

# Another Bias in Quantitative Assessments of Intergenerational Mobility<sup>1</sup>

Seán Mfundza Muller  
School of Economics, University of Cape Town

June, 2007

<sup>1</sup>Thanks to Martin Wittenberg for helpful comments and suggestions. This work was conducted with financial support from the National Research Foundation, the University of Cape Town and the Public Policy Partnership (SA). The usual caveats apply.

# 1 Introduction

Income mobility, in addition to living standards and inequality, is recognised as a key consideration when making an assessment of a given society's economic merits. The intergenerational correlation (IGC) in the incomes of parents and their children provides a summary statistic of mobility, where low income correlations reflect high mobility, whilst high correlations reflect low mobility. As such it is the primary measure of this variable. What it fails to capture is the differences in mobility at different parts of the income distribution; that is best analysed using mobility matrices.<sup>1</sup>

The main literature on the calculation of the IGC has been premised on the notion that 'permanent income' is the key variable in the structural equation. In other words, to the extent that the factors relating parents' income status to their children's can be captured using income correlations, this can be achieved solely through *permanent* income.<sup>2</sup> This appears to have been the premise since the first calculations of this measure were made - see for instance (Bowles, 1972) - but has been especially prominent since the realisation that many earlier estimates of income correlations (in the United States) appear to have been biased downward by the attenuation bias that is the outcome of classical measurement error (CEV).<sup>3</sup> This led various authors - most notably Becker (1988) - to conclude that the United States was a society characterised by a high level of social mobility. Subsequently, a number of studies have shown that using multi-year averages of parental income dramatically increases the calculated regression coefficients and hence the correlation coefficient. In addition, it appears that this effect increases with the number of years used, to the extent that with up to sixteen years the correlation approaches 0.6 (Mazumder, 2005b) as compared to about 0.4 with four years, (Solon, 1992) and (Zimmerman, 1992), and 0.2 with one year (Behrman and Taubman, 1985).<sup>4</sup>

More recently the literature has moved-on in two directions: assessing the dynamics of mobility based on the IGC; and attempting to break the IGC into its constituent parts.<sup>5</sup> In other words, asking how mobility has changed over time, and what factors underlie the intergenerational persistence in income/earnings. Whilst these are important issues - the latter being particularly critical for policy purposes - in this paper we initially return to the original problem of estimating the magnitude of the intergenerational correlation coefficient. Our fundamental proposition is that it is not merely 'permanent income' that impacts on a child's future income but also transitory income.

---

<sup>1</sup>Mobility matrices have their own limitations of course, see Behrman (1999) for an accessible discussion on the subject.

<sup>2</sup>Notice that there is presently no use of causal notions here, or suggestion that the relevant factors are wholly captured by income (permanent or otherwise). See the caveats later in this Introduction and the discussion in section 4.

<sup>3</sup>We prefer the word 'realisation' to 'discovery' in this context because in fact the issue of measurement error appears to have been appreciated from the outset. Becker and Tomes (1986) note that a number of authors had by that time used multi-year averages to address this concern. That their estimates were still very low is perhaps indicative of the additional attenuation bias due to relatively homogenous samples (see the brief discussions in (Solon, 1989) and (Solon, 1992)). In fact, Bowles (1972) appears to have been the first to recognise the problem.

<sup>4</sup>Solon and Zimmerman use different datasets but reach similar estimates: the former uses the University of Michigan's Panel Study of Income Dynamics (PSID) dataset, whilst the latter uses the National Longitudinal Survey (NLS)

<sup>5</sup>See d'Addio (2007) for an excellent survey of the literature on estimates of intergenerational mobility.

In addition, we suggest that transitory income may matter to different degrees depending on the age of the child in the corresponding year. In econometric terms, the first implication of these propositions is that the variables being used to proxy for permanent income may actually belong in the main regression (structural equation). In addition, assuming these to be of equal importance - either as proxies, or even as independent covariates - may itself introduce a bias into the calculation of the IGC. Neither of these possibilities appear to have been formally accounted for in the literature to date.

## Some Caveats in the Interpretation of the IGC

Before proceeding, we should state some important caveats regarding the interpretation of the intergenerational correlation in income.

**IGE versus IGC** First, for exposition purposes we shall, for the rest of this paper, treat the IGE (intergenerational *elasticity*) and the IGC as equivalent.<sup>6</sup> In fact, this is only the case if the variance in the (explanatory) parental income variable is equivalent to that in the (dependent) children's income variable as shown below. If children's log income is represented by  $y_c$ , parents' log income by  $y_p$ , and  $IGE = \beta_y$ ,  $IGC = \rho_y$ , then we have:

$$\rho_y = \beta_y \frac{\sigma_{y_p}}{\sigma_{y_c}}$$

So as (Bowles and Gintis, 2002: 6) note, "In effect, the intergenerational correlation coefficient  $\rho$  is affected by changes in the distribution of income while the intergenerational elasticity is not".

**Causality** A second caveat is that one should not necessarily infer the extent of a causal relation from the value of the IGC. Whilst this paper challenges the assertion that there is *no* causal relation between parental income and children's economic outcomes, it is inevitable that the true IGC overstates any causal relation that does exist because of the correlation between parental income and other explanatory variables in the structural equation for children's economic success. Thus whilst the IGC remains a valid and relevant measure of (im)mobility, the details of what determines that (im)mobility need to be the subject of further enquiry.

**Optimality** Given that a low IGC implies high social mobility - and therefore potentially lower dynastic inequality - it might seem an obvious step to suggest that the lowest possible IGC is best by some egalitarian standard. However, as a number of authors have pointed out, higher mobility is not necessarily desirable.<sup>7</sup> The idea that immobility is bad is largely a function of the belief in the importance of equal opportunity: it seems unfair that some children should earn more than others simply because they were lucky enough to be born to rich parents. And yet, there are few people today who would argue that the inheritance of attractiveness or intergenerational transmission of traits associated with hard work are unfair and should be done away with. Thus

<sup>6</sup>This is a fairly common assumption even in the empirical literature, see Solon (1992) and Mazumder (2005b).

<sup>7</sup>In fact there are a number of reasons why one would not want to reach the extreme of complete mobility represented by an IGC of zero. For instance, Harding et al. (2005) suggest that there are at least three reasons - genes, assortative mating, and 'cultural ideals and preferences' - why we would still calculate a non-zero IGC even if full equality of opportunity prevailed. For more detailed discussions of the philosophical issues around mobility and equal opportunity, see Roemer (2000) and Swift (2005).

the inferences we make about the desirability of a given society based on its IGC are fundamentally reliant on the factors underlying that correlation - which is why this is such a major concern in the recent literature.

**Life-Cycle Bias** A final caveat relates to a possible bias in the calculation of the IGC resulting from the fact that income for parents and their children are often taken at different stages of the life-cycle; the nature of panel datasets is such that children's income is often from the beginning of their careers whereas parents' is observed somewhat later. The standard way of dealing with this problem in empirical work is to first regress the variables on an age and age-squared variable, and use the residuals from these regressions in calculating the intergenerational correlation. Jenkins (1987), however, casts doubt on the merits of this approach. From the perspective taken in this paper we will not assume that our variables have been residualised in this way. The reason is that it is not clear that we necessarily would want to strip-out age variation in income, since this can in some sense be characterised as 'transitory' and the fundamental hypothesis of this paper is that transitory income may have independent explanatory power.

The remainder of the paper proceeds as follows. In Section 2 we discuss the conceptual basis for the proposal that transitory income is of independent importance for children's outcomes. In Section 3 we outline the standard econometric approach to calculating the IGC that has been used in the literature to date, including the estimation issues that have arisen within the bounds of this model. In Section 4, which is the core of this paper, we propose an alternative structural model that includes parental transitory income as an explanatory factor in the equation for children's permanent income. The consequences for the interpretation of past IGC estimates are then demonstrated, and we briefly discuss some possible solutions to the problems with past approaches. Section 5 assesses various estimation options using Monte Carlo simulations, and gives an indication of the extent of the bias in the IGC for different values of the parameters in the alternative model. Section 6 considers some important extensions of these arguments, and examines their implications for public policy based on intergenerational mobility studies. Section 7 concludes.

## 2 The Problem with *Ex Ante* Black-Boxing of Transmission Mechanisms

The neglect of the above-mentioned issues in the literature appears to stem from the view that permanent income is the variable with which we should be exclusively concerned when assessing income persistence. This need not be a problematic assertion per se, but the concept itself is typically not interrogated to any significant degree. In the context of the transmission of material well-being, one needs to ask what the envisioned role of parental income is. Most studies black-box this issue on the grounds that the authors are not interested in the details of the channels of transmission but rather the gross effect.<sup>8</sup> The problem, however, is that if we give insignificant attention to possible causal channels the structural model upon which we base our estimation of the gross effect may be flawed.

To see how this approach can result in incorrect econometric logic consider two hypothetical extreme cases. In the first, we have a society in which all children are to be sent to state boarding schools established in all major towns from the age of 6 until at least the age of 15. The state covers all costs, but parents can choose to have their children return home (i.e. leave school) after the child has completed nine years of schooling. In the second, the society in question is a very poor one, with malnutrition and disease being common problems particularly amongst infants and young children.

In the first example it seems perfectly reasonable to expect that parental income around the period at which the child finishes their ninth year of schooling (and possibly around the time at which the child turns six years old - depending on the extent of enforcement) will exert a greater effect on the child's future income, because of the returns to further education, than that of other periods. This admittedly relies on the non-existence of perfect credit markets, but not on existing credit markets being especially imperfect.<sup>9</sup> Retaining this assumption, in the second example it is again plausible to expect that parental income in the first five years of childhood will have a greater impact on the child's future income than income in other years. This could work (negatively) through children's ability (proxied by IQ) and health, as the most obvious channels.

These examples demonstrate our two key points, that: 1. Transitory income could well be important for child outcomes and hence also their incomes 2. The importance of transitory income may vary by the stage of childhood.

---

<sup>8</sup>Sometimes this is expressed explicitly when explaining the reason for not including explanatory variables other than income. (Mazumder, 2005b: 237) for instance states that: "Other covariates are generally not included (in the regression equation), because the goal is to obtain a summary measure of all factors related to income that are transmitted over generations. Therefore  $\rho$  should not be given a causal interpretation."

<sup>9</sup>The assumption of non-perfect credit markets should not be controversial given that it is in some sense implicit in claims that 'measurement error' is a problem. Later in this paper we make use of the empirical output of longitudinal studies that decompose the variance in income into a permanent component, and transitory white noise and serially correlated components. Although some of the the transitory variance may be attributable to measurement error from data capture it seems unlikely to all be of this sort. Mazumder (2001, 2003) attributes the variance from the white noise component to this, but does not provide his basis for doing so.

Note that in the above we are assuming that the interest in analysing income correlations is a general one i.e. not confined to particular societal contexts or levels of development. The broader intuition can nevertheless be translated into more familiar contexts: replace the decision to stay in school with the decision to enter tertiary education; and replace early childhood malnourishment and disease with non-participation in preschool, and the relevance of the argument to estimates based on developed country datasets becomes more apparent. In the case of education, Cameron and Heckman (2001) in fact suggest that based on their analysis of US data, family income matters primarily for education decisions prior to college enrolment.<sup>10</sup>

## PERMANENT INCOME

Given that the analysis that follows hinges on the above arguments, it is worthwhile considering the notion of permanent income in a little more detail. Essentially the proposition, made by Friedman (1957), is that investment and savings behaviour will be premised on long-term income or expectations thereof rather than year-by-year variations. Consumption and expenditure are also expected to be smoothed over a multi-year period, possibly an entire lifetime. And indeed we assume that in the presence of perfect credit or capital markets (and perfect foresight) this will be the case.

If however these assumptions of perfect markets do not hold, then using one year's income will imperfectly measure 'permanent' income - provided annual (realised) income varies to some degree over an individual's lifetime - and hence the associated investment, savings and consumption decisions. To the extent that parental income affects children's income via any of these channels, and in the absence of controlling for factors such as parental ability, using one year of parental income to calculate intergenerational income correlations is obviously problematic.

A major problem with the notion of permanent income in its original form is that it is notoriously difficult to pin-down empirically. One way around this might be to suggest as Mazumder (2003) does - that permanent income and average lifetime income are equivalents, allowing us to use the latter as our 'ideal'/preferred explanatory variable. There are two reasons to be sceptical of such a formulation. First, actual income is merely a realisation of some underlying, possibly transmissible, earning potential. Since it is this potential that we in fact want to capture, it is more plausible to view actual income as imperfectly proxying for this fundamental, but inherently unobservable, variable. Second, individuals' income expectations are likely to be over limited horizons. So in fact permanent income is not likely to be constant either! Friedman himself actually makes both these points.<sup>11</sup>

<sup>10</sup>Cameron and Heckman study the effect of family income on children's education and find that "(the) evidence suggests that it is family income at earlier ages and not later ones that matters in explaining college attendance" (Cameron and Heckman, 2001: 488).

<sup>11</sup>"It is tempting to interpret the permanent components as corresponding to average lifetime values and the transitory components as the difference between such lifetime values and the measured values in a specific time period. It would, however, be a serious mistake to accept such an interpretation for two reasons... the experience of one unit is itself but a small sample from a more extensive hypothetical universe, so there is no reason to assume that transitory components average out to zero over the unit's lifetime... more important, it seems neither necessary nor desirable to decide in advance the precise meaning to be attached to 'permanent'. The distinction between permanent and transitory is intended to interpret actual behaviour." (Friedman, 1957: 23).

For the purpose of exposition, let us briefly maintain the assumption that lifetime income is our variable of interest. If that were the case and we had data on parents' incomes over their entire lives, simply taking the average of these would yield the appropriate independent variable. Implicitly then we have included all years of parental income in the regression. But what if the different years of parental income are of differing importance as suggested in the motivation above? Then our constructed regressor will be an imperfect measure of the actual independent variable which should be an *appropriately weighted* average of the respective years in which one would expect that the years of income most proximate to the child's period of dependence are more heavily weighted.

In the rest of this paper we will define permanent income as simply the permanent component of income over time. That this fails to capture the full weight of Friedman's concept need not be a major problem for us for two reasons: First, our definition does not serve to exclude the other, transitory, components of income from our analysis since these are key to the primary hypothesis of this paper.<sup>12</sup> Second, as Friedman notes, the notion is primarily intended to explain actual behaviour - provided the conceptualisation achieves this it has served its purpose. Section 4 of this paper outlines a model which we suggest covers a sufficiently broad range of possibilities that it is likely to satisfy this criterion.

One should also note that under the permanent income hypothesis different goods are likely to be associated with different conceptions of permanent income. The 'income horizon' that influences food consumption is likely shorter than that which influences the consumption of durables: "there seems no reason why the horizon should be the same for all individual categories of consumption and some reasons why it should differ systematically. For example, it seems highly plausible that housing expenditures are planned in terms of a longer horizon, and so a different concept of permanent income, than expenditures on, say, food." (Friedman, 1957: 207-208). This is particularly important for the proposals in this paper. Analyses of the time-series properties of individual's income only identify one 'permanent component' which one might view as in fact being the permanent component associated with the longest horizon length. In a developed country like the United States where virtually the whole population is above a basic level of nutrition - whether through their incomes or state support via food vouchers - we would not expect transitory income to affect children's development to a *great* degree via any differences it might make to food consumption. However, in a poor country this may be a primary channel of transmission. We shall return to this issue, but note that in general we might expect that consideration of transitory incomes in estimating persistence will increase the IGC by more in poor countries than richer ones. This is because fluctuations will influence the consumption of goods with shorter horizons at a level at which they continue to have impact on children's outcomes, and this effect will be further reinforced by the relative absence of credit markets.<sup>13</sup>

---

<sup>12</sup>This may however be an important problem for other analyses of persistence which attempt to utilise only the permanent components of income (assumed equivalent to permanent income itself).

<sup>13</sup>Although there has been important progress in the provision of credit to the poor (particularly the rural poor) in some countries, recognised for instance by the awarding of the 2006 Nobel Peace Prize to Muhammad Yunus the founder of Grameen Bank, this remains the exception rather than the norm.

### 3 The Standard Model

The main structural model used in the IGC literature to date is one which assumes children's permanent income to be a function of parents' permanent income and some random noise.<sup>14</sup> The *annual* income of both parents and children is assumed to be a function of their respective permanent incomes and other, transitory, factors. These assumptions are represented in the following equations.

$$y_{0is} = y_{0i} + w_{0is} + v_{0is} \quad (1)$$

$$y_{1it} = y_{1i} + w_{1it} + v_{1it} \quad (2)$$

$$y_{1i} = \rho y_{0i} + \varepsilon \quad (3)$$

Where  $y_{0is}$  represents parental income in year  $s$  and  $y_{1it}$  represents the child's income in year  $t$ . Following Mazumder (2003) these are each expressed as functions of a permanent component ( $y_{0i}$  and  $y_{1i}$ ), transitory component ( $w_{0is}$  and  $w_{1it}$ ) and a white-noise component ( $v_{0is}$  and  $v_{1it}$ ) respectively.<sup>15</sup>

Within the bounds of this structural model, two problems were identified (see Solon, 1989): bias due to homogenous samples, and that due to measurement error. The former has been neglected in the more recent literature because of the increased availability of nationally representative datasets, but it is important in as much as it serves to explain why earlier estimates that corrected for the problem of measurement error by using averaged parental income still calculated correlations much lower than subsequent estimates. We will, however, not discuss this bias any further in this paper. It is the problem created by the transitory factors in the latter two equations that have been the concern of more recent attempts at estimating the true IGC. In particular, it is well known that in this type of case one can show that a calculation based on one measure (year) of the explanatory variable (parental income) will be subject to attenuation bias and hence be lower than the true value. In (4)  $\lambda_T$  is the attenuation factor, with  $0 < \lambda_T < 1$ . The problem can be mitigated however by averaging over  $T$  such measures (years), as shown below.

$$plim \hat{p} = \rho \lambda_T \quad (4)$$

Where

$$\lambda_T = \frac{\sigma_{Y_0}^2}{\sigma_{Y_0}^2 + (1/T)\alpha\sigma_{W_0}^2 + (1/T)\sigma_{V_0}^2}$$

Based on our assumptions above,  $\alpha = 1$ . The reason is that we have assumed that transitory factors (whatever their cause) exhibit no trends but merely constitute an additional source of variance. A more plausible assumption - following Solon (1992),

<sup>14</sup>Previous studies have typically focused on *father's* income rather than parental income as a whole, due in large part to the empirical complications of using mother's income. However, since this paper is not an empirical one, and family income is arguably a more relevant measure - particularly if one believes that there is a causal influence of income on children's outcomes - we assume that the independent variable represents family income.

<sup>15</sup>In fact, Mazumder discards the white-noise component in a later paper (Mazumder, 2005b) as it doesn't add much to his main results. It may however be rather important for the concerns of this paper, and hence we retain it.

Zimmerman (1992) and Mazumder (2005b) - is that there is serial correlation in the transitory component of income:

$$w_{0is} = \delta w_{0is-1} + \xi_{0is} \quad (5)$$

If this is the case, then  $\alpha$  in our attenuation factor  $\lambda$  can now be expressed as:

$$\alpha = \left\{ 1 + 2\delta \left( \frac{T - \delta T - 1 + \delta^T}{T(1 - \delta)^2} \right) \right\}$$

Whilst it is true in both cases that increasing the number of years in the average will decrease the bias, in the latter case the correlation between the transitory components serves to exacerbate the bias. This can be easily seen by noting that  $\alpha > 1, \forall \delta > 0$ . Mazumder's innovation is to note the implications of this result for the extent of attenuation remaining after taking four- or five-year averages as Solon (1992) and Zimmerman (1992) did. By taking averages over much longer periods (Mazumder, 2005b), and using a new technique to account for this possibility (Mazumder, 2003), he argues that the correlation coefficient in the United States is around 0.6, rather than the previous estimates of 0.4.

From the above it should be clear that in the literature to date on calculating IGC's in income, transitory components have been seen as mere nuisance terms - obscuring the true relation between the incomes of children and that of their parents. Below we question this assumption, and examine the implications of children's income being a function of the permanent *and* transitory components of their parents' income.

## 4 Implications of an Alternative View

As noted in the previous discussion of permanent income, the idea of transitory income affecting child outcomes and hence their income is quite plausible. What it does require is an acceptance of a causal link between parental resources and child outcomes. The model above implicitly assumes no correlation between the transitory and permanent components. The latter will capture the impact of such constant factors as parental education, traits, genetic attributes, etc. and hence if transitory income is to have any effect it must be via a direct, causal effect on children's outcomes. Those unfamiliar with this particular literature might be surprised to discover that this possibility is not widely accepted. Shea (2000) for instance finds that parental income has a *negative* effect on children's incomes once other factors are controlled for. And Mayer (1998) concludes her investigation into what parents' money can buy for their children's futures by stating that "although children's opportunities are unequal, income inequality is not the primary reason"(Mayer, 1998: 156).<sup>16</sup>

There are at least two authors though (see Mazumder, 2005b; Hertz, 2005) who have discussed this possibility. (Hertz, 2005: 10-11) states that he prefers "the residency criterion to the biological criterion", and therefore uses averages of parental income earned during childhood (or at least when the child was resident in the household) rather than from other periods. Mazumder does not explicitly do this in his estimations, although given the breadth of his averaging he probably includes most childhood income. However, he does have a fairly detailed discussion (2005b: 251-253) on the possible import of borrowing constraints. Note that such constraints imply an inability to fully smooth the usage of income over the lifecycle, and hence can be captured as a *deviation* from permanent income.

The problem with both these papers is that their discussions are strictly speaking disallowed by their structural models; characterised by equations (1) - (3), which only allow for a relation between children's permanent income and their parents' *permanent* income. The result is a lacuna between work of the kind done by Cameron and Heckman (2001) and that of Mazumder, Solon and others. Even worse, as we will argue in Section 6, it results in potentially serious flaws in the conclusions drawn from disaggregating the intergenerational correlation. To discuss the salience of transitory income in a rigorous fashion requires that we allow for the possibility in our structural models.

### 4.1 An Alternative Model

The necessary modification to the basic model above is shown in (6). The second term allows children's permanent income ( $y_{1i}$ ) to be a function of deviations from parents' permanent income ( $z_{0iq}$ ).

$$y_{1i} = \rho y_{0i} + \sum_q \beta_q(z_{0iq}) + \varepsilon \quad (6)$$

---

<sup>16</sup>A remarkable aspect of Shea's paper is that he does not seek to justify the highly counterintuitive finding of negative, rather than merely insignificant or very small, coefficients on parental income. However, his instrumentation strategy is - as noted by Solon (1999) - not wholly convincing.

$$\begin{aligned} \text{Where } z_{0iq} &= y_{0iq} - y_{0i} = (w_{0iq} + v_{0iq}) \\ \text{and } q &\in Q, s \in S, Q \subset S \end{aligned}$$

Two things are noteworthy here. First,  $q$  indexes years of *childhood*. We will assume henceforth that there are twenty-one such years, including the year preceding the child's birth.<sup>17</sup> Second, the coefficient on these years - represented by  $\beta$  - is allowed to vary by year of childhood. In other words, transitory income may have a different impact depending on what stage of childhood it is experienced in. (This is something we will return to in section 6.)

Under this model we continue to have the problem of correctly estimating the impact of unobservable permanent income, but in addition we now need to estimate the independent impact of the transitory components as well. It seems appropriate to first investigate the implications of our model for the estimations carried-out in previous studies, and on the basis of this we will then suggest some alternative approaches.

## 4.2 Estimation of IGC Using One Year of Parental Income

As noted in the introductory discussion, many earlier estimates of the IGC were based on regressions using a single year of parental income. One might wonder what the probability limits on these coefficients would be under our alternative model. In particular, we are concerned with the extent to which these estimates would pick-up the impact of transitory income if it exists.

An important point to make at this stage is that for any estimations conducted in the context of the alternative model proposed above it is necessary to be explicit about whether the parental income used is from *within* childhood, or *outside* it; where we have assumed 'childhood' to include the year in which the child is *in utero* until they are twenty years of age (though see footnote 17).

### 4.2.1 Income earned outside of childhood

If the single year of income is taken from a period outside of childhood we can characterise the probability limit of the coefficient as follows:

$$plim \hat{B}^* = \frac{\rho\sigma_{Y_0}^2 + \sigma_{W_0}^2 \sum_q \beta_q \delta^{|q-k|}}{\sigma_{Y_0}^2 + \sigma_{W_0}^2 + \sigma_{V_0}^2} \quad (7)$$

Note that we use  $k$  to index the year(s) used in the estimation.

The denominator in the expression above is the same as that in (4) - with the appropriate expression for  $\alpha$  (here,  $\alpha = 1$ ) - but the numerator now has a second term. It represents the sum of the coefficients on transitory income for each year of childhood, each weighted by a value ( $\delta^{|q-k|}$ ) which is a function of the correlation in the transitory component  $w_0$  (i.e.  $\delta$ ), and the proximity of that particular year to the year used in the

<sup>17</sup>The issue of which years are salient is in fact an empirical question. Although the lower bound cannot be extended further, one may argue that there are good reasons for the upper bound to be extended - such as the possible importance of parental income in assisting job search, or keeping children in tertiary education, amongst others.

estimation. Notice that this is dependent on the assumption that  $\delta \neq 0$ . If there was no serial correlation in transitory income the plim would be identical to (4) with  $\alpha = 1$ , so using a year outside childhood would pick-up *none* of the impact of transitory income. The result is that in this model higher autocorrelation can actually play a positive role of sorts with respect to capturing the importance of the transitory component.<sup>18</sup>

#### 4.2.2 Income earned inside childhood

Assuming that we do have access to childhood income, using any one year of it in our regression will produce an estimate with the following probability limit:

$$plim \hat{B}^* = \frac{\rho\sigma_{Y_0}^2 + \sigma_{W_0}^2 \sum_q \beta_q \delta^{|q-k|} + \beta_k \sigma_{V_0}^2}{\sigma_{Y_0}^2 + \sigma_{W_0}^2 + \sigma_{V_0}^2} \quad (8)$$

Using childhood income means that the impact of the white noise term  $v_0$  for the particular year used becomes part of the calculated coefficient. Note in addition that the ‘k’ in this case will be different from the ‘k’ in (7) - it will be closer to childhood income and (based on our assumption of equal importance for those years) the second term in (8) will be larger than the equivalent term in (7). To give an idea of the relative importance of the various components of income, Mazumder (2003) suggests the following values (based on a number of studies of longitudinal income data):  $\frac{\sigma_{W_0}^2}{\sigma_{Y_{0t}}^2} = 0.3$ ,  $\frac{\sigma_{V_0}^2}{\sigma_{Y_{0t}}^2} = 0.2$  and  $\frac{\sigma_{Y_0}^2}{\sigma_{Y_{0t}}^2} = 0.5$ .

The difference between (7) and (8) implies a testable prediction of our alternative model: estimates of the intergenerational correlation based on within-childhood income should be *higher* than those using non-childhood income. At least one paper in the literature has made such a comparison (Behrman and Taubman, 1990), ostensibly to test for credit market constraints, and found that mobility was generally lower (that is, the IGC was higher) when estimated using childhood income - as predicted by our model.

Two recommendations follow from this for empirical work using single-year estimation procedures: 1. Ideally use income earned during childhood, 2. If this is not feasible at least try to use a year that is as close to childhood as possible. The extent to which the calculated coefficient picks-up the impact of transitory income will depend on its distance in years from the childhood ones, and the size of  $\delta$ .

### 4.3 Estimation of IGC Using Multi-Year Averages of Parental Income

As a result of the increased awareness of the attenuation bias problem few authors now use only a single year of parental income to estimate the IGC. Rather the preferred method is to use an average of parental income over as many years as is feasible.<sup>19</sup> In this section we characterise the probability limit of the coefficient in the seemingly

<sup>18</sup>Though once one takes averages the attenuation effect enters this model as it did in the standard one - see section 4.3, equation (9).

<sup>19</sup>Note that in many cases it may not be desirable to use the maximum number of years available because of the reduction this causes in sample size

ideal case where we have data on all years of childhood income and we use an average of these as our explanatory variable. In actual fact, the plim for the coefficient on multi-year averages varies depending on the nature of the overlap between the years used and the years of childhood. However, in the same vein as the results above for single year measures, the coefficient will be highest where we use the maximum amount of childhood income data and so we restrict ourselves to this case for the purpose of exposition.<sup>20</sup>

If we estimate the IGC using an average of all childhood income, the probability limit of the coefficient can be expressed as follows:<sup>21</sup>

$$plim \hat{B}^* = \left( \frac{\rho \sigma_{Y_0}^2 + (1/T) \sigma_{W_0}^2 \sum_q \beta_q \Lambda_q + (1/T) \sum_q \beta_q \sigma_{V_0}^2}{\sigma_{Y_0}^2 + (1/T) \alpha \sigma_{W_0}^2 + (1/T) \sigma_{V_0}^2} \right) \quad (9)$$

Where

$$\Lambda_q = \left( \frac{1 + \delta - \delta^{|q-r|+1} - \delta^{|q-m|+1}}{1 - \delta} \right)$$

and as before,

$$\alpha = \left\{ 1 + 2\delta \left( \frac{T - \delta T - 1 + \delta^T}{T(1 - \delta)^2} \right) \right\}$$

It is not easy to see what this expression implies for the estimated intergenerational correlation coefficient relative to its true value. In the next section we use Monte Carlo simulations to show that in fact, given the assumptions of the model, even the coefficient on a full average of childhood income is bounded above by the true coefficient on the *permanent* component and thus continues to underestimate the true IGC by an amount equivalent to the importance of transitory income ( $\sum_q \beta_q$ ).

#### 4.4 The Wittenberg-Lubotsky (WL) Estimator

Another method for estimating the IGC is that proposed by Lubotsky and Wittenberg (2006). They propose a new method of utilising multiple proxy variables, which involves weighting the coefficients of the various proxies derived from a simple OLS regression in which they are the explanatory variables for the dependent variable of interest. The optimality of this approach is demonstrated under particular conditions, one of which is that the proxies do not belong in the structural equation.<sup>22</sup> Of the two applications of this technique in their paper, one is the calculation of the effect of family income on children's reading comprehension scores. The objective of using the WL estimator in this instance is to reduce the noise in the independent variable - which in the structural model is permanent family income - in such a way that accounts for the variation in this noise (i.e. relative magnitude of the variance due to transitory factors) in earnings over the life-cycle, and which is therefore optimal.<sup>23</sup> The parameter is

<sup>20</sup>Let  $K$  and  $Q$  represent the sets indexing the years used in the average, and the years of childhood respectively. Then there are seven possible types of overlap that are relevant for the calculations. The first three are where  $K \subset Q$ ,  $K \supset Q$ , or  $K = Q$ . The other four are for the case where  $K \cap Q = 0$ , and  $K \cap Q \neq 0$ . The expression in (9) in fact cover cases 2 and 3.

<sup>21</sup>The details of this calculation, and earlier ones, are available from the author on request.

<sup>22</sup>See Lubotsky and Wittenberg (2006) for the full technical details

<sup>23</sup>The premise being that the earnings in earlier years are a more noisy measure of permanent income than later ones; an assumption widely accepted within the literature.

estimated using a three-step procedure: 1. Regress test scores separately on each individual year of family income, and calculate a set of weights for each measure (proxy) by dividing each estimated coefficient by the largest such value estimated. 2. Run a multiple regression of test scores on all the proxies entered separately 3. Weight the multiple regression coefficient for each proxy by the weight calculated for it in stage 1, sum over all proxies and divide by the average of the weights.

Using this method the authors find a substantially higher coefficient: “Using family income when the mother is 22 to 39, the effect from using the optimally weighted coefficients is 2.2, compared to only 1.6 when income is averaged prior to the regression, an increase of 31%.” (Lubotsky and Wittenberg, 2006: 558). Since the measurement error problem here is identical to the one we would face if we were trying to calculate the IGC (in which case the dependent variable would just be a measure of children’s income), the method used should give a more accurate measure of this coefficient too.

The key point the authors makes is that the WL estimator is a better estimator than that which averages income prior to the regression (which, as we have seen, is the norm), or that which utilises a multiple regression and takes a simple average of the estimated coefficients. Were we using the standard model of section 3 the WL estimator would certainly be better, but notice that our alternative model implies that one of the assumptions of the procedure is violated - namely the assumption, mentioned above, that the proxies do not have a direct effect on the dependent variable. Nevertheless, we might still wonder what the nature of the WL estimate would be and whether it would be an improvement on the other approaches. As it happens we can use the results above to give an idea. In particular, the weight (‘p’) applied to an individual year can be represented by:

$$\hat{p}_j = \frac{\hat{\beta}_j}{\hat{\beta}_i}$$

Where  $\hat{\beta}_j$  comes from estimating  $y_{1it} = \beta_j y_{0ij} + e$ , and similarly for  $\hat{\beta}_i$  which is here assumed to be the largest estimated coefficient so that  $\hat{p}_i = 1$ .

Using our previous result from (8) we can show that

$$plim(\hat{p}_j) = \frac{plim(\hat{\beta}_j)}{plim(\hat{\beta}_i)} = \frac{\rho\sigma_{Y_0}^2 + \sigma_{W_0}^2 \sum_q \beta_q \delta^{|q-j|} + \beta_j \sigma_{V_0}^2}{\rho\sigma_{Y_0}^2 + \sigma_{W_0}^2 \sum_q \beta_q \delta^{|q-i|} + \beta_i \sigma_{V_0}^2} \quad (10)$$

In words, on the assumption that equations (1),(2),(5) and (6) are valid, the WL estimator will weight the multiple regression coefficients on the individual years of childhood income by their relative *importance* ( $\beta_j$  in the numerator versus  $\beta_i$  in the denominator), *and* their relative *proximity* to years of relatively greater importance ( $\sum_q \beta_q \delta^{|q-j|}$  versus  $\sum_q \beta_q \delta^{|q-i|}$ ). On the basis of this one might therefore expect that if transitory income matters the WL estimator will be closer to the true IGC, and therefore higher than estimates based on the typical approaches outlined above. We confirm this intuition in our Monte Carlo simulations in section 5.

## 4.5 Better Estimation Methods?

The implications outlined above of using different approaches to estimating the IGC clearly indicate that there is a serious problem in estimates to date if indeed transitory

income matters. The question then is one of finding alternatives. At the very least we would like to characterise the extent of the problem - i.e. underestimation - so as to be able to make some inference about the validity of past estimates.

Leaving issues of data availability aside, one might think that using an average of all years of parental income would yield the true correlation coefficient  $(\rho + \sum_q \beta_q)$ . Indeed, in the context of the standard model of section 3, accepting the notion that permanent income can be equated to average lifetime income (as assumed for instance by Mazumder (2003, 2005a)) implies that using such an average as the explanatory variable *will* capture the true IGC. Our result in (9) suggests however that this intuition may be overly optimistic. An alternative would be to explicitly exploit the fact that transitory income outside childhood plays no role in the structural equation for children's permanent income. For instance, one could run a regression on all years of childhood income entered as individual regressors, along with an average of all non-childhood income. We expect that that the coefficient on the latter in a simple regression will be akin to that in (9), but with the second and third terms in the numerator being relatively small. This suggests that entering it into the multiple regression would provide an effective control for  $\rho$ , thereby allowing us to estimate  $\sum_q \beta_q$ .

In the next section we examine these possibilities using Monte Carlo simulations and confirm, for various parameter values, the earlier assertions in this section regarding the bias that results from using the conventional estimation approaches.

## 5 Simulation Methodology and Results

For the purposes of this paper we fix all parameters in our simulations except for the relative importance of permanent and transitory factors. As noted in section 4.1.2 we will follow Mazumder (2003) and assume that:  $\frac{\sigma_{w_0}^2}{\sigma_{Y_{0t}}^2} = 0.3$ ,  $\frac{\sigma_{v_0}^2}{\sigma_{Y_{0t}}^2} = 0.2$ ,  $\frac{\sigma_{Y_0}^2}{\sigma_{Y_{0t}}^2} = 0.5$  and  $\delta = 0.5$ .<sup>24</sup> In addition, we will assume that the true IGC is fixed at 0.55. That is,  $\rho + \sum_q \beta_q = 0.55$ .

The simulations work as follows: First, we generate lifetime incomes (over 45 years) for 10,000 hypothetical individuals. The first year is generated by taking draws for the permanent, serially correlated and random components from normal distributions in such a way that the variance in annual income explained by the components corresponds to the parameter values above. The subsequent years of income are generated based on this one, incorporating the fact that  $w_0$  is correlated across years. We then generate one year of children's income as a function of the permanent component of parental income ( $y_0$ ) and the individual years of parental income from childhood ( $y_{0q}$ ); where the former is weighted by our assumed value for  $\rho$  and the latter by our assumed values for the  $\beta_q$ 's (which for these simulations are assumed to be all equal so that if  $\sum_q \beta_q = X$ , then  $\beta_q = \frac{X}{21}, \forall q$ ). This provides us with a set of data satisfying the assumptions of our alternative model. Having done this we then run a set of regressions on the generated data. The first set of these are aimed at giving a numerical characterisation of the bias that results from using traditional estimates of the IGC. The second set explore alternative estimation approaches. Each is iterated 10,000 times.<sup>25</sup>

The results of the first set of estimations are shown in Table 1. This reports the results of regressions of children's income on: 1. A single year of parental income from far (twenty years) outside childhood, 2. A single year of income earned in the middle of childhood, 3. A five-year average of income outside childhood, 4. An average of all non-childhood income, and 5. An average of all parental income.<sup>26</sup> All estimated values should be compared to the true values for  $\sum_q \beta_q$  and  $\rho$ .

The results confirm the well-known fact that the coefficient on the permanent component is heavily attenuated when using single-year measures of parental income, and as Mazumder (2005b) has demonstrated, even averages using five years of income substantially underestimate the true coefficient. In the context of the model proposed in this paper, there are two aspects of these results that are particularly notable. First, that there is a noticeable difference between the coefficients estimated using a single year of childhood and non-childhood income, with the latter being lower as expected. However, only for the second set of parameters is this latter coefficient outside of a 95% confidence interval for the former.<sup>27</sup> Second, note that *none* of the estimators - even the

<sup>24</sup>Solon (1999) makes similar assumptions

<sup>25</sup>The Stata .do file is available from the author on request

<sup>26</sup>In the third regression the average begins ten years outside childhood ( $s=31$ ) and finishes four years hence ( $s=35$ ). The reason for noting this detail is that since  $0 < \delta < 1$ , we can assume that the second term in the numerator of (7) will effectively equal zero if  $|q - k| > 10, \forall k$ . Which serves to accentuate the difference between using childhood and non-childhood income since the latter picks-up none of the salience of transitory income.

<sup>27</sup>The confidence interval is calculated using the standard deviation of the estimates (not shown), on the assumption that these follow a normal distribution.

last which uses an average of *all* parental income - pick-up any substantial proportion of the IGC due to the transitory components over-and-above the value attributable to the permanent component. This demonstrates that even using long averages of income as Mazumder (2005b) will not capture the salience of transitory income.

Table 2 presents the results of the second set of regressions exploring alternative estimation methods. Again we have a year of children's income as our dependent variable. This is regressed on: 1. An average of all childhood income, 2. All years of childhood income separately, 3. All years of parental income separately, and 4. All years of childhood income *and* the average of all non-childhood parental income. 5. Calculates the Wittenberg-Lubotsky estimator (see section 4.4) using the coefficients from 2. (Note that with the multiple regressions we sum the individual coefficients to give the result presented in the table.)

The first row reveals that the even a full average of childhood income fails to capture more than the coefficient on permanent income - a result that is not surprising given that, as we noted above, an average of *all* income did not achieve this. Using these simulation results, Figure 1 confirms the validity of the probability limit of this coefficient presented earlier in equation (9). Rows 2 and 3 merely confirm that the sum of the coefficients in the multiple regressions are equivalent to the coefficient on an average of those separate years of income. Row 5 confirms our earlier (section 4.4) intuition that the Wittenberg-Lubotsky estimator produces higher estimates than any of the approaches used in the literature to date.<sup>28</sup> However, even for the second set of parameter values in which transitory income is responsible for 0.4 of the 0.55 IGC, the WL estimator captures only 0.03 of this.<sup>29</sup>

The most promising results from our simulations relate to the fourth row of Table 2, in which we regress a year of children's income on all years of childhood income *and* an average of all non-childhood income - as suggested in section 4. In that case the sum of the coefficients on the individual years, combined with the coefficient on the average provide values much closer to the true IGC of 0.55 than those from any other estimation method. Whilst this result appears positive, notice that for the second set of parameters this still underestimates the IGC by 0.1.<sup>30</sup>

The fundamental point made by these simulations is that all existing estimates of the intergenerational correlation in income are biased downward in proportion to the relative importance of transitory income. The results in Table 2 suggest some possible solutions to this problem, but none appear definitive at this stage.

---

<sup>28</sup>It is perhaps worth mentioning at this point that in this paper we ignore attempts to instrument for permanent income (see for instance Solon, 1992; Zimmerman, 1992). However, it should be fairly clear that the use of instrumental variables will not resolve the problem that results from the exclusion of transitory income from the structural model.

<sup>29</sup>This may suggest that the fairly dramatic increase obtained by Lubotsky and Wittenberg (2006) *is* due to the reasons they suggest in that paper - see discussion in section 4.4.

<sup>30</sup>Although this approach appears to result in *over*estimates for the other two parameter sets, the true IGC is well within a 95% confidence interval for these values.

## 6 Further Issues and Extensions

### 6.1 The Empirical Importance of Social Context: Developing vs. Developed Countries

Section 5 and 6 suggest a number of ways in which the alternative model presented in section 4 might be tested. Although we hypothesise that the differences between IGCs calculated using this model and the standard model are likely to be significant in most cases, it is important to note that this will vary across societies. As is well known in the literature on intergenerational mobility, more developed societies in which there is substantial public provision of healthcare, education and other social services will be ones in which the importance of income of both a transitory and permanent nature is mitigated. Furthermore, such societies are likely to have better credit markets which are accessible to a greater proportion of the population, and be characterised by employment opportunities of a less volatile nature than in less developed societies. The result is that we would expect the bias arising from the standard model's exclusion of transitory income in the structural equation for children's permanent income to be greater in less developed societies.

Indeed, although both Mayer (1998) and Shea (2000) argue that parental income is not an important causal factor for children's economic success in the United States, they acknowledge that: 1. This may be due in large part to the presence of "programs such as Food Stamps, housing subsidies, and Medicaid (which) have helped most American families meet their basic material needs" (Mayer, 1998: 148). 2. As a result the conclusions might be very different in less developed countries. Shea therefore notes that Duflo's duflo:pension demonstration of the importance of pension income for children's outcomes in South Africa does not necessarily contradict his findings since "the impact of parental resources on children may be higher in developing countries than in the contemporary US, where public investments in schooling and child health are relatively high" (Shea, 2000: 160). As Solon puts it: "the steady-state intergenerational earnings elasticity depends positively on the strength of the mechanical heritability of income-generating traits and the earnings return to human capital investment, and *it varies inversely with the progressivity of government investment in children's human capital (for example, through public provision of education or health care)*." (Solon, 2002: 65, my emphasis).

We emphasise this point for two reasons. The vast majority of datasets available for making detailed analyses of intergenerational mobility of the kind we have been discussing are from highly developed countries. Whilst these present the opportunity for testing the assertions of this paper, in the event that the alternative model is not found to have significantly greater explanatory power than the one based solely on permanent income we should not conclude that this will always be the case.<sup>31</sup> In section 2 we suggest that the alternative model is theoretically superior to the simplistic permanent income model, and that therefore the former is the more correct way to estimate the IGC because it requires fewer initial restrictions on the process of intergenerational transfer. The second reason is that as data becomes available, researchers attempting to estimate the IGC in developing countries should be particularly cautious when drawing

---

<sup>31</sup>The reverse is not the case: if transitory income turns-out to be important in developed countries it seems certain that it will be at least as important in developing countries, for the reasons outlined above.

conclusions from estimates based on methods associated with the standard model. As demonstrated in section 5, these could be substantially biased.<sup>32</sup>

## 6.2 The Importance of the Age of Observation

One of the primary motivating factors for the proposal that transitory income matters was that it seems plausible to believe that parental income may be more or less important for children's outcomes depending on when it is earned (recall our two extreme examples in section 2). So far we have not in fact addressed this issue, although notice that it was the reason that we first used  $\beta_q$  rather than simply  $\beta$  in (6) to characterise the importance of transitory factors for childhood income.

Within the existing framework there appear to have been at least two attempts in the literature to assess whether there is some difference in the importance of parental income at different ages of the child. Hertz (2005) estimates the IGE using three-year averages of family income taken at different ages of childhood (1-3years, 4-6years up to 16-18years), and further compares these over a period of 25years (1950-1975). Although there are clearly differences (sometimes substantial) between the estimates within a given year, no obvious pattern emerges. (Mayer, 1998: 72-75) also makes an attempt at assessing something akin to the effect of the age at which income is earned but her approach seems to be excessively restrictive and unsurprisingly she fails to find anything of significance. From our earlier analysis it should be quite clear that Hertz's approach is not likely to pick-up much of the impact of transitory income. Each of his estimates can be characterised by an equation similar to (9), with  $T=3$  and appropriate values for 'r' and 'm'.<sup>33</sup> Both  $\rho$  and  $\sum_q \beta_q$  will be heavily attenuated, whilst the latter will also be captured to a relatively small degree.

In a future version of this paper we intend to explore the effect on estimates based on the standard model of different distributions of the values of  $\beta_q$  across all  $q$ , and possibly propose a method of empirically determining these *individual* coefficients.<sup>34</sup>

## 6.3 Decomposing the Intergenerational Correlation

As noted in the Introduction, a primary concern of the current literature is with decomposing the calculated intergenerational correlation in income; that is, determining the channels through which this correlation is being generated, and ascertaining their relative importance.<sup>35</sup> This can be done by estimating the relation between the variable representing the channel of interest (years of schooling for instance) and *children's* income in a multiple regression including variables representing all hypothesised

---

<sup>32</sup>South Africa, for instance, is just beginning its first National Income Dynamics Study, which within a decade will begin providing data to estimate this relationship.

<sup>33</sup>We say 'similar' to (9) because in fact as we noted in section 4.3 the derivation of that equation - in particular, the expression for  $\Lambda_q$  is sensitive to the relation between the detailed nature of the overlap between the years used and years of childhood. In this instance however the qualitative conclusions will not be very different.

<sup>34</sup>One might think of this as 'decomposing' the intergenerational correlation due to transitory income, much as other authors have tried to decompose the IGC due to permanent income (see 6.3).

<sup>35</sup>Again it is important to emphasise that we are talking of the generation of the *correlation* rather than children's outcomes, since if anything the majority view appears to shy away from the notion of a causal relation.

channels, then multiplying this by the correlation between the channel and *parental* income.<sup>36</sup> By doing this we are breaking the IGC down into the ‘direct’ and ‘indirect’ effects of parental income.

Some channels which have received particular interest are those relating to the transfer of genetic ability (generally using twin and/or sibling studies), educational attainment and personality traits.<sup>37</sup> A consensus has yet to emerge however on even these three channels. For instance, Loehlin (2005) finds that personality traits explain little of the correlation, whereas Mayer (2005) in the same volume suggests they do explain a relatively large portion of it. In addition, some authors such as Grawe and Mulligan (2002) - following the models of family investment and intergenerational transfer of Becker and Tomes - emphasise the distinctive implications of economic models of transmission, whilst others (see Goldberger, 1989; Bowles and Gintis, 2002) take a more ‘mechanical’ approach.<sup>38</sup>

There is also a tendency to use analyses of these channels to infer the existence, or importance, of a causal relationship between parental income and children’s outcomes (and hence income). One example of this sort is Solon’s finding that the IGC only explains 0.16 of the 0.4 correlation between brothers’ incomes and that therefore that “of the 40% or so of permanent earnings inequality that arises from the family and community background factors shared by brothers, probably only a minority share is related to parental income” (Solon, 1999: 1784). This argument is based on Solon’s decomposition of the sibling correlation in earnings (1999: 1777, eq.21). But the logic is potentially problematic because if the estimated IGC (0.4 in this example) is underestimated then it will be biased toward the conclusion that parental income per se is not particularly important.<sup>39</sup> Furthermore, in this instance there may be an additional problem: that calculated correlations in sibling income *do* pick-up the impact of transitory parental income to a greater degree than the IGC to which they are compared, thereby increasing the likelihood that we underestimate the salience of parental income as a causal factor. Until we have greater confidence in our estimates of the IGC and, in particular, until we have accounted for the possible importance of transitory income it would be advisable to be somewhat cautious in the inferences drawn from such comparisons.

## 6.4 Implications for Public Policy

There are a number of reasons why we should be interested in intergenerational mobility from a policy perspective. Perhaps the primary one is that we may be interested in achieving, to the greatest degree possible, a society characterised by equal opportunity (with the caveat noted in the Introduction). To the extent that a high IGC indicates a failure in this regard it suggests the possible need for government intervention. The

---

<sup>36</sup>Where it is assumed that all variables are normalised. See Bowles and Gintis (2002) for a full discussion of the details.

<sup>37</sup>See Solon (1999) for a survey of studies on sibling correlations in income and their relation to the intergenerational correlation.

<sup>38</sup>“Unlike the models of parental and child behavior accounting for persistence pioneered by Becker and presented in this issue by Grawe and Mulligan, our approach is more diagnostic, not giving an adequate causal account of the transmission process, but indicating where to look to find the causes.”(Bowles and Gintis, 2002: 9-10).

<sup>39</sup>In fact, based on Solon’s decomposition, an IGC of 0.6 would explain  $(0.6)^2 = 0.36$  of the 0.4 correlation between siblings leading to a very different conclusion.

main point made in the literature on this subject is that one can only determine whether this is the case by decomposing the IGC into its constituent channels and making ethical determinations of their desirability. Swift (2005) puts forward one set of criteria in this regard which, though they may seem extreme to some, are appealing in as much as they take popular conceptions of what constitutes 'fair' transmission channels to their logical conclusions.

These arguments are based on the notion that intergenerational transmission occurs through permanent income. An additional appeal of considering transitory income is that if we can identify it to have a significant effect the policy implications would appear to be more immediate. Essentially: if transitory income affects children's future economic status this suggests that income *per se* is affecting a child's opportunities, which is something that is generally incompatible with even relatively weak formulations of equality of opportunity. Thus the greater the importance of transitory income relative to permanent income, the stronger the case for government intervention.

The study by d'Addio (2007) clearly indicates an increased awareness amongst policy makers of the importance of intergenerational mobility, and by implication a greater role for mobility studies in influencing policy. Given that the explicit motivation for that study is derived from the statement by OECD Social Policy Ministers that "the OECD should identify which interventions alleviate and will contribute to the eventual eradication of child poverty, break the cycle of intergenerational deprivation, and develop the capacity of children to make successful transitions through the life course" (d'Addio, 2007: 10), it is quite clear that the role for mobility analyses from a policy perspective is going to be identifying the optimal areas for government intervention. The kind of problems identified in this paper that result from neglecting the importance of transitory income could well affect the validity of any such recommendations. But on a more positive note, as per the discussion in 6.2, they also present the possibility of identifying both the stages of childhood that are most important for children's eventual outcomes, as well as the relative extent of this importance.

## 7 Conclusion

In this paper we argue that the structural model which underlies the literature on intergenerational correlations in income is incomplete, because it fails to allow for the influence of transitory parental income on children's outcomes and hence their permanent income. In section 4 we present an alternative model, and derive the probability limits of the estimators used to date in the context of these assumptions. Our simulation results in Section 5 confirm that traditional estimation methods are incapable of capturing the import of transitory income.

Whilst we do not demonstrate that transitory income *does* matter - something which is fundamentally an empirical question - we do provide a structure in which the question can be properly asked, as opposed to the rather *ad hoc* manner in which it has been addressed in the literature to date. Given that studies of the intergenerational correlation appear likely to inform future government policies, the issue is not merely a theoretical one. The existing model is biased toward the conclusion that parental income is not a key determinant of children's future economic status, and whilst that conclusion may yet be confirmed, there is also the possibility that we shall discover a much greater causal role for parental income - with the concomitant implications this would have for redistributive social policy.

## References

- Becker, G.: 1988, Family economics and macro behavior, *American Economic Review* **78**, 1–13.
- Becker, G. and Tomes, N.: 1986, Human capital and the rise and fall of families, *Journal of Labour Economics* **4**, S1–S47.
- Behrman, J. R.: 1999, Social mobility: Concepts and measurement, in N. Birdsall and C. Graham (eds), *New Markets, New Opportunities?: Economic and Social Mobility in a Changing World*, Brookings Institution Press, pp. 70–100.
- Behrman, J. and Taubman, P.: 1985, Intergenerational earnings mobility in the United States: Some estimates and a test of Beckers intergenerational endowments model, *Review of Economics and Statistics* **67**(1), 144–151.
- Behrman, J. and Taubman, P.: 1990, The intergenerational correlation between children's adult earnings and their parents' income: Results from the Michigan Panel Survey of Income Dynamics, *Review of Income and Wealth* **36**(2), 115–127.
- Bowles, S.: 1972, Schooling and inequality from generation to generation, *Journal of Political Economy* **80**(3), S219–S251.
- Bowles, S. and Gintis, H.: 2002, The inheritance of inequality, *Journal of Economic Perspectives* **16**(3), 3–30.
- Cameron, S. V. and Heckman, J. J.: 2001, The dynamics of educational attainment for black, hispanic and white males, *Journal of Political Economy* **109**(31), 455–499.
- d'Addio, A. C.: 2007, Intergenerational transmission of disadvantage: Mobility or immobility across generations? a review of the evidence for OECD countries, *OECD Social, Employment and Migration Working Papers* **No.52**.
- Friedman, M.: 1957, *A Theory of the Consumption Function*, Princeton University Press, Princeton.
- Goldberger, A.: 1989, Economic and mechanical models of intergenerational transmission, *American Economic Review* **79**(3), 504–513.
- Grawe, N. D. and Mulligan, C. B.: 2002, Economic interpretations of intergenerational correlations, *Journal of Economic Perspectives* **16**(3), 45–58.
- Harding, D. J., Jencks, C., Lopoo, L. M. and Mayer, S. E.: 2005, The changing effect of family background on the incomes of American adults, in S. Bowles, H. Gintis and M. O. Groves (eds), *Unequal Chances: Family Background and Economic Success*, Princeton University Press, pp. 100–144.
- Hertz, T.: 2005, Attrition- and age-bias-corrected estimates of the trend in the intergenerational persistence of family income. Unpublished draft.
- Jenkins, S.: 1987, Snapshots versus movies: Lifecycle biases and the estimation of intergenerational earnings inheritances, *European Economic Review* **31**, 1149–1158.

- Loehlin, J. C.: 2005, Resemblance in personality and attitudes between parents and their children, in S. Bowles, H. Gintis and M. O. Groves (eds), *Unequal Chances: Family Background and Economic Success*, Princeton University Press, pp. 192–207.
- Lubotsky, D. and Wittenberg, M.: 2006, Interpretation of regressions with multiple proxies, *Review of Economics and Statistics* **88**(3), 549–562.
- Mayer, S. E.: 1998, *What Money Can't Buy: Family Income and Children's Life Chances*, Harvard University Press, Cambridge (MA).
- Mayer, S. E.: 2005, Personality and the intergenerational transmission of economic status, in S. Bowles, H. Gintis and M. O. Groves (eds), *Unequal Chances: Family Background and Economic Success*, Princeton University Press, pp. 208–231.
- Mazumder, B.: 2001, Earnings mobility in the US: A new look at intergenerational inequality, *Federal Reserve Bank of Chicago Working Paper* **2001-18**.
- Mazumder, B.: 2003, Revised estimates of intergenerational income mobility in the United States, *Federal Reserve Bank of Chicago Working Paper* **2003-16**.
- Mazumder, B.: 2005a, The apple falls even closer to the tree than we thought: New and revised estimates of the intergenerational inheritance of earnings, in S. Bowles, H. Gintis and M. O. Groves (eds), *Unequal Chances: Family Background and Economic Success*, Princeton University Press, pp. 80–99.
- Mazumder, B.: 2005b, Fortunate sons: New estimates of intergenerational mobility in the United States using social security earnings data, *Review of Economics and Statistics* **87**(2), 235–255.
- Roemer, J.: 2000, Equality of opportunity, in K. Arrow, S. Bowles and S. Durlauf (eds), *Meritocracy and Economic Inequality*, Princeton University Press, pp. 17–32.
- Shea, J.: 2000, Does parents' money matter, *Journal of Political Economy* **77**, 155–184.
- Solon, G.: 1989, Biases in the estimation of intergenerational earnings correlations, *Review of Economics and Statistics* **71**(1), 172–174.
- Solon, G.: 1992, Intergenerational income mobility in the United States, *American Economic Review* **82**, 393–408.
- Solon, G.: 1999, Intergenerational mobility in the labor market, in O. Ashenfelter and D. Card (eds), *Handbook of Labour Economics*, Vol. 3, Elsevier, pp. 1761–1800.
- Solon, G.: 2002, Cross-country differences in intergenerational earnings mobility, *Journal of Economic Perspectives* **16**(3), 59–66.
- Swift, A.: 2005, Justice, luck and the family: The intergenerational transmission of economic advantage from a normative perspective, in S. Bowles, H. Gintis and M. O. Groves (eds), *Unequal Chances: Family Background and Economic Success*, Princeton University Press, pp. 256–276.
- Zimmerman, D. J.: 1992, Regression toward mediocrity in economic stature, *American Economic Review* **82**, 409–429.

FIGURE 1

