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FROM EARNINGS INEQUALITY TO CONSUMPTION INEQUALITY*

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This paper studies the paths from inequality in earnings to inequality in household consumption. We show that careful study of the evolution of the variances and covariances of earnings and consumption within cohorts across time can identify permanent and transitory shocks. We present an application to the evolution of inequality in the United Kingdom. We extend previous results to recognise separate earnings of partners in couples.

The path from inequality in hourly wages to inequality in household consumption and ultimately welfare is mediated by numerous household decisions. Consumption changes are influenced by labour supply choices and by the availability of saving and transfers to buffer temporary and unexpected shocks and by the existence of formal or informal insurance arrangements. This paper argues that the simultaneous analysis of earnings and consumption data can add key insights to our understanding of the evolution of inequality. In particular, the simultaneous analysis of consumption and earning inequality can be helpful in: (i) decomposing shocks to earnings and wages into transitory and permanent components; (ii) determining which shocks individual households are able to smooth out and which they are not; (iii) differentiating responses to various components of earnings – in particular, the effect of shocks to primary earners and spouse.

The large increase in wage inequality during the 1980s and early 1990s (documented, for instance, by Katz and Murphy, 1992; Levy and Murnane, 1992; Karoly, 1993; Katz and Autor, 1999) spurred more recent research that has attempted to decompose shocks into transitory and permanent components. Gottschalk and Moffitt (1994), Moffitt and Gottschalk (1995), Buchinsky and Hunt (1996), Gittleman and Joyce (1996), for instance, studied longitudinal data to document a strong increase in the variance of permanent shocks in the 1980s and a progressively more important role for transitory shocks.

Several studies, such as Cutler and Katz (1991, 1992) and Slesnick (1993), have looked at the evolution of consumption inequality and documented an increase during the same period, albeit not as large. Other studies including Mace (1991) and Attanasio and Davis (1996) have used consumption and wages simultaneously

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to test the hypothesis that shocks to wages are perfectly insured and therefore not reflected in changes in consumption.

Blundell and Preston (1998) have shown how to use the dynamics of consumption and income (cross sectional) variances to identify, under the hypothesis of life cycle behaviour, the variances of the permanent and transitory components of income shocks. The idea is simple: an increase in the variance of transitory shocks should increase the cross sectional variance of income, but not that of consumption, as these shocks are smoothed out. In this paper we develop this approach to take into account the evolution of the earnings of individual members in the household. The material we present is a first step in understanding the channels through which households absorb shocks to incomes and earnings.

1. Decomposing Inequality

Before presenting our theory we look at earnings and consumption inequality using data from the United Kingdom. Our data come from the UK Family Expenditure Survey (FES) over the period 1978–99.[1] We take a sample of all husband and wife households (with or without children) and follow three cohorts defined on the basis of year of birth of household head: those with heads born in the 1930s, 1940s and 1950s.

Fig. 1 shows the evolution of the variances of log household earnings and of log equivalised expenditure within each cohort. As we see, the lines slope up, showing inequality within cohorts rising over time. This accords with the theory outlined below which suggests that we should expect this to happen as a consequence of the cumulative impact of permanent shocks to household income (see Deaton and Paxson, 1994). Note also that younger cohorts face higher levels of earnings and expenditure inequality when observed at the same age as adjacent cohorts. To the extent that consumption inequalities reflect permanent differences in household incomes we can interpret this as indicating increasing initial levels of permanent inequality. For the cohorts born in the 1940s and 1950s, the increase in consumption inequality stops in the 1990s.

If we compare the two pictures we note that for all cohorts there is a tendency for income variance to rise faster than expenditure variance over time. This is particularly evident in the second part of the sample – the 1990s. It is clear that underlying these movements there must be something happening to incomes which is not completely feeding through into consumption. In the context of a permanent income model it would be natural to think that this might have to do with transitory variation which consumers can attempt to smooth away by intertemporal consumption decisions.

Fig. 2 takes two cohorts and separates the variance paths for different cohorts onto different panels. A distinction is now drawn between couples with one and two earners and the variances of the earnings of the two partners are separated. We

[1] We exclude self employed households. Our income deflator is a Stone price index based on the household budget shares for nondurable expenditures and monthly indices for prices. Our equivalence scale is the McClements scale.

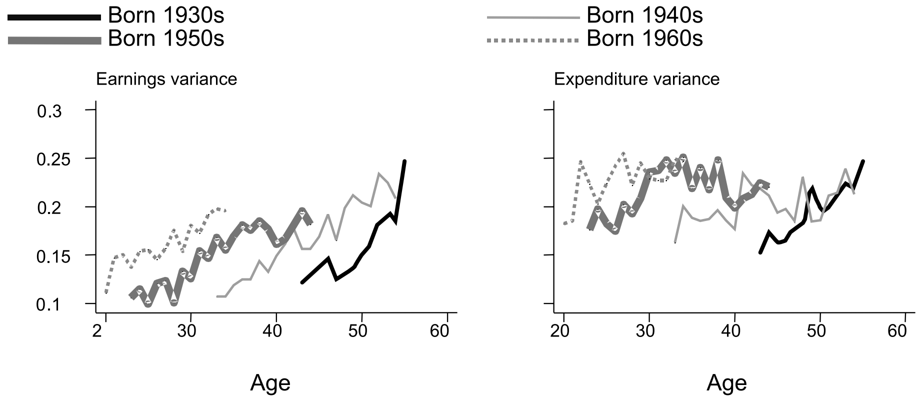

Fig. 1. *Earnings and Expenditure Variances within Cohorts*

see that the pattern of rising variances with increases in earnings variances dominating those in consumption variances is preserved for the primary earner. Earnings of second earners show much greater variances with less systematic patterns of evolution. Participation rates within cohorts vary considerably over ages and cohorts.

Making sense of these different pictures requires that we recognise the links between the different dimensions of inequality and the numerous household decisions which connect them. In the following section we develop a model of income processes and consumption decisions that allows us to link the evolution of observed variances to the variances of permanent and transitory shocks to partners' earnings.

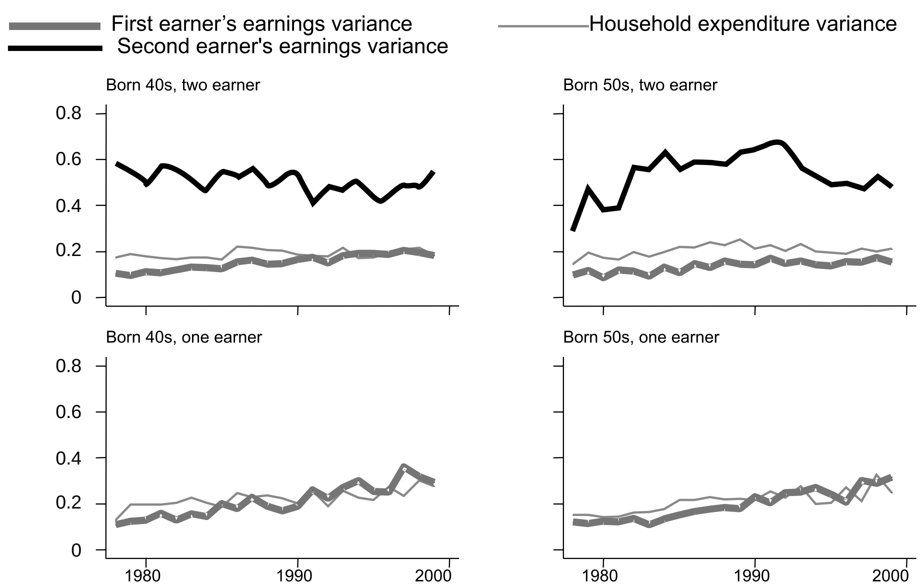

Fig. 2. *Variances by Cohort and Labour Market Status*

2. Tracking Shocks

Incomes

Let household income y_t be the sum of the primary earner's income y_{1t} and that of the secondary earner y_{2t} if participating:

$$y_t = y_{1t} + D_t y_{2t}$$

where $D_t = 1$ if and only if the secondary earner participates.

We assume each partner's underlying income evolves according to the sort of permanent–transitory processes postulated in Blundell and Preston (1998) and common in the earnings dynamics literature:

$$\begin{aligned}\Delta \ln y_{1t} &= \gamma_{1t} + \Delta u_{1t} + v_{1t}\\ \Delta \ln y_{2t} &= \gamma_{2t} + \Delta u_{2t} + v_{2t}\end{aligned}$$

where γ_{1t} and γ_{2t} are known deterministic trends, u_{1t} and u_{2t} are transitory shocks and v_{1t} and v_{2t} are permanent shocks. Shocks of either type can be correlated between the two partners in any one period but shocks of the two types are not correlated.

Assume also that participation evolves according to a Markov process with common known transition probabilities

$$\begin{aligned}\Pr(D_{t+k} = 1 | D_{t+k-1} &= 1) = \pi_{1t}\\ \Pr(D_{t+k} = 1 | D_{t+k-1} &= 0) = \pi_{0t}.\end{aligned}$$

Note that the transitions are time-varying so that we allow for participation probabilities to vary with anticipated age-related circumstances such as child bearing and health. What we exclude however is dependence of transitions on realisations of the two income processes, so that these are not economic responses to aspects of the earnings process.[2]

This implies a sequence of participation probabilities for all future periods given the current state

$$p_k^i = \Pr(D_{t+k} = 1 | D_t = i) = \Pi^k \begin{pmatrix} i \\ 1 - i \end{pmatrix} \quad i = 0, 1$$

where $\Pi = \begin{pmatrix} \pi_{1t} & \pi_{0t} \\ 1 - \pi_{1t} & 1 - \pi_{0t} \end{pmatrix}$.

Consumption

We suppose that households have preferences given by an intertemporally separable constant relative risk aversion utility function defined over household consumption c_t. Optimality implies a constant discounted expected marginal utility, that is, a Euler equation of the familiar kind (see Hall, 1978) that, under certain conditions, can be written as:

[2] This will be the focus of future work. A decomposition including labour supply is developed in Attanasio *et al.* (2001).

$$\Delta \ln c_{t+k} \simeq \phi \Delta \ln \lambda_{t+k}$$
$$\Delta \ln \lambda_{t+k} \simeq \omega_{t+k} + \varepsilon_{t+k}$$

where ϕ is the (constant) intertemporal substitution elasticity, λ_t is the marginal utility of consumption, ω_t (which is half the conditional variance of $\Delta \ln \lambda_t$) captures precautionary savings motives and ε_t is an innovation.

Approximating the Intertemporal Budget Constraint

We need to relate the innovation to marginal utility ε_t to the income shocks through the intertemporal budget constraint

$$\sum_{k=0}^{T-t} q_{t+k} c_{t+k} = \sum_{k=0}^{L-t} q_{t+k} y_{t+k} + A_t \tag{1}$$

where T is death, L is retirement, $q_{t+k} = \prod_{i=1}^{k} (1 + r_{t+i})^{-1}$, $k = 1, \ldots, T - t$ is an appropriate discount factor (and $q_t = 1$) and A_t denotes financial assets.

To do this we take logs on both sides, loglinearising using an approximation similar to the one suggested by Campbell (1993). On each side we expand around paths that would be followed if shocks happened to be zero. (See Appendix for details.)

Taking differences in expectations, for large $L - t$ and A_t small relative to expected future labour income, allows us to relate the consumption innovation and the shocks as required:

$$\phi \varepsilon_t \simeq (a_t^i v_{1t} + b_t^i v_{2t}) + Z_t \tag{2}$$

where $a_t^i = \sum_{k=0}^{T-t} \left[p_k^i \rho_k^1 s_{t+k} + \left(1 - p_k^i\right) \rho_k^0 \right]$, $b_t^i = \sum_{k=0}^{T-t} p_k^i \rho_k^1 (1 - s_{t+k})$, Z_t involves terms arising from revisions in ω which we assume common to all in the same cohort, the ρ_k^1 are weights, s_{t+k} income shares of the partner and p_k^i participation probabilities (details are spelled out in the Appendix). Consumption responds only to permanent shocks and does so according to weights a_t^i and b_t^i reflecting anticipated future s_{t+k} and p_k^i. We have assumed: (i) terms arising from revisions to the future p_k^i can be neglected if $L - t$ is large – these are large only with regard to the near future and their influence should therefore disappear like transitory effects; (ii) households are aware of shocks to the secondary earner's latent income process even when not participating. This latter assumption seems least reasonable for transitory shocks but this makes no difference to the result. It is more important for permanent shocks and here the appropriate treatment is arguable – one can imagine some idiosyncratic shocks to human capital that would clearly be known even if not participating (health shocks) but others (personal responses to workplace technology) that might not.

Variances

Given (1) we can derive a relationship between the changes in the cross sectional second moments and the variances of the shocks. Sample moments are computed within a cohort and participation status group. Specifically

$$\begin{pmatrix} \Delta\mathrm{Var}_i(\ln c_t) \\ \Delta\mathrm{Cov}_i(\ln c_t, \ln y_{1t}) \\ \Delta\mathrm{Cov}_i(\ln c_t, \ln y_{2t}) \\ \Delta\mathrm{Var}_i(\ln y_{1t}) \\ \Delta\mathrm{Cov}_i(\ln y_{1t}, \ln y_{2t}) \\ \Delta\mathrm{Var}_i(\ln y_{2t}) \end{pmatrix} = \mathbf{A}_t^i \begin{pmatrix} \mathrm{Var}(v_{1t}) \\ \mathrm{Cov}(v_{1t}, v_{2t}) \\ \mathrm{Var}(v_{2t}) \\ \Delta\mathrm{Var}(u_{1t}) \\ \Delta\mathrm{Cov}(u_{1t}, u_{2t}) \\ \Delta\mathrm{Var}(u_{2t}) \end{pmatrix}$$

where

$$\mathbf{A}_t^i = \begin{pmatrix} (a_t^i)^2 & 2a_t^i b_t^i & (b_t^i)^2 & 0 & 0 & 0 \\ a_t^i & b_t^i & 0 & 0 & 0 & 0 \\ 0 & a_t^i & b_t^i & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \end{pmatrix}, \qquad i = 0, 1.$$

It is clear that the variances and covariances involving consumption reflect permanent shocks only. Indeed $a_t^i v_{1t} + b_t^i v_{2t}$ is interpretable as the annuitised permanent shock to household earnings and the change in the variance of consumption as an estimate of the variance of permanent shocks. On the other hand, the evolution of the earnings variances also contains the influence of changes in the transitory variances. However, simply differencing the changes in household income and consumption variances does not give an estimate of the change in the variance of transitory shocks as in Blundell and Preston (1998). The household income process is not a simple permanent–transitory process – there are three types of shocks: those that are unambiguously permanent (v_{1t}), those that are permanent but intermittent in effect (v_{2t}) and those that are transitory (u_{1t}, u_{2t}). Separating these is more complicated. The full variance–covariance matrix of shocks is unidentified taking either participation group in isolation, even for known $\mathbf{A}_t^i$, since $\mathbf{A}_t^i$ has rank 5 only. Several alternatives to achieve identifications are available such as restricting the covariance processes of the shocks.

3. Implications for Interpreting the Growth in Inequality

The empirical analysis of Section 1 documented the growth in earnings inequality and consumption inequality in the United Kingdom over the 1980s and 1990s. Section 2 has outlined an intertemporal model of consumption choices for a household with two working age adults both facing earnings risk to interpret the observed growth in inequality. Putting the empirical and theory results together, this analysis points to differences in the growth of permanent and transitory components of earnings inequality across time and over the life cycle for different date of birth cohorts. It suggests that younger cohorts face higher levels of earnings inequality, that there is growth in transitory inequality over the period and that there is strong evidence of increasing initial levels of permanent inequality for longer cohorts. Much of the strong growth in earnings inequality in the 1980s is attributable to this growth in permanent inequality among younger cohorts and is much less steep within cohorts.

4. Conclusions

The model we discuss is just a first step towards an understanding of the paths that go from wage shocks to observed consumption allocations. The most pressing issue we need to address is the treatment of labour supply. This would allow us to consider reactions in hours of work and, in the model above, give us a model of participation transitions, recognising them as an economic decision associated with the factors driving the income processes.

The other direction we think important is to consider insurance markets and other mechanisms people have to smooth consumption. In the model above, the distinction was between transitory shocks (which in a life cycle framework individuals can self insure) and permanent shocks (which induce consumption changes). The presence of liquidity constraints, however, might mean that some transitory shocks might be only partly smoothed out, while the presence of insurance mechanisms might make permanent shock partly insurable. Therefore an alternative classification would be that between insurable and uninsurable shocks. In this sense our research is related to and will develop the studies of perfect insurance (see Townsend, 1994; Attanasio and Davis, 1996). Within that framework it is important to distinguish among shocks at different frequencies and among alternative smoothing mechanisms.

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Appendix

On the left hand side of (1) we use the approximation

$$\mathrm{E}_t \ln \sum_{k=0}^{T-t} q_{t+k} c_{t+k} \simeq \ln\left\{1 + \sum_{k=1}^{T-t} \exp\left[\sum_{i=1}^{k} (\phi\omega_{t+i} - r_{t+i})\right]\right\} + \sum_{k=0}^{T-t} \zeta_k (\mathrm{E}_t \ln c_{t+k} - \sum_{i=1}^{k} \phi\omega_{t+i})$$

where $\zeta_k = \exp\left[\sum_{i=1}^{k}(\phi\omega_{t+i} - r_{t+i})\right] \Big/ \left\{1 + \sum_{k=1}^{T-t} \exp\left[\sum_{i=1}^{k}(\phi\omega_{t+i} - r_{t+i})\right]\right\}$ for $k = 1, \ldots, T-t$ and $\zeta_0 = 1 - \sum_{k=1}^{T-t} \zeta_k$.

On the right hand side of (1), assuming $A_t/(\mathrm{E}_t \sum_{k=0}^{T-t} q_{t+k} y_{t+k} + A_t)$ small, we can use the approximations

$$\mathrm{E}_t \ln \sum_{k=0}^{T-t} q_{t+k} y_{t+k} \simeq \ln\left\{1 + \sum_{k=1}^{T-t}\left[p_k^i \exp\left(\sum_{i=1}^{k} \delta_{t+i}^1\right) + (1 - p_k^i) \exp\left(\sum_{i=1}^{k} \delta_{t+i}^0\right)\right]\right\} + \sum_{k=0}^{T-t}\left\{p_k^i \rho_k^1 \left[\mathrm{E}_t \ln(y_{1t+k} + y_{2t+k}) - \sum_{i=0}^{k}(\gamma_{1t+i} + \gamma_{2t+i})\right] + (1 - p_k^i)\rho_k^0 \left(\mathrm{E}_t \ln y_{1t+k} - \sum_{i=0}^{k} \gamma_{1t+i}\right)\right\}$$

and

$$\mathrm{E}_t \ln(y_{1t+k} + y_{2t+k}) \simeq s_{t+k}\mathrm{E}_t \ln y_{1t+k} + (1 - s_{t+k})\mathrm{E}_t \ln y_{2t+k} - [s_{t+k} \ln s_{t+k} + (1 - s_{t+k}) \ln(1 - s_{t+k})]$$

where, for $i = 0, 1$,

$$s_{t+k} = \mathrm{E}_t y_{1t+k}/\mathrm{E}_t(y_{1t+k} + y_{2t+k})$$
$$\delta^i_{t+i} = \gamma_{1t+i} + i\gamma_{2t+i} - r_{t+i}$$
$$\rho^i_k = \exp\left(\sum_{i=1}^{k} \delta^i_{t+i}\right) \bigg/ \left[1 + \sum_{k=1}^{T-t} \exp\left(\sum_{i=1}^{k} \delta^i_{t+i}\right)\right] \text{for } k = 1, \ldots, T - t$$
$$\rho^i_0 = 1 - \sum_{k=1}^{T-t} \rho^i_k.$$

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