INTERNATIONAL CENTRE FOR ECONOMIC RESEARCH

ICER

WORKING PAPER SERIES

Rolf Aaberge and Magne Mogstad

ON THE DEFINITION AND MEASUREMENT OF CHRONIC POVERTY

Working Paper No. 36/2006

On the Definition and Measurement of Chronic Poverty

Rolf Aaberge and Magne Mogstad

Research Department, Statistics Norway

November 2006

Abstract

As an alternative to the conventional methods for measuring chronic poverty, this paper proposes to use an interpersonal comparable measure of permanent income as a basis for defining and measuring chronic poverty. This approach accounts for the fact that individuals may undertake inter-period income transfers if it is to their advantage. Moreover, it allows for individual-specific interest rates on borrowing and saving as well as for the presence of liquidity constraints. Due to its general nature the proposed method proves useful for evaluating the theoretical basis of the standard methods for measuring chronic poverty.

Keywords: Intertemporal choice, liquidity constraints, permanent income, chronic poverty.

JEL classification: D71, D91, I32.

Acknowledgement: The Norwegian Research Council has provided financial support for this project. Parts of this paper were written when Rolf Aaberge was visiting ICER in Torino. ICER is gratefully acknowledged for providing financial support and excellent working conditions.

1. Introduction

Over the last decades, increasing discontent has been expressed with poverty snapshots based on observations of income for a single year. The reason is that annual incomes fluctuate heavily due to transitory shocks and institutional factors such as the accounting and tax rules without fully reflecting changes in the economic resources available for consumption and material well-being. As a consequence, poverty scholars have worked on broadening the perspective of distributional analysis to study the chronically poor, i.e. those with persistent inability to pursue material well-being because of lack of economic means. A regularly applied method for analysing chronic poverty, the so-called spell-approach pioneered by Bane and Ellwood (1986), distinguishes chronically poor from transient poor by the time span the individuals have endured low annual income. An underlying assumption for the validity of this approach is, as indicated by Rodgers and Rodgers (1993), that income is perfectly transferable within the year that it is earned, but not transferable between years. This assumption is, however, in conflict with empirical evidence, which shows that households undertake intertemporal income transfers to smooth consumption.[1] Thus, the spell-approach pays excessively attention to the time-patterns of income, but is rather insensitive to the magnitude of the actual income streams. For example, a person that on a single occasion experience annual income above the given annual-specific poverty threshold, and for that reason is not defined as chronically poor, may have an income stream with less consumption potential in each year compared to the income stream of a chronically poor person who experiences a complete spell with incomes below the annual-specific poverty lines. This method also suffers from an additional deficiency since it, by construction, is unable to reflect the depth of poverty as well as the inequality in well-being among the poor.

As a response to the excess sensitivity of spell-based estimates of chronic poverty to fluctuations in annual incomes, alternative methods for measuring chronic poverty based on an extended accounting period of income have been proposed. One such method for measuring chronic poverty simply adds up real annual incomes over a set of consecutive years. Accordingly, the chronically poor are identified as those with average real income below the average poverty threshold.[2] Making incomes from different periods comparable is, however, not merely a question of accounting for changes in the price of goods, but rather accounting for the price of consumption. The price of consumption depends on the real interest rates, which determine how much future consumption an individual must give up for being able to consume more today. By exclusively adjusting for changes in the prices of goods when aggregating annual incomes, one only accounts for parts of the costs and benefits of receiving income at different times.

As pointed out by Rodgers and Rodgers (1993), the concept of permanent income emerging from the theory of intertemporal choice may form a more relevant basis for analysing chronic poverty. Specifically, they propose a permanent income measure defined as the maximum sustainable annual consumption level an individual can achieve for a given real income stream. An underlying assumption of the maximum sustainable consumption method (MSC) is that carrying out equalizing income transfers at the prevailing interest rates to achieve exactly constant consumption level over time is preferable. For it to be optimal to have constant consumption levels over time, it is, however, necessary to rely on rather restrictive intertemporal preferences. Thus, it may seem that the MSC approach lacks the strong theoretical basis of intertemporal optimisation that it claims to have. While standard theory of intertemporal choice assumes that individuals can, if they prefer, make consumption-equalising income transfers, the MSC approach insists that they strictly prefer to make

[1] See Browning and Crossley (2001) for a survey of income and consumption smoothing among households.

[2] Duncan and Rodgers (1991) and Aaberge et al. (2000) demonstrate that poverty estimates are rather sensitive to whether chronic poverty estimates rely on information about the time span individuals have endured low annual income or are based on the average real income over the given sequence of years.

such transfers. Indeed, it is important to emphasize that within the intertemporal choice framework, inter-period income transfers are carried out to ensure that the marginal utility of consumption is constant over time, which often will result in consumption levels that differ between time periods. To abandon the assumption of constant consumption levels over time we introduce a more flexible representation of permanent income that is compatible with a more general preference structure, and moreover can be considered as a money-metric measure of the well-being level associated with the income stream for a given individual. Specifically, this measure of permanent income, denoted the equally-allocated equivalent income (EAEI), is defined as *the minimum annual income the individual would need in order to be as well off as he could be by undertaking inter-period income transfers subject to his budget constraints*.

This paper is organised as follows. Section 2 provides a brief discussion of the importance of drawing on the theory of intertemporal choice as a basis for defining and measuring chronic poverty. Furthermore, we introduce and derive an expression for the permanent income measure EAEI. Section 3 uses the EAEI framework for evaluating and interpreting the theoretical basis of some standard approaches for measuring chronic poverty. Although the justification of the MSC approach relies on the assumption of constant annual consumption levels over time, we prove that the MSC-related measure of permanent income can be used as a measure of the well-being associated with a given set of income streams even in situations where the optimal consumption levels vary over time. Thus, the MSC permanent income forms an appropriate basis for measuring chronic poverty in a broader context than suggested by Rogers and Rogers (1993). Moreover, it is demonstrated that the EAEI method encompasses the MSC approach as well as other alternative methods for measuring chronic poverty. However, as is demonstrated in Section 4 it is solely the EAEI approach that is able to account for liquidity constraints as well as for the effect of individual-specific interest rates on savings and borrowing in a sound manner. If chronic poverty essentially is about identifying those with persistent inability to pursue well-being because of the lack of economic means, it is important to use methods that are capable of capturing the fact that some individuals cannot participate unconstrained in the credit market as borrowers. In Section 5, we illustrate the sensitivity of poverty estimates to the choice between the EAEI method and the conventional methods for measuring chronic poverty. Concluding remarks are provided in Section 6.

2. Permanent income and chronic poverty

> *"The identification of low measured income with 'poor' and high measured income with 'rich' is justified only if measured income can be regarded as an estimate of expected income over a lifetime or a large fraction thereof" (Friedman, 1957; p38).*

Acknowledging that income is a good that does not have intrinsic value but is important merely as an instrument for individuals to pursue well-being, it follows that defining a person with relatively low income as poor requires that measured income can be regarded as an empirically sound estimate of the economic resources available to achieve well-being. On the basis of theory of intertemporal choice, one may argue that studies based on annual income risks to provide a misleading picture of the consumption possibilities of individuals, and consequently also the poverty in a society. The underlying behavioural assumption in mainstream theory of intertemporal choice is that individuals optimise their choices intertemporally given their budget constraints, by undertaking inter-period income transfers if it is to their advantage. Thus, consumption today is a function of expected income over the lifetime, or at least a large fraction thereof, rather than current income. Accordingly, annual incomes, which may heavily fluctuate due to transitory shocks, do not provide a meaningful basis for identifying those with insufficient economic resources to achieve an acceptable level of well-being. Furthermore, individuals may themselves behave such that annual incomes vary substantially over time without reflecting changes in economic resources available for consumption. In particular,

institutional factors such as the accounting and tax rules for income from self-employment and financial assets may have strong impact on the assessment of annual income.[3]

In this regard, it is of interest that most households in the OECD-countries actually carry out intertemporal income transfers, largely by means of mortgage on houses as well as pension schemes.[4] This should lead to greater prevalence in transitory components in current income relative to current expenditures, and in consequence greater income than expenditure inequality. As a matter of fact, the distribution of household expenditure is repeatedly demonstrated to be less unequal then that of income.[5] Indeed, consumer expenditure analyses show that households that are typically defined as poor based on income data for a singe year, as the main rule, spend more than their income, which may be interpreted as evidence for borrowing and saving behaviour (Slesnick, 1993, Mayer and Jencks, 1989).[6] Moreover, survey information suggests that a large proportion of households with low annual income perceive that they are able to borrow (Mayer and Jencks, 1989). A reason is that numerous behavioural and institutional responses seem to fill in the holes left by market imperfections in the insurance and credit market facing households with temporarily low income (Murdoch, 1995). In particular, households appear to utilise "internal capital markets" to smooth consumption by adjusting the purchase of durables to match economic fluctuations.[7] Arguably, methods used to analyse chronic poverty should reflect that incomes can be and regularly are used for consumption not only within the year that it is obtained, but also between years.

As a way of reducing the measurement problem of fluctuating annual income, and to obtain a reliable estimate of the economic resources available for consumption and saving (i.e. future consumption), it seems plausible that the accounting period of income should be extended from one to several years. When extending the accounting period of income, and consequently incorporating that individuals subject to their budget constraints are capable of undertaking inter-period income transfers, it is for aggregation purposes necessary to make incomes from different years comparable. To this end, it appears attractive to draw on economic theory of intertemporal choice. For expositional reasons, we will firstly introduce a method under the assumption of a perfect credit market and with a rather general form of the common intertemporal utility function.

2.1 Equally-allocated equivalent income

A method for measuring chronic poverty on the basis of income requires normative judgements concerning measurability and comparability of income streams across heterogeneous individuals. The common practice of using the average real income as a measure of permanent income implicitly relies on rather restrictive conditions of the intertemporal preference structure and the credit market. Thus, it appears attractive to introduce an alternative measure of permanent income that respects the basic structure of intertemporal choice theory. To achieve interpersonal comparability a common intertemporal utility function will form the basis of computing the permanent income for every individual. The justification for this choice is that the definition and measurement of permanent income will be considered as an integral part of the social choice framework required for analysing

[3] See Fjærli and Aaberge (2000) who provide empirical evidence of tax-dependent income-reporting behaviour.

[4] See Borsch-Supan (2003) for a cross-country study of life-cycle savings.

[5] Studies from OECD-countries that have found income inequality to be greater than expenditure based inequality include Cutler and Katz (1992) and Johnson and Sipp (1997) for the United States, Pandakur (1998) for Canada, and Barret, Crossley and Worswick (2000) for Australia.

[6] Alternatively, this may be because low-income households systematically underreport their incomes relative to high-income households.

[7] In fact, empirical analyses of the expenditure pattern on durables and non-durables suggest that unemployed and others that are likely to be liquidity constrained use the purchase of durables as a tool to smooth marginal utility (Gruber and Dynarski, 1997, Browning and Crossley, 1999). This finding breaks the standard relationship between expenditure smoothing and marginal utility smoothing.

poverty. Rather than claiming that the introduced model of intertemporal choice is a descriptively accurate representation of the behaviour of heterogeneous individuals, we justify it primarily as a normative standard for social evaluation. Specifically, the definition of permanent income that we have in mind is defined as

> *the minimum annual income the individual would need in order to be as well off as he could be by undertaking inter-period income transfers subject to the budget constraints if it is to his advantage*.

To provide a formal counterpart of this definition, we rely on the conventional model of intertemporal choice, the so-called discounted utility model, where preferences are assumed to be intertemporal separable and additive.[8] The instantaneous common utility function u is assumed to be stationary, increasing, concave, continuous and differentiable. Furthermore, we assume that the rate of time preference d, which reflects the preference for immediate utility over delayed utility, is non-negative and constant over time. While the concavity assumption motivates the individual to smooth consumption over time, a positive rate of time preference motivates him to give priority to consumption at present. Let $C_1,C_2,..,C_T$ and $y_1,y_2,..,y_T$, be the vectors of consumption levels and exogenous real incomes net of interests of the individual (after accounting for scale economies in consumption by the use of an equivalence scale). Under the assumption of a perfect credit market, the real interest rates on savings and borrowing are equal and invariant across the population, though they may vary over time. Let $r_1,r_2,..,r_T$ be the vector of real interest rates for period t = 1,2,..,T. The individual's optimal consumption profile $(C_1^*, C_2^*,\ldots, C_T^*)$ is defined as the solution of

$$\max_{C_1,\ldots,C_T} \sum_{t=1}^{T} u(C_t)(1+d)^{1-t} \tag{2.1}$$

subject to the budget constraint

$$\sum_{t=1}^{T-1} C_t \prod_{j=1+t}^{T}(1+r_j) + C_T = \sum_{t=1}^{T-1} y_t \prod_{j=1+t}^{T}(1+r_j) + y_T\,. \tag{2.2}$$

As is well known the optimal consumption level in period t, C_t^*, can be expressed as a function of the optimal consumption level in period 1

$$u'(C_t^*) = \frac{(1+d)^{t-1}}{\prod_{j=2}^{t}(1+r_j)} u'(C_1^*), \quad t = 2,3,\ldots,T\,. \tag{2.3}$$

From (2.3) and (2.2), we get that C_t^* can be expressed as a function, say f_t, of u, d, $y_1,y_2,..,y_T$, *and* $r_1,r_2,..,r_T$, i.e.

$$C_t^* = f_t(u, d, y_1, y_2,\ldots,y_T, r_1, r_2,\ldots,r_T) \text{ for all } t=1, 2, \ldots,T. \tag{2.4}$$

[8] See Koopmans (1960) for an attempt to axiomatically justify the discounted utility model in general, and Kahneman, Wakker and Sarin (1997) for an axiomatic rationalisation of the assumption of additive separability in instantaneous utility. Over the last decades, important underlying assumptions of the discounted utility model have been questioned and found to be descriptive invalid in at least some situations (for a survey see Frederick, Loewenstein and Donoghue, 2002). In particular, it is repeatedly claimed that the choice of exponential discounting resulting in a constant rate of time preferences lacks empirical support. Although it would complicate the calculations, it is possible to modify the method for measuring chronic poverty proposed in this paper by permitting, for example, declining discount rates or hyperbolic discounting.

By inserting for (2.4) in (2.1) the maximum utility level ($\hat{U}$) is given by

(2.5) $$\hat{U} \equiv \sum_{t=1}^{T} u(C_t^*)(1+d)^{1-t} .$$

The individual-specific optimal consumption profiles derived from a common utility function subject to the budget constraints may form the basis for defining and measuring interpersonal comparable permanent income. Accordingly, the minimum annual income (*Z*) that is required to obtain the maximum utility level $\hat{U}$ emerges as an appropriate measure of interpersonal comparable permanent income. Thus, replacing the optimal C_t^* with *Z* for every t in the second term of equation (2.5) yields

(2.6) $$Z = u^{-1}\left(\Delta^{-1}\hat{U}\right),$$

where $u^{-1}(t) = \inf\{x : u(x) \geq t\}$ is the left inverse of *u* and ? is defined by

(2.7) $$\Delta = \sum_{t=1}^{T} (1+d)^{1-t} = \frac{1+d}{d}\left(1-(1+d)^{-T}\right).$$

The minimum annual income *Z* will be denoted the equally-allocated equivalent income (EAEI). Since the individual-specific Zs can be considered to be comparable measures of well-being that represent individual-specific vectors of incomes over a sequence of years, the distribution of the Zs constitutes the basis of definition and measurement of chronic poverty. Thus, the EAEI may be viewed as an attempt to integrate theory of intertemporal choice to the social choice framework required for analysing poverty.

Note that the notion of EAEI can be considered as an analogous to the certainty equivalent in the theory of choice under uncertainty and the equally-distributed equivalent income in analyses of income inequality[9]. However, while the equally-distributed equivalent income represents a money-metric measure of the social welfare for a given distribution of income across individuals, the EAEI represents a money-metric measure of the well-being level associated with the income stream for a given individual. Thus, the social planner considers the income vector $y_1^1, y_2^1, .., y_T^1$, to be preferable to the income vector $y_1^2, y_2^2, .., y_T^2$, if and only if Z^1 exceeds Z^2.

3. Evaluation of alternative methods for measuring chronic poverty

Below, we show the usefulness of the EAEI method for evaluating the theoretical basis of the standard approaches for measuring chronic poverty. In fact, under the assumption of a perfect credit market the method introduced in this paper proves to encompass alternative methods for measuring chronic poverty based on an extended accounting period of income.

3.1 Measuring chronic poverty on the basis of the maximum sustainable consumption

[9] See Atkinson (1970).

Motivated by the idea of letting the individuals' permanent incomes form the basis for analysis of chronic poverty, Rodgers and Rodgers (1993) introduced the maximum sustainable consumption of an income stream as a device for making incomes added up over several years comparable across individuals. Specifically, their focal variable for the measurement of chronic poverty is the annual income that is equal to the maximum sustainable annual consumption level (A) an individual can achieve for a given real income stream. The behavioral counterpart of this method is that each individual carries out intertemporal income transfer at the prevailing interest rates to achieve a constant consumption level over time. For simplicity, suppose that the real interest rates on saving and borrowing in each year are equal. Then, the permanent income measure introduced by Rodgers and Rodgers (1993) coincides with the annuity equivalent (A) of the individual's actual income stream over the given period, which is derived by replacing the variables representing the consumption levels of the various periods in the intertemporal budget constraint (2.2) by A. Provided that year T is the basis for the annuity calculations, the annual income level that is equal to the maximum sustainable annual consumption level is, as proposed by Rodgers and Rodgers (1993), given by

$$A = \frac{y_T + \sum_{t=1}^{T-1} y_t \prod_{j=t+1}^{T} (1+r_j)}{1 + \sum_{t=1}^{T-1} \prod_{j=t+1}^{T} (1+r_j)} . \tag{3.1}$$

The MSC approach can, as stated in Proposition 3.1, be considered as a special case of the more general EAEI method introduced in Section 2. The proof of Proposition 3.1 follows by straightforward calculation from equations (2.3) and (2.2).

PROPOSITION 3.1. *Let $y_1,y_2,\ldots,y_t$ and $C_1^*, C_2^*,\ldots, C_T^*$ be the vector of real incomes and optimal consumption levels for periods 1,2,..,T where d is rate of time preferences and $r_1,r_2,\ldots, r_T$ are the real interest rates, and let Z and A be defined by (2.6) and (3.1), respectively.*

Then

$$Z = A = C_1^* = C_2^* = \cdots = C_T^*$$

if and only if

$$d = r_1 = r_2 = \ldots = r_T$$

It follows from Proposition 3.1 that the permanent income measure stemming from the EAEI method is equal to that of the MSC method if, and only if, the rate of time preferences and the real interest rate coincide in each period.[10]

As stated in the following corollary, the MSC method can be considered as an extension of a frequently applied approach using average income over a sequence of years after adjusting for yearly inflation as a measure of permanent income.[11] This method implicitly assumes that the rates of time preferences as well as the real interest rates are equal to zero.

[10] Note that the condition $d=r_t$ for all t can be abandoned in the case where the intertemporal utility function u coincides with the maximin criterion, i.e. when the utility function is of Leontief type where the periods are viewed as perfect complements. This implies that the utility is equal to the minimum consumption level over the sequence of years. An underlying assumption for such an utility function is that each individual is assumed to prefer to make intertemporal income transfer independent of the price he has to pay in terms of interest rate payments, as long as such transfer do not reduce his maximum sustainable annual consumption level.

[11] See Duncan and Rodgers (1991), Aaberge et al. (2000), Hill and Jenkins (2001), OECD (2001) and Valletta (2006) for analyses of poverty based on average real income over a sequence of years.

Corollary 3.1. *Let $y_1,y_2,\ldots,y_t$ and $C_1^*, C_2^*,\ldots, C_T^*$ be the vector of real incomes and optimal consumption levels for periods 1,2,..,T where d is the rate of time preferences and $r_1,r_2,\ldots,r_T$ are the real interest rates, $\bar{y}$ the mean of the real income vector, and let Z and A and be defined by (2.5) and (3.1), respectively.*

Then

$$Z = A = C_1^* = C_2^* = \cdots = C_T^* = \bar{y}$$

if and only if

$$d = r_1 = r_2 = \cdots = r_T = 0.$$

Thus, by using the average income as a measure of permanent income one attempts to make the incomes added up over time comparable by accounting for the average change in prices for a representative basket of consumer goods. A person may then be defined as chronically poor if he has an average real income level below the average poverty line over the chosen sequence of years.

Making incomes from different periods comparable, however, is not merely a question of accounting for changes in the *price of goods*, but rather for changes in the *price of consumption*. Should not the price of consumption today reflect its opportunity cost? The opportunity cost of consumption today has to do with the alternative use of an one's income, which depends on the real interest rates determining how much future consumption we must give up in exchange for being able to consume more today. Hence, it is the real interest rates that should be used to make incomes from different periods comparable. The price of goods coincides with the price of consumption as long as it is costless to carry out intertemporal transfers of income (i.e. the real interest rates are equal to zero). In fact, relying solely on the consumer price index to make incomes from different periods comparable implies that one only accounts for part of the costs and benefits of receiving income at different times. According to the average real income method, the real incomes for two periods given by, say, 1 in the first period and 100 in the second period is viewed as equally good as the real incomes given by 100 in the first period and 1 in the second period. However, the latter income profile can obviously produce higher consumption and well-being in each period compared to the former income profile simply by utilizing the opportunity to save at a positive real interest rate. Thus, we may infer that the average real income method fails to provide an adequate description of the constraints in the intertemporal optimisation problem of the individuals. Furthermore, the fact that exact choice of rate of time preference can be controversial is, of course, not an argument for setting the rate of time preferences equal to zero, which is implicitly done in the average real income approach.

3.2. On the use of the MSC approach when optimal consumption levels differ between time periods

The discussion in Section 3.1 demonstrates that the theoretical justification of the MSC approach introduced by Rogers and Rogers (1993) relies on rather restrictive intertemporal preferences for consumption. At first glance, it may appear that the MSC approach based on *A* lacks the strict theoretical basis of intertemporal optimisation that it claims to have. While the theory of intertemporal choice assumes that individuals can, *if they prefer*, make consumption-equalising income transfers, the MSC approach insists that they *strictly prefer* to make such transfers. Indeed, within the intertemporal choice framework income transfers are made in order to achieve constant marginal utility of consumption over time, which means that consumption levels normally will differ between time periods. Thus, an interesting question is whether *A* defined by (3.1) can be considered as a valid measure of comparable permanent income even in cases where the assumption of equal consumption levels over time is abandoned. To discuss this question we will consider the case where the optimal consumption profile is separable in the sense that the optimal consumption for any period can be

expressed as a product of a function of the real interest rates and the real income vector as well as a time-dependent function of preference parameters and interest rates

(3.3) $$C_t^* = q_t C_1^*$$

where q_t is defined implicitly by

(3.4) $$g(q_t) = \frac{(1+d)^{t-1}}{\prod_{j=2}^{t}(1+r_j)}, \; t=2, 3, \ldots, T$$

and $g(x) = u'(x)$. Thus, the ratio between the optimal consumption levels for two arbitrarily chosen periods depends on the instantaneous utility function u, the rate of time preference d, and the real interest rates $r_1, r_2, \ldots, r_T$, but not on the vector of real incomes $y_1, y_2, \ldots, y_T$. As demonstrated in Theorem 3.1 the consumption profile defined by (3.3) is optimal if and only if the utility function is of the Box-Cox type, which is by far the most popular specification of the instantaneous utility function in intertemporal choice theory (Davies and Shorrocks, 2000).

Theorem 3.1. *Let $C_1^*, C_2^*, \ldots, C_T^*$ be the vector of optimal consumption levels for periods $1, 2, \ldots T$ where u is the instantaneous utility function, d is the rate of time preferences and $r_1, r_2, \ldots, r_T$ are the real interest rates, and let q_t be defined by (3.4). Then*

(i) $$C_t^* = q_t C_1^* \quad for \; t = 2, 3, \ldots, T$$

if and only if the instantaneous utility function has the following form

(ii) $$u(x) = \begin{cases} \frac{1}{1-e}(x^{1-e} - 1) & if \; e \neq 1 \\ \log x & if \; e = 1. \end{cases}$$

Proof. Assume that $C_t^* = q_t C_1^*$ where q_t is defined by (3.4). Now, inserting for (3.3) and (3.4) in (2.3) we obtain the following functional equation

$$g(q_t C_1^*) = g(q_t) g(C_1^*) \quad for all \; q_t > 0 \; and \; C_1^* > 0,$$

which has the solution (see Aczél, 1966) $g \equiv 0$ or 1, or there exists $e \in \mathbb{R}$ such that

$$u'(x) = g(x) = x^{-e}.$$

Hence, (i) implies (ii).
The converse statement follows by inserting (ii) in (2.3). □

Remark. Although the purpose of this paper is to introduce a framework for analysing chronic poverty and only indirectly concerns intertemporal behaviour of individuals, Theorem 3.1 demonstrates that individuals will behave in accordance with the separable optimal consumption profile (i) if and only if the instantaneous utility function of the preferences structure (2.1) is of the Box-Cox type (ii).

As will be demonstrated below, the result of Theorem 3.1 proves useful for identifying the relationship between *A* defined by (3.1) and *Z* defined by (2.6). To this end, it is convenient to introduce the notation a_t defined by

$$a_t = \frac{1+\sum_{t=1}^{T-1}\prod_{j=t+1}^{T}(1+r_j)}{q_T+\sum_{t=1}^{T-1}q_t\prod_{j=t+1}^{T}(1+r_j)}q_t\,, \tag{3.5}$$

and $k(\varepsilon,\delta)$ defined by[12]

$$k(\varepsilon,\delta)=\begin{cases}\left[\dfrac{\sum_{t=1}^{T}a_t^{1-\varepsilon}(1+\delta)^{1-t}}{\Delta}\right]^{\frac{1}{1-\varepsilon}} & \text{when } \varepsilon\neq 1\\ \prod_{t=1}^{T}a_t^{\frac{(1+\delta)^{1-t}}{\Delta}} & \text{when } \varepsilon=1\end{cases}, \tag{3.6}$$

where ? is defined by (2.7).

Theorem 3.2. *Let $C_1^*,C_2^*,\ldots,C_T^*$ be the vector of optimal consumption levels for periods 1,2,…T where $\varepsilon\in$ □ and d is a positive real number. Moreover, let Z, A, q_t and $k(\varepsilon,\delta)$ be defined by (2.6), (3.1), (3.4) and (3.6). Then*

(i) $$C_t^* = q_t C_1^* \quad for\, t=2,3,\ldots,T$$

implies

(ii) $$Z = k(\varepsilon,\delta)A.$$

Proof. By inserting for $C_t^* = q_t C_1^*$ in equation (2.2) we get

$$C_1^* = \frac{\sum_{t=1}^{T-1} y_t\prod_{j=t+1}^{T}(1+r_j)+y_T}{\sum_{t=1}^{T-1}q_t\prod_{j=t+1}^{T}(1+r_j)+q_T}\,, \tag{3.7}$$

where $q_1 = 1$.

Next, inserting for (3.1), (3.5) and (3.7) in $C_t^* = q_t C_1^*$ yields

[12] For convenience the dependence of *k* on $r_1,r_2,\ldots,r_T$ is suppressed in the notation for *k*.

(3.8) $$C_t^* = a_t A \ for \ t = 2,3,...,T.$$

Moreover, it follows from Theorem 3.1 that the instantious utility function u is given by (ii) of Theorem 3.1. By inserting (3.8) and specification (ii) for u in equation (2.5) we get

(3.9) $$\hat{U} = \frac{1}{1-e}\left[A^{1-e} \sum_{t=1}^{T} a_t^{1-e} (1+d)^{1-t} - \Delta \right].$$

Now, inserting for (3.9) and the inverse of the Box-Cox utility function u (defined by (ii) in Theorem 3.1) in (2.6) yields

(3.10) $$Z = k(e,d)A. \qquad \square$$

Since a common intertemporal utility function determined by the social planner forms the basis for computing the permanent incomes, it follows that e and d, and thus $k(e,d)$ is the same for all individuals. Furthermore, because methods for quantifying (relative) poverty are required to be invariant with respect to scale transformations of the chosen income measure (permanent income in this case), Theorem 3.2 demonstrates that A and Z will produce identical poverty results for a given set of income data when the utility function u is of the Box-Cox type. Thus, in contrast to what is claimed by Rogers and Rogers (1993) the permanent income measure A may form the basis of poverty analysis even in case where the optimal consumption levels differ between time periods. Moreover, it follows from Theorem 3.2 that poverty estimates based on the EAEI approach are *independent* of the actual parameter values for e and d, provided that the chosen instantaneous utility function is of Box-Cox type.[13] These results obviously generalises to distributional assessments requiring the income measure to be invariant with respect to scale transformations, such as in the standard measurement of income inequality.

3.3. An illustration of the EAEI, the MSC and the average real income method

To illustrate the methods discussed above, we consider a three-period case. As is well known and demonstrated in Table 1, consumption will be growing or declining over time according to whether the impatience of the individual in terms of current consumption is dominated by the effect from the price differential between consumption today and consumption tomorrow. Thus, the sign of this effect is determined by whether the real interest rates are greater or lower than the rate of time-preferences. For a given difference between real interest rates and the rate of time preferences, the larger the intertemporal elasticity of substitution e^{-1} the steeper is the profile of the time-pattern of consumption. The permanent income measure based on the EAEI method will exceed or be equal to that of the MSC method. The reason is that only the method for deriving Z is based on a preference structure flexible enough to allow individuals to adjust their consumption profiles to take advantage of intertemporal incentives caused by any deviation between the rates of time preferences and the real interest rates. However, as demonstrated by Theorem 3.2 and illustrated in Table 1, the ratio of Z and A will be equal for all real income vectors independent of the chosen values of the preference parameters d and e as well as the magnitudes of the real interest rates as long as they are to equal for all individuals.

[13] Thus, unlike the cost-benefit literature where results appear to be rather sensitive to the choice of social discount rates, poverty measurement based on the EAEI approach will in fact be independent of the actual parameter values for e and d. In practice, countries have used widely different rate of time preferences for official cost-benefit analysis, ranging from 3 per cent real rate in Germany to 8 per cent real rate in France (Evans and Sezer, 2004)

The average real income $\bar{y}$ will differ from A, and thus from Z, when the real interest rates on inter-period income transfers are non-zero. As is illustrated in Table 1, $\bar{y}$ will be larger (lesser) than A when the real income vector leads to borrowing (saving) in each period. This is due to the fact that the average real income disregards the costs and benefits of inter-period income transfers.

Table 1. Optimal consumption profiles and permanent income measures for a set of real income vectors by real interest rates and preference parameters*

(y_1, y_2, y_3)	(d, e, r_2, r_3)	(C_1^*, C_2^*, C_3^*)	$\bar{y}$	A	Z	$k=Z/A$
(10, 100, 1000)	(*0.03, 0.2, 0.1, 0.1*)	(240.4, 333.9, 463.9)	370.0	339.0	341.4	1.0072
(700, 100, 500)	(*0.03, 0.2, 0.1, 0.1*)	(312.1, 433.6, 602.4)	433.3	440.2	443.4	1.0072
(600, 200, 70)	(*0.03, 0.2, 0.1, 0.1*)	(217.6, 302.4, 420.1)	290.0	306.9	309.2	1.0072
(10, 100, 1000)	(*0.03, 0.2, 0.02, 0.05*)	(357.7, 340.6, 375.0)	370.0	357.5	357.5	1.0002
(700, 100, 500)	(*0.03, 0.2, 0.02, 0.05*)	(434.3, 413.6, 455.3)	433.3	434.1	434.1	1.0002
(600, 200, 70)	(*0.03, 0.2, 0.02, 0.05*)	(295.8, 281.7, 310.1)	290.0	295.6	295.7	1.0002
(10, 100, 1000)	(*0.1, 2, 0.02, 0.05*)	(369.1, 355.4, 347.2)	370.0	357.5	357.7	1.0006
(700, 100, 500)	(*0.1, 2, 0.02, 0.05*)	(488.1, 431.5, 421.6)	433.3	434.1	434.3	1.0006
(600, 200, 70)	(*0.1, 2, 0.02, 0.05*)	(305.2, 293.9, 287.1)	290.0	295.6	295.8	1.0006

* The instantaneous utility function is assumed to take the Box-Cox functional form.

4. Measurement of permanent income and chronic poverty when the credit market is imperfect

Under the assumption of a perfect credit market we have demonstrated that analyses based on the MSC and EAEI permanent incomes will produce identical poverty results, provided that the underlying instantaneous utility function is a member of the Box-Cox family of utility functions. Below, we abandon the assumption of a perfect credit market and explore whether any of the previously discussed approaches can be extended to account for individual-specific interest rates on savings and borrowing as well as for liquidity constraints. [14] If chronic poverty essentially is about identifying those with inability to pursue material well-being because of the lack of economic means, it might be important to take into account that at least certain sub-groups of the population cannot participate unconstrained in the credit market as borrowers. Specifically, individuals can face borrowing constraints since judgements about future labour income involve not only uncertainty but also asymmetric information about skills and propensities to induce effort. This may, in particular, be the case for individuals outside the labour force, such as unemployed or disabled, who are at risk of falling seriously short of the resources commanded by most individuals or households in the community in which they live.

4.1 The EAEI approach

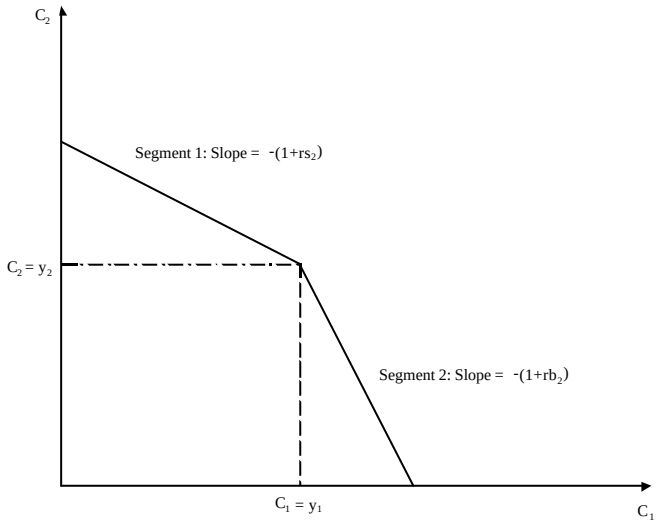
When interest rates on borrowing and savings differ then (2.2) is no longer a valid representation of the budget constraints. Consequently, the optimal consumption levels defined as the solution to (2.1)

[14] The empirical studies carried out by Flavin (1981) and Blinder and Deaton (1985) reject the permanent income hypothesis with perfect credit markets. There are also strong theoretical reasons why the credit market does not clear and liquidity constraints arises, e.g. such that borrowers may default on their loans (Stiglitz and Weiss, 1981). See Hayashi (1987) for a review of other possible mechanisms that result in liquidity constraints.

and (2.2) will in this case not form an appropriate basis for defining and measuring the EAEI. Thus, the method outlined in Section 2 for deriving the optimal consumption profiles has to be revised.

In order to make the derivation of optimal consumption profiles under the assumption of imperfect credit markets as transparent as possible, consider first the simple two-period case illustrated in Figure 1 where the real interest rate on borrowing (rb) exceeds that of savings (rs). This leads to a piecewise-linear and concave budget constraint with two segments. The individual concerned has three options: save (segment 1), borrow (segment 2), or consume his entire income in each period (kink). Prohibiting borrowing corresponds to segment 2 being a vertical line that intersects the x-axis at $C_1 = y_1$. To determine the optimal consumption profile, we first derive the conditional consumption profile for each of the linear segments; the term conditional is used because it describes the choice of consumption conditional on having chosen to save or to borrow. By computing the utilities of the conditional consumption profiles, we can determine whether the individual is treated as a saver, a borrower, or neither a saver nor a borrower, and his optimal consumption profile. Notice that the income and substitution effects of changes in real interest rates and incomes will depend on whether the individual remains at the segments or the kink. Small changes can, therefore, affect the consumption profile through adjustments within the given segment and/or by changing the choice of segment or kink.

Figure 1. Piecewise-linear and concave intertemporal budget constraint with two segments



Formally, we can apply the Kuhn-Tucker method to derive the conditional and optimal consumption profiles in the case of imperfect markets. For simplicity, assume that each individual is faced with a single borrowing interest rate and a single savings interest rate (but different individuals may face different borrowing and/or savings rates). If there are no liquidity constraints, the optimal consumption profile $(C_1^*, C_2^*, ..., C_T^*)$ is defined as the solution of (2.1) subject to the budget constraints

$$
\begin{aligned}
& S_0 = 0 \\
& S_t = (1 + rg_t) S_{t-1} + y_t - C_t, \; t = 1,2,...,T-1 \\
& S_T = (1 + rg_t) S_{T-1} + y_T - C_T = 0
\end{aligned}
\tag{4.2}
$$

where S_t represents the assets at the end of period t earning an interest rate rg_{t+1}, and

(4.3) $$rg_t = \begin{cases} rs_t & if\ S_{t-1} \geq 0 \\ rb_t & if\ S_{t-1} < 0 \end{cases}, -1 < rg_t < \infty, \quad t = 2,3,...,T .$$

Solving this maximization problem requires comparison of 3^{T-1} conditional consumption profiles. The consumption profiles are distinctive in terms of whether the individual in the various periods is considered to be a saver, a borrower, or locate at the kink and thereby consume all his assets. Each of these conditional consumption profiles is a candidate for the individual's optimal consumption profile provided that the budget constraints are satisfied for the given values of y_t and rg_t. The optimal consumption profile is determined as the utility maximising choice among the conditional consumption profiles satisfying their respective budget constraints. By inserting the consumption levels of the optimal consumption profiles into (2.5), the corresponding EAEI (*Z*) is obtained from (2.6).

Presence of liquidity constraints will reduce the number of available conditional consumption profiles that have to be compared. For example, the case where borrowing in each period is prohibited corresponds to reducing the number of conditional consumption profiles to those satisfying $S_t \geq 0$. Thus, deriving EAEI subject to liquidity constraints is straightforward and can be considered as a special case of the method outlined above[15].

4.2. The MSC approach

When the savings rate differs from the borrowing rate, the maximum sustainable annual consumption level defined by (3.1) is, as acknowledged by Rodgers and Rodgers (1993), not valid as a measure of permanent income. This is due to the fact that we do not know in advance whether the individual in question will be a saver or a borrower in the various periods. For this reason, Rodgers and Rodgers (1993) introduced an iterative procedure based on the mean annual income as a first approximation of *A*, which is adjusted according to the corresponding savings/borrowing pattern until assets at the final year is acceptably close to zero. In end effect, they obtain an estimate of *A* defined as annual income plus the savings/minus the borrowing required to achieve a constant consumption level over time.

By contrast, the framework outlined in Section 4.1 does not require application of an iterative procedure for computing the annual income that corresponds to the maximum sustainable annual consumption level of a given income stream. Specifically, replacing C_t with *A* for each *t* in (4.2) yields *T* equations for determining *A* and S_t. Since S_t can be larger, lesser, or equal to zero in each of the *T*-1 periods, there are 3^{T-1} candidates for A. Note that these candidates share the common feature of constant consumption levels over time, but are distinctive in terms of the values of S_t and thus rg_t. Specifically, *A* is determined as the highest consumption level among the candidates satisfying their respective budget constraints.

The method outlined above is not only simpler and computationally less burdensome compared to the iterative procedure proposed by Rodgers and Rodgers (1993), but also provides an exact measurement of A. But more importantly, the above method serves as a framework for identifying the underlying assumptions inherent in the iterative procedure. In fact, it can be straightforwardly demonstrated that a necessary condition for the optimal consumption profile $(C_1^*, C_2^*, \ldots, C_T^*)$ defined as the solution to the maximisation of (2.1) subject to (4.2) under the constraint $C_1^* = C_2^* = \ldots = C_T^*$, is that $d = rb_t$ for any

[15] A program for computing the permanent income *Z* is available from the authors upon request.

$S_{t-1}<0$ and $d = rs_t$ for any $S_{t-1}>0$.[16]

This result has some troublesome implications for the MSC approach. On one hand, interpersonal comparability of income streams requires a common intertemporal utility function. On the other hand, introducing an imperfect credit market, where some individuals are borrowers and others savers, implies interpersonal variation in real interest rates. However, allowing interpersonal variation in the real interest rates and insisting on identical rate of time preferences across individuals is incompatible with the MSC requirement of the rate of time preferences being equal to the real interest rate for each individual. Hence, comparability of incomes in the MSC approach is incompatible with an imperfect credit market. By contrast, the EAEI approach justifies interpersonal comparability of permanent incomes even when there is interpersonal variation in the real interest rates, since it does not require constant consumption levels over time. Furthermore, even if one ignores the comparability problem, the MSC method is not able to handle liquidity constraints in a sound manner, since constant consumption levels may not be attainable when borrowing is restricted. Consider, for example, an individual restricted from borrowing with a two-period vector of real incomes given by 1 in the first period and 100 in the second period. In this case, the annual income equal to the maximum sustainable annual consumption level obtained from the iterative procedure is equal to the relatively low income in the first period, and is in fact unaffected by the magnitude of the income in the second period. By contrast, the EAEI of the individual will not be determined solely by the income level in the first period; although he is not as well off as he would if there were no borrowing constraint, he will still receive some utility from the high income in the second period. This illustrates that the MSC method is not flexible enough to incorporate liquidity constraints. In fact, in the presence of liquidity constraints the MSC method suffers from the same weakness as cross-section snapshots of poverty, since neither recognizes that a bad year does not render an otherwise well-off person poor.

4.3. The spell approach

"Any model of income estimated with longitudinal data implicitly or explicitly provides a model of intertemporal dynamics" (Bane and Ellwood, 1986; p2).

A widely used method for measuring chronic poverty is based on the time span individuals have endured low annual income. After Bane and Ellwood (1986), it has become common to use hazard regression models and/or first-order Markov models to estimate the lengths of poverty spells which are defined as continuous periods during which income falls below the year-specific income threshold.[17] Chronic poverty is then defined by relatively long continuous spells or somewhat shorter but recurrent spells. Essentially, the novelty of Bane and Ellwood (1986) was to apply methods designed for analysis of duration events, such as unemployment, to analyse changes in annual income over time.[18] At first glance, this methodological framework appears promising since concern is changed from the question of 'who has low income at a given point in time' to the question of 'who has persistently low income'. Moreover, this approach enables researchers to study the association between transitions into and out of a low annual income status and demographic and macroeconomic variables. However, an interesting question is whether the model of intertemporal dynamics underlying the spell-based

[16] As long as there is an interior optimum, this condition is necessary and sufficient for the optimal consumption profile to consist of consumption levels that are constant over time. Suppose there is a boundary optimum, i.e. $S_t = 0$ for at least one t=1,2,..,T-1. In this case, it is also required that $C_{t-1}^* = C_t^* = C_{t+1}^*$ for any $S_t = 0$, which in general will not be the case.

[17] Prior to Bane and Ellwood (1986), it was common to simply tabulate the proportion of the population with annual income below the year-specific income threshold in t out of T years, where $0 \leq t \leq T$. In this case, the chronically poor are defined as those who had annual income below the year-specific income threshold in most or all years. Essentially, the distinguishing feature of spell studies compared to tabulation studies is that they sample from the flow rather than the stock to avoid selection problems. See for example Levy (1977), Coe (1978), Rainwater (1981), Hill (1981), and Duncan et al. (1984) for tabulation studies, and Stevens (1994, 1999, 2002) and Cappellari and Jenkins (2004) for spell studies.

[18] See e.g. Lancaster (1989) for a review.

approach produces a reasonable relationship between the observed income pattern and the associated well-being level.

As the main rule, poverty studies based on the spell-approach defines the chronically poor as those experiencing a complete poverty spell over the period of observation. The formal counterpart of this definition implicitly relies on an intertemporal utility function defined as

$$\sum_{t=1}^{T} u_t(C_t) \tag{4.4}$$

where the instantaneous utility function is given by

$$u_t(C_t) = \begin{cases} 1 & if\ C_t \geq m_t \\ 0 & if\ C_t < m_t \end{cases},\ t = 1,2..,T \tag{4.5}$$

and m_t is a year-specific income threshold either imposed exogenously or determined as a percentage of, say, the median in the distribution of income in year *t*. Note that the rate of time preferences is assumed to be zero.

The individual is assumed to be maximising (4.4) subject to the budget constraints

$$S_t = y_t - C_t = 0,\ t = 1,2,...,T \tag{4.6}$$

following from the assumption of incomes not being transferable between periods, which corresponds to

$$rs_t = -1 \text{ and } rb_t \to \infty,\ t = 2,3,..,T\ . \tag{4.7}$$

Defining chronic poverty as experiencing a complete poverty spell is thus equivalent to classifying those with $\sum_{t=1}^{T} u_t(C_t) < T$ as chronically poor.

Arguably, the intertemporal model of dynamics underlying the spell-based approach to chronic poverty suffers from an unsatisfactory specification of the budget constraints and a controversial intertemporal preference structure. The spell-based approach assumes, as pointed out by Rodgers and Rodgers (1993), that income is perfectly transferable within the period that it is earned, typically a year, but not transferable between periods. As previously addressed, this assumption is in conflict with substantial empirical evidence, which shows that most households undertake inter-period income transfers. A model of intertemporal dynamics should reflect that incomes could be used for consumption not only within the year that it is obtained, but also between years. In fact, fluctuating income is, as the main rule, neither the same as fluctuating consumption or well-being level. Thus, the recent trend of studying the so-called ins and outs of poverty based on changes in annual income risks to be misleading.[19] Indeed, Duncan et al. (1995) and other applications the spell-based approach implicitly acknowledges the problem of excess sensitivity to fluctuations in incomes as they restrict poverty transitions to those that involve an income change of, say, at least 20 per cent. Even if one takes the stand that certain individuals are constrained from borrowing they may be capable of saving and others can undertake inter-period income transfers by borrowing as well as by saving. By assuming away any kind of inter-period income transfers for the entire population, the spell-approach fails to account for interpersonal variation in real interest rates in general and liquidity constraints in

[19] See for example Stevens (1994, 1999) for studies of transition into and out of poverty based on information about changes in annual incomes.

particular; not only incomes but also the opportunities to smooth consumption by borrowing may vary across the population.

Even if one for some reason finds it reasonable that each individual is incapable of saving and borrowing, the spell-based approach also requires that the intertemporal utility function is exclusively determined by the length of time in which a person happens to have income below a specific annual income threshold. Thus, the method pays excessively attention to the time-patterns of income, but is rather insensitive to the magnitude of the actual income streams. For example, a person that on a single occasion experiences annual income above the year-specific income threshold, and for that reason is not defined as chronically poor, may have an income stream with less consumption potential in each period compared to the income stream of a chronically poor person experiencing a complete poverty spell. Moreover, since the spell approach only utilize parts of the available income information, it will not be possible to consider distributional issues such as the poverty gap and the inequality among the poor.

4.4. Illustrating the sensitivity of poverty estimates to the choice between the EAEI method and the spell approach

Below, we illustrate the extent to which chronic poverty estimates depend upon the choice of method for measurement in the case of an imperfect credit market. Specifically, Table 2 contrasts the EAEI approach with the frequently applied spell approach in the three-period case. The reason for excluding the MSC approach is partly because it fails to account for liquidity constraints, but also due to lack of interpersonal comparability of permanent incomes when the real interest rates on savings and borrowing differ across individuals.

Table 2. Chronic poverty status for a set of real income vectors according to the EAEI method and the spell-approach*

(y_1, y_2, y_3)	Spell-approach (Complete poverty spell)	Spell-approach (2-period poverty spell)	EAEI ($rs_t = 0.02$, $rb_t = 0.05$, t=2,3)	EAEI ($rs_t = 0.02$, rb_t ? 8 , t=2,3)	EAEI ($rs_t = -1$, rb_t ? 8 , t=2,3)
(90, 90, 90)	Chronic poor	Chronic poor	Chronic poor	Chronic poor	Chronic poor
(10, 110, 10)	Not chronic poor	Chronic poor	Chronic poor	Chronic poor	Chronic poor
(500, 90, 90)	Not chronic poor	Chronic poor	Not chronic poor	Not chronic poor	Not chronic poor
(90, 90, 130)	Not chronic poor	Chronic poor	Not chronic poor	Chronic poor	Chronic poor
Poverty threshold	100	100	100	100	100

* The poverty thresholds are assumed to be fixed and equal to 100 for both methods and under all specifications of the credit markets. The instantaneous utility function is under the EAEI method assumed to take the Box-Cox functional form with $d = 0.03$ and $e = 2$.

Let us first consider the chronic poverty status following from the spell-approach when the chronically poor are defined as those experiencing a complete poverty spell over the three years. In this case, the first individual is the only chronically poor, despite his relatively high income stream compared to the second individual. This illustrates that studies relying on the spell-approach risks that a non-poor individual has an income stream that is well below the income stream of a person defined as chronically poor. The reason is that the second individual happens to have, in a single year, annual income above the year-specific poverty threshold, which excludes him from the poor population regardless of the relative size of his actual income stream. Defining the first individual unlike the second individual as chronically poor seems flawed, since the first individual could, by saving, sustain a higher consumption level than the first individual in each year.

At first glance, this problem appears to be solvable by adjusting the time span necessary for individuals to have endured low annual income to be defined as chronically poor. Suppose that the chronically poor are defined as those experiencing a poverty spell of at least two years in length out of the three years. In this case, all four individuals presented in Table 2 are defined as chronically poor. However, defining the third individual as chronically poor is clearly unreasonable, since he by saving could achieve annual consumption level in each year that is well above the poverty threshold. This demonstrates that the weaknesses of the spell-approach cannot simply be solved by ad-hoc adjustments of the length of poverty spells it takes to define chronic poverty. On the contrary, one is forced to deal explicitly with the unsatisfactory specification of the budget constraints and the controversial intertemporal preference structure inherent in the spell-approach.

Consider the chronic poverty status in Table 2 following from the EAEI method under the various specifications of the imperfections in the credit market. In the case of no liquidity constraints but real interest rates that differ between borrowing and saving, the first two individuals are chronically poor whilst the last two individuals are non-poor. This means that we do not have the problem as in the spell-approach where the first individual unlike the second was defined as chronically poor. In the case where borrowing is prohibited, individual four is also defined as chronically poor. Although individual four receives some benefits from having a relatively high income in the last year, he is not as well off as he was when he could undertake intertemporal income transfers to smooth consumption. This leads to a relatively low Z for individual four when he is faced with a binding borrowing constraint, since this reduces the well-being level associated with his real income. Finally, consider the special case of the EAEI method where, just as in the spell-approach, it is assumed that individuals cannot borrow or save. However, due to the less restrictive intertemporal utility function the EAEI method does not suffer from the excess sensitivity of poverty estimates to the time-pattern of annual incomes as the spell-approach does. Thus, the second individual is defined as chronically poor because he/she is restrained from making income transfers between periods, even though he has a high income in a single year. This demonstrates that arguments of the kind that individuals are incapable of carrying out income transfers between years are not only empirically false, but even if they were true do not imply that one should apply the spell-approach. Instead, one should account explicitly for liquidity constraints as is done in the EAEI method.

5. Concluding remarks

As an alternative to the conventional methods for measuring chronic poverty, this paper proposes to use an interpersonal comparable measure of permanent income as a basis for defining and measuring chronic poverty. The introduced measure of permanent income is compatible with a general preference structure of intertemporal consumer behaviour and moreover can be considered as a money-metric measure of the well-being level associated with the income stream for a given individual. Acknowledging that not only incomes but also the opportunities to smooth consumption by borrowing may vary across individuals, the proposed method is flexible enough to allow for individual-specific interest rates on borrowing and saving as well as for presence of liquidity constraints. Although this paper has focused on the definition and measurement of chronic poverty, the results generalises to any distributional assessments where the income measure is required to be invariant with respect to scale transformations, such as in the standard measurement of income inequality.

6. References

Aaberge, R, A. Andersen, and T. Wennemo (2000): "Extent, Level and Distribution of Low Income in Norway, 1979-1995", in B. Gustafsson and P. Pedersen (eds.): *Poverty and Low Income in the Nordic Countries*, Aldershot, U.K.; Brookfield, Vt. and Sydney: Ashgate.

Blinder, A. and A. Deaton (1985): "Consumption: Beyond Certainty Equivalence", *American Economic Review*, 78, pp. XX.

Browning, M. and T. Crossley (1999): "Shocks, Stocks and Socks: Consumption Smoothing and the Replacement of Durables during an Unemployment Spell", Working Paper in Economics and Econometrics, No. 376, Australian National University.

Browning, M. and T. Crossley (2001): "The Life-Cycle Model of Consumption and Saving", *Journal of Economic Perspectives*, Vol. 15, No.3, Summer.

Bane, M. and D. Ellwood (1986): "Slipping Into and Out of Poverty: The Dynamics of Spells", *Journal of Human Resources*, Vol. 21, No. 1, pp. 2-23.

Borsch-Supan, A. (2003): *Life-cycle Savings and Public Policy: A Cross-National Study of Six Countries*, Academic Press, San Diego.

Cappellari, L. and S. P. Jenkins (2004): "Modelling Low Income Transitions", *Journal of Applied Econometrics*, 19.

Coe, R. (1978): "Dependency and Poverty in the Short and Long Run", in G. Duncan and J. Morgan (eds.): *Five Thousand American Families: Patterns of Economic Progress*, Vol. 6, Ann Arbor, Michigan, Institute for Social Research.

Cutler, D. and L. Katz, (1992): "Rising Inequality?", *American Economic Review*, 82(2):546-551.

Davies, J. and A. Shorrocks (2000): "The Distribution of Wealth" in A. Atkinson and F. Bourguignon (eds.) in *Handbook of Income Literature*, Volume 1, North-Holland, Amsterdam.

Duncan, G., R. Coe, and M. Hill (1984): "The Dynamics of Poverty", in G. Duncan, R. Coe, M. Corcoran, M. Hill, S. Hoffman (eds.): *Years of Poverty, Years of Plenty*, and J. Morgan, Ann Arbor, Michigan, Institute of Social Research.

Duncan, G. and W. Rodgers (1991): "Has Children's Poverty Become More Persistent", *American Sociological Review*, Vol. 56, No. 4, pp. 538-550.

Duncan. G., B. Gustafsson, R. Hauser, G. Schmaus, S. Jenkins, H. Messinger, R. Muffels, B. Nolan, J. Ray, and W. Voges (1995) "Poverty and Social-Assistance Dynamics in the United States, Canada, and Europe" in K. McFate, R. Lawson, and W. Wilson (eds.) *Poverty, Inequality and the Future of Social Policy: Western States in the New Social Order*, Russell Sage Foundation, New York.

Expert Group on Household Income Statistics (2001): *Final Report and Recommendations*, Ottawa, Canada.

Flavin, M. (1981): "The Adjustment of Consumption to Changing Expectations about Future Income", *Journal of Political Economy*, 89, pp. XX.

Fjærli, E. and R. Aaberge (2000): "Tax Reforms, Dividend Policy and Trends in Income Inequality: Empirical Evidence based on Norwegian Data", Discussion Paper, No. 284, Statistics Norway.

Frederick, G. Loewenstein, and T. O'Donoghue (2002): "Time Discounting and Time Preference: A Critical Review", *Journal of Economic Literature,* Vol. XL, June, pp. 351-401.

Friedman, M. (1957): *A Theory of Consumption Functions*, Princeton, Princeton Univ. Press.

Gruber, J and S. Dynarski (1997): “Can Families Smooth Variable Earnings?”, *Brooking Papers on Economic Activity*, 1, pp. 229-284.

Hayashi (1987): “Test for Liquidity Constraints: A Critical Survey and some New Observations”, in T. Bewley (ed.) *Advances in Econometrics: Fifth World Congress*, Vol. 2, 91-120.

Hill, M. (1981): "Some Dynamic Aspects of Poverty", in G. Duncan and J. Morgan (eds.): *Five Thousand American Families: Patterns of Economic Progress*, Vol. 6, Ann Arbor Michigan, Institute for Social Research.

Hill, M. and S. Jenkins (2001): “Poverty among British Children: Chronic or Transitory?”, in B. Bradbury, S. Jenkins, and J. Micklewright (eds.) *The Dynamics of Child Poverty in Industrialised Countries*, Cambridge University Press, Cambridge.

Johnson D. and S. Shipp (1997): “Trends in Inequality in the United States using Consumption Expenditures: 1960-1993”, *Review of Income and Wealth*, Vol. 43, No. 2, pp. 131-152.

Kahneman, D., P. Wakker, and R. Sarin (1997): “Back to Bentham? Explorations of Experienced Utility”, *Quarterly Journal of Economics*, Vol. 112, pp. 375-405.

Koopmans, T. (1960): “Stationary Ordinal Utility and Impatience”, *Econometrica*, Vol. 32, pp. 82-100.

Lancaster T. (1989); *The Econometric Analysis of Transition Data*, Cambridge University Press, Cambridge.

Levy, F. (1977): "How Big is the American Underclass", Working Paper, 0090-1, Washington D.C., Urban Institute.

Mayer, S. and C. Jencks (1989): “Poverty and the Distribution of Materiel Hardship", *Journal of Human Resources*, Vol. 24, No. 1, pp. 88-115.

Murdoch, J. (1995): “Income Smoothing and Consumption Smoothing”, *Journal of Economic Perspectives*, Vol. 9, No. 3, pp. 103-114.

OECD (2001): “When Money is Tight: Poverty Dynamics in OECD Countries”, Chapter 2 in *OECD Employment Outlook 2001*, OECD, Paris.

Rainwater, L. (1981): "Persistent and Transitory Poverty: A New Look", Working Paper, No. 70, Joint Center for Urban Studies of the MIT and Harvard University, Cambridge: MIT, Harvard.

Rodgers, J. L. and J. R. Rodgers (1993): "Chronic Poverty in the Unites States", *Journal of Human Resources*, Vol. 28, No. 1, pp. 25-54.

Slesnick, D. (1993) “Gaining Ground: Poverty in the Postwar United States”, *Journal of Political Economy*, Vol. 101, No. 1, February, pp. 1-38, 1993.

Stevens, A. (1994): "The Dynamics of Poverty Spells: Updating Bane and Ellwood", *American Economic Review*, Vol. 84, No. 2, pp. 34-37.

Stevens, A. (1999): "Climbing Out of Poverty, Falling Back In", *Journal of Human Resources*, 34, pp. 557-588.

Stiglitz and Weiss (1981): “Credit Rationing in Markets with Imperfect Information”, *American Economic Review*, 71, 393-410.

Valletta, R. (2006): “The Ins and Outs of Poverty in Advanced Economies: Government Policy and Poverty Dynamics in Canada, Germany, Great Britain, and the United States”, *Review of Income and Wealth, Vol. 52*, No. 2, pp 261-284.