherent problems in using consumption data to make welfare comparisons across families from different birth cohorts at a point in time (BLUNDELL and PRESTON, [1998]). Nonetheless, researchers also recognize, that from a policy perspective, the evolution of the cross-section distribution of resources is the benchmark by which governments are most often judged in terms of promoting social justice.

Permanent income is the relevant resource concept for measuring household well-being if capital markets allow consumers to transfer resources freely across their working lives, and certainty equivalence is a reasonable characterization of family preferences in the face of uncertainty. If, on the other hand capital markets are inexistent and credit constraints are binding for everyone, then household disposable income is more relevant than permanent income for measuring well-being. Because permanent income is a weighted sum of a family's remaining income receipts (cf. 9), it is to be expected that the distribution of permanent income is less dispersed than that of disposable income. Differences between the two distributions will be related amongst other things to the age structure of the population, but also to the extent to which income fluctuates about permanent income at a point in time and over the life cycle.

In order to construct a cross-section distribution of household permanent incomes, we may distinguish two approaches. One approach would consist in estimating the joint system [10-12] using the merged data from the four cohorts, and deriving the predictor η_W^* using the resulting parameter estimates of the cross-section model. We shall call the resulting distribution, *the cross-section distribution of permanent income*. A second approach would consist in pooling the cohort data on η_W^* obtained from the separate cohort model estimates of Table A1. The resulting distribution is now called the *pooled cohorts distribution of permanent income*.

Table 6 presents summary statistics for the distribution of disposable income and the permanent income cross-section and pooled cohorts distributions. The mean level of resources in the three distributions, is respectively, CHF 52'460, 55'780 and 53'820. Inequality is highest for the distribution of disposable income and lowest for the cross-section distribution of permanent income: in the three distributions, the coefficient of variation is respectively, 0.64, 0.26 and 0.30. Let Q_{10} and Q_{90} denote the order statistics corresponding to 10*th* and 90*th* percentiles of a given distribution. Then the decile ratio Q_{90} / Q_{10} is respectively 3.10, 1.66 and 1.94 for the three distributions.

TABLE 6
The cross-section distribution of resources

Summary Statistic	disposable income (a)	Permanent income cross-section distribution (b)	Permanent income pooled cohorts distribution (c)
Q_{10}	26.39	42.79	37.29
Q_{20}	32.21	45.56	41.59
Q_{50}	46.88	52.61	51.38
Q_{80}	66.91	64.13	63.86
Q_{90}	82.01	71.03	72.37
ave.	52.46	55.78	53.82
CV	0.64	0.26	0.30
Q_{90}/Q_{10}	3.10	1.66	1.94

Notes:1. Incomes measured in thousands of Swiss francs.
2. In column (b) the permanent income measure is obtained from estimating a unique model for the cross-section.
3. In column (c) the permanent income measure is obtained via estimating a separate model for each cohort.
4. Q_p denotes the order statistic corresponding to the p-th percentile of a given distribution, ave denotes the average, and CV the coefficient of variation.

The fact that the cross-section distribution of permanent income is more egalitarian than the pooled cohorts distribution therefore deserves some explanation. Underlying the cross-section approach is an assumption that the time horizon of families is infinite. In its empirical counterpart, we assume the income process is homogeneous across cohorts, and likewise that a 'representative cohort' can be used to model the consumption processes of the four age groups. More specifically, the cross-section approach assumes returns to education and marginal propensities to consume are identical across cohorts. As a result, the homogeneous process governing the cross-section evacuates a source of permanent income inequality arising from the heterogeneity in the income and consumption process across the various cohorts.

It is natural to inquire as to which of the two approaches to constructing the cross-section distribution is to be preferred. From a life-cycle theory perspective, it is clear that provided individuals have finite lives, there will be little support in favour of an approach which assumes the consumption function, and in particular the marginal propensity to consume out of life-cycle resources, to be identical across cohorts. In this sense, the answer should hinge on whether it is possible to treat the structural parameter estimates pertaining to the four cohorts as being equal. If this is so, the case for preferring one approach over the other would have to be made on other grounds than those discussed above.

For a given cohort l, ($l = 1, ..., 4$) define π_l as a g–dimensional vector of structural parameters which is the subject of interest for a particular test hypothesis. Here we are interested in testing whether it is possible to aggregate the data from the four separate cohorts in order to estimate a unique cross-section income and consumption model. Our null hypothesis is therefore $H_o : \pi_1 = \pi_2 = \pi_3 = \pi_4$. Accordingly, stack the four parameter vectors π_l in a column vector Π, i.e.

$$\Pi \doteq \begin{bmatrix} \pi_1 \\ \pi_2 \\ \pi_3 \\ \pi_4 \end{bmatrix}$$

and define the matrix

$$R \doteq \begin{bmatrix} I & -I & 0 & 0 \\ 0 & I & -I & 0 \\ 0 & 0 & I & -I \end{bmatrix}$$

If $\widehat{\Pi}$ denotes a consistent estimator of Π, then a Wald test of the null hypothesis of equality of the π_l vectors is a given by the statistic

$$\zeta^2 = \widehat{\Pi}' R' [R \operatorname{cov}(\widehat{\Pi})\, R']^{-1} R\widehat{\Pi} \tag{18}$$

which is distributed under H_o as a χ^2 variate with $3g$ degrees of freedom.

If we stack in π, the structural parameters of γ, δ_m, β_c and δ_c, the test statistic of equality of π_1 to π_4 takes on a value of 128.9 (a P-value of 0.000). In this sense, the null hypothesis of equality of estimates from the four cohorts must be rejected. For a comparison of cohorts 1 and 2, $\zeta^2 = 30.7$ ($P = 0.006$), for cohorts 2 and 3, $\zeta^2 = 28.2$ ($P = 0.013$). It is only for cohorts 3 and 4 that the estimates of structural parameters are not substantially different. There, $\zeta^2 = 20.3$ ($P = 0.120$). On the basis of these findings, overall we would favour the approach of constructing the distribution of permanent income using the pooled cohorts approach, constructed via separate model estimates for each age group.

5 Conclusions

It is a well documented fact that the set of households which are identified as being poor is not invariant to the choice of welfare indicator. If income and consumption expenditure do not convey the same information on a household's long run economic status, there is a rationale for combining these two welfare indicators in order to identify the poor. Several approaches in the literature therefore offer multidimensional perspectives on poverty and well-being by constructing welfare indices via linear combinations of commonly used welfare indicators.

Our approach in this paper has been to propose one such multidimensional approach in relation to an intertemporal model of consumption based on the certainty equivalence assumption. This has allowed us to work with an explicit definition of household permanent income, and to derive multiple indicator indices of well-being obtained as linear predictors of this unobserved variable in the cross-section.

Our empirical applications show that the permanent income framework is of potential interest in identifying the poor. There are instances where the income, consumption and permanent income definitions broadly agree that a family is poor. However, there are also cases of families which the permanent income approach treats as being poor, while the income and consumption definitions classify them as being non-poor. Of related interest is how alternative welfare indicators order populations in terms of general well-being. There again, we have found instances where the ordinal ranking of income distributions is reversed depending on whether household income or expenditure is used to define family resources. There, a permanent income definition may offer a complementary perspective to the researcher alongside the income and consumption perspectives when examining distributions of household well-being.

One lesson from our empirical results we wish to emphasize, is the need to treat the cross-section as a collection of data pertaining to different cohorts, each governed by its own income and consumption process. For this reason, we recommend constructing the cross-section distribution of permanent income via separate estimation of the parameters of interest in each given cohort. Using such an approach we find that the distribution of permanent income exhibits considerably less inequality (half the level of the coefficient of variation) than the cross-section distribution of income.

This finding is most probably a very conservative estimate, i.e. a lower bound as to the true level of inequality underlying the distribution of permanent incomes. In practice, households will not be able to smooth their consumption to the extent predicted by the certainly equivalence assumption. The introduction of more realistic behavioural assumptions in our framework, such as precautionary saving, however usually require some knowledge of quantities which are not readily available in cross-section consumption surveys, the data environment considered in this paper. ■

References

ABUL NAGA R. and BURGESS R. (1997). – « Prediction and Determination of Household Permanent Income », *Distributional Analysis Research Programme* D.P. 32, Sticerd, London School of Economics.

ANDERSON G. (1996). – « Nonparametric Tests of Stochastic Dominance in Income Distribution », *Econometrica* 64, pp. 1183-93.

BEHRMAN J. (1997). – « Intrahousehold Distribution and the Family », in M. Rosenzweig and O. Stark (eds), *Handbook of Population and Family Economics*, Amsterdam Elsevier.

BJÖRKLAND A. (1993). – « A Comparison Between Actual Distributions of Annual and Lifetime Income: Sweden 1951-1989 », *Review of Income and Wealth* 39, pp. 377-86.

BLOMQUIST S. (1981). – « A Comparison Between Actual Distributions of Annual and Lifetime Income: Sweden Around 1970 », *Review of Income and Wealth* 2, pp. 243-64.

BLUNDELL R. and PRESTON I. (1998). – « Consumption Inequality and Income Uncertainty », *Quarterly Journal of Economic*s 113, pp. 603-40.

BOLZANI E. (2001). – « Distribution des salaires et dynamique de l'Emploi 1992-1997 », *doctoral dissertation*, Université de Lausanne, École des Hautes Études Commerciales.

BOURGUIGNON F. and CHAKRAVARTY S. (2003). – « Measurement of Multi-Dimensional Poverty », *Journal of Economic Inequality* 1, pp. 25-49.

BROWNING M. and LUSARDI A. (1996). – « Household Saving: Micro Theories and Micro Facts », *Journal of Economic Literature* 34, pp. 1797-855.

CAMPBELL J. (1987). – « Does Saving Anticipate Declining Labor Income? An Alternative Test of the Permanent Income Hypothesis », *Econometrica* 55, pp. 1249-73.

CARDOSO N. and GARDES F. (1996). – « Caractérisation et analyse de comportements de consommation des ménages pauvres sur données individuelles françaises », *Revue Économique* 47, pp. 687-98.

CHAUDHURI S. and RAVAILLON M. (1994). – « How Well Do Static Indicators Identify the Chronically Poor? », *Journal of Public Economics*, 53, pp. 367-94.

CHESHER A. (2003). – « Identification in NonSeparable Models », *Econometrica* 71, pp. 1405-41.

Conférence Suisse des Institutions d'Action Sociale (2000). – « Aide sociale, concepts et normes de calcul », Bern, Paul Hampt AG.

DEATON A. (1992). – « Understanding Consumption », Oxford, Oxford University Press.

DEATON A. and PAXSON C. (1994). – « Intertemporal Choice and Inequality », *Journal of Political Economy* 102, pp. 437-67.

FOSTER J. and SHORROCKS A. (1988). – « Poverty Orderings », *Econometrica* 56, pp. 173-7.

FLÜCKIGER Y. and RAMIREZ J. (2000). – « Analyse comparative des salaires entre les hommes et les femmes sur la base de la LSE 1994 et 1996 », Observatoire Universitaire de l'Emploi, Laboratoire d'Économie Appliquée, Université de Genève.

GLEWWE P. and VAN DER GAAG J. (1990). – « Identifying the Poor in Developing Countries: Do Different Definitions Matter? », *Word Development*, 18, pp. 803-14.

GODFREY L. (1988). – « Misspecification Tests in Econometrics », Cambridge, Cambridge University Press.

GOURINCHAS P.-O. and PARKER J. (2002). – « Consumption over the Life Cycle », *Econometrica* 70, pp. 47-89.

HAGENAARS J. (1991). – « The Definition and Measurement of Poverty », in I. Osberg (ed.), *Economic Inequalities and Poverty, International Perspectives*.

JÖRESKOG K. and GOLDBERGER A. (1975). – « Estimation of a Model with Multiple Indicators and Multiple Causes of a Single Latent Variable », *Journal of the American Statistical Association*, 70, pp. 631-9.

KOLODZIEJCZYK C. (2005). – « Les suisses sont-ils prudents ? », *Swiss Journal of Economics and Statistics* 141, pp. 129-64.

LOLLIVIER S. and VERGER D. (1999). – « Inégalités et cycle de vie : les liens entre consommation, patrimoine et revenu permanent », *Annales d'Économie et Statistique* 54, pp. 203-46.

MEYER B. and SULLIVAN J. (2003). – « Measuring the Well-Being of the Poor Using Income and Consumption », National Bureau of Economic Research, *working paper* 9760, Cambridge MA.

MERCADER-PRATS M. (1998). – « Identifying Low Standards of Living: Evidence from Spain », *Research on Income Inequality*, 8, pp. 155-73.

MILES D. (1997). – « A Household Level Study of the Determinants of Incomes and Consumption », *Economic Journal* 107, pp. 1-25.

MUELLBAUER J. (1983). – « The Measurement of Long-Run Living Standards with a Permanent Income Model », *mimeo* Nuffield College, Oxford.

Office Fédéral de la Statistique (1999). – « Enquête sur les revenus et la consommation 1998: nomenclature des dépenses et des revenus », Neuchâtel, Publications de l'Office Fédéral de la Statistique.

POLLAK R. and WALES T. (1992). – « Demand System Specification and Estimation », Oxford, Oxford University Press.

ROSATTI N. (2001). – « How Has Economic Inequality Evolved over the Past Two Decades? A Look at the Italian Experience », D.P. 02-2001, Department of Economics, University College London.

Singh I., Squire L. and Strauss J. (1986). – « Agricultural Household Models », Baltimore, Johns Hopkins University Press.

Townsend P. (1979). – « Poverty in the United Kingdom », Harmondsworth: Allen Lane.

Whelan C., Layte R., Maitre B. and Nolan B. (2001). – « Income, Deprivation and Economic Strain: an Analysis of the European Community Household Panel », *European Sociological Review* 17, pp. 357-72.

6 Appendix 1

Potential Specification Biases

This appendix discusses potential biases in relation to the specification of the empirical framework [10-12]. By definition, transitory income u_{im} is that component of m_i which does not correlate with consumption. Likewise, if u_{ic} denotes transitory consumption, we are assuming in (11) that this variable arises because of accidental factors unrelated to income changes, such as illness. Together (10) and (11) imply that income and consumption are jointly correlated via their dependence on η, and that the remaining transitory variance components are uncorrelated as stated in (13c).

Consider then each of [13a-d] in turn. Equation (13a) is a standard assumption underlying the decomposition of income into permanent and transitory components. It is valid if, conditional on the demographics D_{im}, family income can be treated as a random draw on a variable with mean $\eta_i + \delta_m' D_{im}$. One way (13a) could be violated, would be due to the endogeneity of a subset D_{im}^*, of the demographic characteristics D_{im} which explain income, which in turn would lead to the mis-specification of (10). To give an example, the temporary employment of a younger household member (who say takes on a summer job), may result in a transitory increase in income which is correlated with the number of working household members. A general specification test for this purpose consists therefore of testing for a non-zero correlation between D_{im}^* and u_{im}[13].

One scenario which could lead to the violation of (13b) is the occurrence of a non-zero correlation between a determinant of consumption and u_{ic}. A test for endogeneity of D_{ic} may be conducted similarly to the earlier one discussed in the context of D_{im}. A related source of mis-specification for (11) has to do with the form of the marginal utility function λ (.). Under certainty equivalence, the function λ (.) is linear so that consumption does not react to changes in exposure to risk. Now consider other preference structures such that λ (.) is a convex function. Under such circumstances, consumption could potentially be sensitive to earnings risk. If in turn, earnings risk is correlated with other determinants of consumption, then the failure to account for earnings risk would lead to a mis-specification of (11) because of an omitted variable problem[14].

Under (13c), transitory components are taken to be uncorrelated. MUELLBAUER [1983] gives one example which would lead to the violation of this

13. One way to do so consists in regressing D_{im}^* on a set of variables which are uncorrelated with u_{im} (for instance D_{ic}). We then add the residuals of this latter regression, say $\widehat{u}_m^*$, in (10) and perform a test for the significance of the coefficients on $\widehat{u}_m^*$, as described for instance in GODFREY [1988, pp. 145-50].
14. Earnings risk could be important for novices in the labour market, and could become less significant as families approach retirement. However, because many European countries offer generous unemployment benefits and other forms of income support, it is empirically difficult to determine the extent to which family level consumption is really determined by earnings risk. In the context of Switzerland for instance, the evidence regarding the sensitivity of consumption to earnings risk is quite mixed; see KOLODZIEJCZYK [2005].

assumption. If a temporary absence of an income earner from the household also leads to a temporary reduction in consumption needs, than this would induce a non-zero correlation between u_{im} and u_{ic}. It may be noted however, that when (13c) is violated [10-12] remains minimally identified in the sense of CHESHER [2003]. That is, consistent estimators of γ, δ_m, β_c and δ_c may still be obtained, though the covariance between transitory components is not identified[15,16].

We now turn to our final assumption (13d). To understand the status of Z variables in the present model, substitute for η in (11) using (10); in other terms, proxy household permanent income by disposable income m. We then have:

(19) $$c_i = \beta_c m_i + \delta_c' D_{ic} - \beta_c \delta_m' D_{im} + u_{ic} - \beta_c u_{im}$$

As such, identification will require that an instrument is (i) a correlate of permanent income, (ii) that it does not figure in the list of explanatory variables of (19), and (iii) that Z be orthogonal to the disturbances of (19). Economic theory restrictions may guide us toward ensuring that the first two requirements are met (see respectively our discussions of sub-section 3.1 for the choice of instruments and of section 2 for the determinants of consumption). To evaluate the third requirement, the validity of (13d), we perform Sargan tests of exogeneity for Z variables (GODFREY, [1988; pp. 168-174]).

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15. The test (18) for the system [10-12] is constructed to be robust to the correlation structure between u_m and u_c.
16. Note also that the predictors of permanent income (the classes C_Y and C_W) are also generally parametrized in terms of the vectors γ, δ_m, β_c and δ_c.

7 Appendix 2

Estimations

Table A1 presents parameter estimates for the joint system [10-12] for the four separate cohorts. Demographic control variables (*D* type) used for the income and consumption equations included the number of workers, the number of children under the age of ten, as well as a dummy for marital status. The set of *Z* variables contains the education and sex of the household head, an interaction variable between education and sex, and a dummy *GER* for residence in the more opulent Mittelland and Zurich areas. We have discussed in section 3 the role of education in generating wealth. The sex dummy is included here as there are several studies for Switzerland which have documented an important pay differential between men and women over the last thirty years[17]. The interaction variable controls for different returns to education in the two sexes, while finally *GER* controls for differences in the permanent income generating process according to the geographic area of residence[18].

By examining the parameter estimates of Table A1 across the four cohorts, we may note a degree of consistency in the findings in the sense that the coefficients do not change signs. It may be worth mentioning however that the parameter estimates produced here are not comparable in magnitude to those found in cross-section studies, unless it is the case that the income and consumption process is identical across age groups. In general however, cross-section estimates are weighted sums of the estimates pertaining to the various cohorts. Having said this, we may note that the marginal propensity to consume out of permanent income (the parameter β_c) rises as we move toward the older cohorts[19]. A 95% confidence interval for β_c however falls short of unity for all four cohorts. The coefficients on education (γ_1) are all significant, and imply higher returns to education for the older cohorts. There is a negative premium associated with being a female householder, even though the estimate of γ_2 is not statistically different from zero in either of the four cohorts. The coefficient on the interaction variable *EDU.SEX* suggests, other things equal, a higher return to education for male household heads (though statistically insignificant). The coefficient on the dummy *GER* is positive in all four cohort estimates, but is only statistically different from zero in the second cohort comprising family heads aged between 30 and 39 in 1998.

17. According to FLÜCKIGER and RAMIREZ [2000], the female to male wage ratio in Switzerland is in the order of 0.70. It has slowly progressed from 0.69 in 1970 to 0.72 in 1997. In comparison, the pay ratio has substantially increased in many European nations over this same period, and is in the order of 0.85 to 0.90 in Scandinavian countries.
18. There are several studies which establish a link between the geographic area of residence and the earnings generating process in Switzerland. Using data from the Swiss Labor Force Survey, BOLZANI [2001 *ch.* 2] estimates a wage premium of 8% to living in large metropolitan areas. According to the author however, these geographic differences in income processes mainly reflect the effect of living in large metropolitan areas rather than other factors which are frequently attributed to cultural differences.
19. We offer two explanations which may be compatible with this finding. Firstly, credit market imperfections may be less binding for older families. Secondly, the effect of future earnings risk may likewise become less important on consumption decisions as families approach retirement.

TABLE A1
Income / consumption MIMIC: cohort estimates

Variable	Coeff.	Cohort			
		18-29	**30-39**	**40-49**	**50-65**
INC	β_1	1.000	1.000	1.000	1.000
CONS	β_c	0.594 (0.101)	0.688 (0.073)	0.727 (0.075)	0.806 (0.080)
EDU	γ_1	2.952 (0.917)	4.282 (0.708)	4.181 (1.098)	5.595 (1.163)
SEX	γ_2	-2.107 (3.342)	-0.286 (2.634)	-3.668 (4.075)	-2.539 (4.060)
EDU.SEX	γ_3	0.795 (1.121)	0.557 (0.784)	0.833 (1.220)	0.205 (1.287)
GER	γ_4	0.744 (1.453)	1.902 (0.967)	1.199 (1.532)	2.446 (1.601)
INDEP TEST		1.238 [0.216]	0.676 [0.499]	-1.256 [0.209]	0.926 [0.354]
SARG TEST		2.417 [0.660]	3.375 [0.497]	4.313 [0.365]	2.755 [0.600]

Notes: 1. Standard errors appear inside parentheses. Test P-values are reported inside square brackets.
2. INDEP TEST is the test of independence between D_m variables and disturbances u_m.
3. SARG TEST is the Sargan test for endogeneity of Z variables.

The final two lines of the table reports tests and *P*-values for the assumptions that (*i*) D_m variables are exogenous and (*ii*) that the *Z* variables satisfy the required orthogonality restrictions. The independence test *INDEP* is an omnibus specification test for the income equation. In accordance with the discussion of Appendix 1, here we test for the endogeneity of the number of workers (using a citizenship dummy as an auxiliary variable). Given the *P*-values, there is no evidence of endogeneity for this variable. Omissions of other potential D_m variables would also induce a correlation between D_m and u_m, and would indicate a potential mis-specification in face of the *INDEP* test. Next consider the Sargan test. Given the large *P*-values, it may be concluded that when education is a valid instrument, the remaining three instruments provide valid over-identifying information.

The cohort estimates are used to construct predictors of household permanent income. Let η_Y^* and η_W^* denote, respectively, specific members of the classes C_Y and C_W (cf. equations 16 and 17). Below we select η_Y^* and η_W^* to exhibit a property of minimum mean square prediction error within the classes C_Y and C_W respectively. If $\Sigma_Y \doteq E(YY')$ and $\tau^o \doteq \frac{MSE(\widehat{\eta_Z})}{MSE(\widehat{\eta_Z})+MSE(\eta_Y^*)}$, where *MSE* is the mean-square error operator, then the required predictors, derived in ABUL NAGA and BURGESS [1997], are given by

$$\eta_Y^* \doteq \left(\beta'\Sigma_Y^{-1}\beta\right)^{-1}\beta'\Sigma_Y^{-1}\left(Y-\delta' D\right) \tag{20}$$

and

$$\eta_W^* \doteq \tau^o \eta_Y^* + (1-\tau^o)\widehat{\eta_Z} \tag{21}$$

where $\widehat{\eta_Z}$ is as defined in (15). The predictor η_Y^* is then a weighted sum $b_1(m_i - \delta_m^{'} D_{im}) + b_2(c_i - \delta_c^{'} D_{ic})$. From Table A2, we have $b_1 = 0.689$ and $b_2 = 0.524$ for the first cohort, $b_1 = 0.812$ and $b_2 = 0.273$ for the second cohort, etc. The coefficients on the *Z* variables for the predictor $\widehat{\eta_Z}$ are given next. Finally, the coefficients on the predictor η_W^* are obtained by multiplying those of η_Y^* by τ^o, and those of $\widehat{\eta_Z}$ by $(1 - \tau^o)$. The values taken by τ^o for the four cohorts are respectively 0.436, 0.540, 0.496 and 0.413.

TABLE A2
Prediction of household permanent income

Variable/ coeff.	**Cohort 18-29**			**Cohort 30-39**			**Cohort 40-49**			**Cohort 50-65**		
	YPRED	**ZPRED**	**WPRED**	**YPRED**	**ZPRED**	**WPRED**	**YPRED**	**ZPRED**	**WPRED**	**YPRED**	**ZPRED**	**WPRED**
INC	0.689		0.300	0.812		0.438	0.485		0.241	0.498		0.206
CONS	0.524		0.228	0.273		0.147	0.708		0.351	0.623		0.257
EDU		2.952	1.665		4.281	1.969		4.181	2.107		5.595	3.284
SEX		-2.107	-2.107		-0.286	-0.286		-3.668	-3.668		-2.539	-2.539
EDU. SEX		0.795	0.795		0.557	0.557		0.833	0.833		0.205	0.205
GER		0.744	0.744		1.902	1.902		1.199	1.199		2.446	2.446
tau			0.436			0.540			0.496			0.413

Notes: 1. YPRED is the predictor η^*_Y*, ZPRED is the predictor* η_Z *and WPRED is the predictor* η^*_W*.*
2. tau is the weight assigned to YPRED in the calculation of WPRED.