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A model-based approach using panel data for the 1990s[♣]

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ABSTRACT

Using panel data for the Netherlands, Germany and the UK for seven years in the late 1980s and early 1990s the paper examines the comparative evidence on longitudinal income and persistent poverty for the three countries. Elaborating on the existing methodological literature of income dynamics, a panel regression model has been estimated to arrive at population wide estimates of the population in persitent and transitory poverty in a comparative perspective. What the model actually pursues is to disentangle income over time in a permanent and transitory part. The idea behind the approach is that what really matters for people's welfare in the long run is their permanent income. The basic assumption is that people have a kind of latent long-term income-to-needs level from which occasional departures are possible due to temporary income shortfalls or income surpluses associated with the occurrence of events such as (un)employment, disability or illness, overtime work or working time reductions. According to this framework, poverty can be seen as a state in which permanent income falls below a predefined threshold being the long-term poverty line. The approach can therefore be helpful in estimating the size of the population in persistent poverty. When appropriate variables are added to the empirical model, it is possible to monitor the effect of socio-economic events on the permanent income-to-needs level.

Following Esping-Andersen's seminal work on welfare-state regimes, one might perceive the UK as a liberal welfare state although in a less prototypical sense as it exists in the US. Germany should clearly be considered to belong to the corporatist prototype and the Netherlands to the social-democratic type. Then, presumably, the UK has the lowest permanent income-to-needs level, the highest persistent poverty incidence and the highest income mobility. The findings confirm the presumption that permanent income is lower in a liberal welfare state as the UK although not very much lower than in the other countries. Hence, the transitory part of income is slightly larger in this liberal type of welfare state. The results also show that permanent income is more unequally distributed in the UK than in the Netherlands and Germany and that income inequalities have a less permanent character in the Netherlands. Besides, transitory shocks in income have a less permanent effect in the Netherlands than in the two other countries. The inclusion of household composition or labour market variables does not alter the main results. Viewing the effect of labour market status variables, like living in a household with a not working head, it is shown that members of these households are more likely persistent poor, particularly when the head is female. The effects of household structure on persistent poverty appear quite large. Especially, lone-parents households seem prone to persistent poverty in all three welfare regimes but single elderly particularly in the UK.

Keywords: persistent poverty, income dynamics, inequality, panel data, error component models

JEL Classification: C23, D31, I32

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The data for the Netherlands used in this paper are from the Dutch Socio-economic Panelsurvey and were made available by Statistics Netherlands. The German data are from the German Socio-economic Panel and were made available by the Deutsche Institut für Wirtschaftsforschung. The data for the UK were made available through the ESRC Data Archive. The data were originally collected by the ESRC Research Centre on Micro-social Change at the University of ESSEX. Neither the original collectors of the data nor the Data Archive, in the case of the UK data, bear any responsibility for the analyses or interpretations presented here.

NON-TECHNICAL SUMMARY

The notion of life-cycle income refers to the income level of individuals averaged over their life-time. In the long run, individual and household income is subject to numerous fluctuations. Hence, periods of unemployment or non-participation, for example, will reduce income compared to the life-cycle average. On the other hand, promotions or increases in the number of hours worked will increase the income level compared to its long-run average. Changes in household composition might have similar effects. The distinction between permanent and transitory income has important implications for the study of income poverty. Using cross-sectional snap-shots it is impossible to determine whether situations of low income are long lasting or just temporary. If cross-sectional poverty results from short run income fluctuations within the population, the burden of poverty throughout the years will be shared rather equally. If, on the contrary, cross-sectional poverty has a permanent character it implies that incomes are rather immobile and that, over the life cycle, it is always the same people who carry the burden of poverty. The goal of alleviating poverty as modern welfare states pursue, matters a great deal more in the long than the short term. Instant poverty can be unpleasant but is not life threatening and in some circumstances hardly matters at all. Many of us have been temporarily poor as students, or experienced short periods of poverty between jobs, being forced to run down savings, borrow and belt-tighten. Medium and long-term poverty, on the other hand, causes serious distress and often detaches people from their normal social contacts, leisure pursuits and 'mainstream' lifestyle.

Following Esping-Andersen's seminal work on welfare-state regimes, one might perceive the UK as a liberal welfare state although in a less prototypical sense as it exists in the US. Germany should clearly be considered to belong to the corporatist prototype and the Netherlands to the social-democratic type. Here, we concentrate on the question how well these various welfare regimes perform in terms of promoting long-term income mobility and preventing persistent poverty. Using seven years of panel data for the Netherlands, Germany and the UK, income is decomposed into a permanent and transitory part. Permanent or average income over seven years is taken as an indicator of life-time income and transitory income is supposed to measure the temporary deviations from this life-time income. Poverty is then defined as a state in which permanent income falls below a pre-defined poverty line. The findings confirm the presumption that permanent income is lower and the transitory part of income slightly larger in a liberal welfare state as the UK. The results also show that permanent income is more unequally distributed in the UK than in the Netherlands and Germany and that income inequalities have a less permanent character in the Netherlands. Besides, temporary changes in income have a less permanent effect in the Netherlands than in the two other countries. Viewing the effect of labour market status variables, such as living in a household with a not working head, it is shown that members of these households are more likely to be persistent poor, particularly when the head is female. The effect of household structure on persistent poverty appears to be quite large. Especially, lone-parents households seem prone to persistent poverty in all three welfare regimes but single elderly particularly in the UK.

1 INTRODUCTION

Research on the topic of poverty shows that, from a dynamic perspective, poverty has two dimensions. On the one hand, there is a great deal of mobility and turnover in the stock of people living in poverty. A part of the poor population remains in poverty only for rather short periods but might return quickly after having left poverty. On the other hand, a substantial number of poor can be said to be persistently poor. The goal of alleviating poverty as modern welfare states pursue, matters a great deal more in the long than the short term. Instant poverty can be unpleasant but is not life threatening and in some circumstances hardly matters at all. Many of us have been temporarily poor as students, or experienced short periods of poverty between jobs, being forced to run down savings, borrow and belt-tighten (see Headey et al., 2000). Medium and long-term poverty, on the other hand, causes serious distress and often detaches people from their normal social contacts, leisure pursuits and 'mainstream' lifestyle. It might discourage people to apply for jobs and to enter the labour market because of its negative effect on the incentives-to-work. It therefore creates long-term welfare dependency. Policies should be designed in such a way that it promotes economic mobility and prevents welfare dependency. By comparison of three more or less prototypical welfare states over the medium term we want to evaluate how well different welfare state regimes perform in terms of preventing persistent poverty. These policy achievements are assessed on the basis of panel data for three European countries: the Netherlands, Germany and the United Kingdom (cf. Goodin et al. 1999). A longitudinal data-file for the three countries was created covering a period of altogether seven years in the late 1980s and the 1990s.

Using cross-sectional snap-shots, it is impossible to determine whether situations of low income are long lasting or just temporary. If cross-sectional poverty results from short run income fluctuations within the population, the burden of poverty throughout the years will be shared rather equally. If, on the contrary, cross-sectional poverty has a permanent character it implies that incomes are rather immobile and that, over the life cycle, it is always the same people who carry the burden of poverty. The presence of highly persistent income inequalities may point to the inflexibility of institutional arrangements affecting individual's life-cycle incomes, while temporary income inequalities point to the existence of rather flexible institutions fostering income mobility.

Elaborating on the existing literature on modelling income dynamics, a panel regression model is estimated in order to disentangle income in a permanent and a transitory component. The basic idea behind this approach is that people are most concerned not with short-term changes in welfare but with maintenance of their welfare level in the long run and hence, with their permanent income. Within this model, poverty can be seen as a state in which permanent income falls below a predefined threshold, the poverty line. Hence, the model can be used to estimate the size of the population in persistent poverty and to compare the prevalence of persistent poverty across welfare regimes. Then the hypotheses were tested that were formulated using Esping-Andersen's theory about the performance of the different policy regimes especially with a view to the combat of persistent poverty. In the next stage the model has been used to monitor the effect of socio-economic variables representing particular socio-economic events on persistent poverty and to compare their impact across the three welfare regimes.

In Section 2, the theoretical hypotheses derived from the literature are explained. Then Section 3 deals with measurement issues regarding income and poverty. The empirical model is explained in Section 4 and the data used for estimation are briefly presented in Section 5. Cross-sectional results on poverty incidence are presented in Section 6, and our estimation results for persistent poverty are discussed in Section 7. In the final section, Section 8, some conclusions are drawn.

2 EXPECTATIONS

In his seminal work, Esping-Andersen (1990) elaborates a typology of welfare state regimes in which he makes a distinction between liberal, corporatist and social democratic welfare regimes. In this typology, the UK welfare state can, to some extent and with a lot of 'good will', be classified as a liberal one, not as a prototype like the American welfare state, but at least sharing some features of the archetype. The nature of the German welfare state is predominantly that of a corporatist regime type. As to the Netherlands, it can be viewed as a social democratic welfare regime. Each of the welfare state regimes strive for their own specific socio-economic objectives. Speaking in general terms, by promoting employment, avoiding work disincentives and welfare dependency, liberal welfare states pursue the objectives of increased economic growth and living standard. Liberal welfare states usually provide low, means tested benefits. Social democratic welfare states aim at reducing poverty, income inequality and unemployment

through a redistributive tax-benefit system and an active labour market policy. Social democratic welfare states typically provide relatively generous replacement incomes. Corporatist welfare states seek to promote income stability and social integration by a well developed, status-group oriented or selective system of social insurance. The corporatist type is perceived as a typical 'breadwinner-state' relying heavily on employment protection for the head of household and on family support to maintain the welfare of other household members.

Although the purpose of welfare state arrangements is broader than the sole prevention of (long-term) poverty, it must be recognised that the issue of persistent poverty alleviation is an important one for welfare policies. Here, we concentrate on the question how well these various welfare regimes, as represented by the Netherlands, Germany and the UK, perform in terms of promoting long-term income mobility and preventing persistent poverty:

- Given the welfare state features of these three countries, it can be expected that the long-term poverty rate in the UK is larger than in Germany and the Netherlands;
- Similarly, permanent income is expected to be more equally distributed in Germany, next lowest in the Netherlands and most unequally distributed in the UK;
- Due to the large level of income volatility in liberal type welfare states, temporary income shocks are expectedly largest in the UK, lower in the more status oriented German system and lowest in the egalitarian Dutch welfare state.

3 ISSUES OF MEASUREMENT

3.1 Income and poverty

In the paper, the focus is on persistent poverty, where poverty is defined in terms of low welfare or lack of cash income, i.e. having an income below some predefined cash-income threshold. The income concept is that of annual equivalent net household income. Household income is standardised using the modified OECD equivalence scale giving a weight of 1 to the first adult, 0.5 to any other household member aged 14 or more and 0.3 to each child aged less than 14. Given that our analyses are at the individual level, annual equivalent net household income is attributed to every person in the household.

In order to determine the poverty status, a relative poverty line has been used that is set equal to 50% of the median equivalent household income.

The procedure to derive a poverty threshold sketched above might be criticised because it reduces the notion of poverty to one of relative inequality. Also the choice of the half-median equivalent income is somewhat arbitrary. However, the method has considerable advantages for our approach. First, because it can be constructed in a consistent manner across time and countries which is very useful for performing longitudinal comparative analyses of poverty. Next, it is transparent and easily computable from readily available data sets.

Dividing equivalent income by the poverty line level gives us income-to-needs ratios. It is a continuous measure of the income situation but it can easily be converted into a discrete indicator by setting the cut-off point in the distribution of income-to-needs to 1, the break even point between income and needs. Individuals with income-to-needs levels below 1 are considered poor while those with income-to-needs levels above 1 are not.

3.2 Longitudinal indicators of poverty

From an economic point of view, it is important to make a distinction between temporary and persistent income inequalities. The more persistent income inequality is, the lower income mobility is. This could point to the existence of institutional rigidities that strongly affects someone's life-cycle income, implying that the burden of inequality over time is passed on to the same people. On the other hand, if cross-sectional inequalities were due to short-term income disparities, a high degree of income mobility would imply a more equal distribution of income. The same reasoning applies to poverty. Since persistent and transient poverty require distinctive policy responses, it is essential to develop tools for measuring the extent of both types of poverty.

Four types of persistent poverty indicators have been used in the literature. These are the n-year income-to-needs ratio, the fraction of n years in poverty, the spell approach and model-based estimates of persistent poverty (see Duncan & Rodgers 1991). The *n-year income-to-needs* ratio is the ratio of aggregated income over n years to the aggregated needs (poverty line) over these n years. It is thereby assumed that an income surplus in one year can compensate for an income shortfall in another. This measure refers to Friedman's notion of permanent income. According to the *fraction of n-years in poverty*

measure (or tabulation method), persistent poverty is defined as having an income below the poverty line for a predefined number of years, preferably a large fraction of the years in the observation period. This index is a measure of the stability of positions below the poverty line. The *spell based measure of persistent poverty* as proposed by Bane and Ellwood (1986) departs from constructed spells of poverty. Starting form the standard life table approach, persistent poverty is defined in terms of the likelihood of leaving poverty after a spell of n years. These three measures have been widely used in poverty research (see Muffels et al., 1999). The *model-based approach to persistent poverty*, based on the estimation of error component panel regression models, on the other hand, has been less widely used. In this paper the latter type of approach is adopted.

4 TOWARDS A MODEL-BASED ESTIMATION OF PERSISTENT POVERTY

Income at any point in time can be decomposed into a permanent component, that represents the level of income an individual enjoys on average over time, and a transitory component measuring deviations (positive or negative) from this average. At the end of the 1970s, Lillard and Willis (1978) presented a methodology to analyse earnings dynamics of male employees in this way. They estimate a panel regression model of earnings with permanent and transitory components and derive a measure for persistent poverty. This type of approach will be followed here but applied to the study of household income dynamics. The approach assumes that what really matters for people in the long run is their permanent income. The basic assumption is that people have a kind of latent long-term income-to-needs level from which occasional departures are possible due to temporary income shortfalls or income surpluses following some life events. While similar models to the one used here have been applied to study the dynamics of earnings at the individual level (most often employed males), only few studies have been published where this methodology is applied to study household income dynamics. In this respect, the articles by Duncan (1983), Duncan and Rodgers (1991) and, more recently, Stevens (1999) are of interest. However, all these studies are based on US data, supposedly because of the availability of longer running panels such as the PSID. The increasing availability of longer panel in Europe makes it possible to estimate such models for European countries and to study cross-national differences in greater detail.

Like in Duncan and Rodgers (1991), the model estimated in this paper presumes that the life-cycle distribution of income-to-needs ratios is a function of the distribution of

permanent income-to-needs, year specific shocks and an auto-regressive parameter that determine how the effect of these shocks persist through time.
Formally, the model can be written as:

$$y_{i,t} = X_{i,t}\beta + \mu_i + \delta_{i,t} \qquad [1]$$

$i = 1,...,N$
$t = 1,...,T$

$$\mu_i \sim \left(\bar{\mu}, \sigma_\mu^2\right) \qquad \delta_{i,t} \sim \left(0, \sigma_\delta^2\right)$$

where $y_{i,t}$ is the natural logarithm of the income-to-needs ratio, $X_{i,t}$ is a matrix of covariates which may include age, sex, employment status, household structure, etc., β is a vector of parameters, μ_i is a random individual component accounting for unmeasured variables (unobserved heterogeneity) with mean $\bar{\mu}$ and constant variance ($E\left(\mu_i^2\right) = \sigma_\mu^2$), and $\delta_{i,t}$ is a random residual term. This model can be estimated with and without covariates. In the model without covariates, $\bar{\mu}$ represents the level of permanent income-to-needs unadjusted for observed individual and household characteristics. σ_μ^2 is a measure of the dispersion (inequality) of the permanent income-to-needs ratio and σ_δ^2 measures the dispersion of temporary income shocks, so that the variance of income is in part due to variations in permanent income and for the rest to variations in transitory income ($\sigma_y^2 = \sigma_\mu^2 + \sigma_\delta^2$).

Observed covariances are often found to decline with time distance (see Appendix 2). To comply with this fact, the model allows for serial correlation of the transitory residual term (AR1):

$$\delta_{i,t} = \rho\delta_{i,t-1} + \varepsilon_{i,t} \qquad [2]$$

$$\varepsilon_{i,t} \sim N\left(0, \sigma_\varepsilon^2\right)$$

where $\varepsilon_{i,t}$ is an incidental shock in income-to-needs ratios and the auto-correlation coefficient ρ measures the serial correlation between the random shocks from one period to the following. It also measures of the effect of serially correlated unobserved variables on income. Like Lillard and Willis (1978), this carry-over effect is assumed constant over time. The incidental disturbances $\varepsilon_{i,t}$ are assumed to be normally distributed with mean zero and variance σ_{ε}^2 that is constant across individuals and years ($E(\varepsilon_{i,t})=0$; $E(\varepsilon_{i,t}^2)=\sigma_{\varepsilon}^2$). It measures the effect of transitory shocks on income, but also incorporates measurement error. μ_i and $\varepsilon_{i,t}$ are assumed to be independent ($E(\mu_i\varepsilon_{i,t})=0$). More complex error structures have sometimes been used in the literature, such as a mixed autoregressive moving average process as in MaCurdy (1982) or Dickens (2000) for example. However, introducing a more complex error structure in equation [2] complicates the interpretation of the model in terms of permanent and transitory effects. Since the purpose of the paper is precisely to disentangle temporary and permanent income components, the more parsimonious model specification as given by equations [1] and [2] is preferred.

In this model, persistent poverty can be defined as a state in which permanent income is below the poverty line. It is assumed that the logarithm of the life-cycle permanent income-to-needs is normally distributed with mean $\bar{\mu}$ and variance σ_{μ}^2 estimated from the sample of respondents. Given these assumptions, the proportion of the population with a permanent income below the poverty line or, equally, the probability of having a log income-to-needs below zero, can be derived from the cumulative standard normal distribution of income-to-needs:

$$pr(persistent\ \ poor) = pr(\mu_i \le 0) = F\left(-\frac{\bar{\mu} + X_{i,t}\hat{\beta}}{\hat{\sigma}_{\mu}}\right). \qquad [3]$$

This notation is analogous to that in Lillard and Willis (1978: 996) and Duncan and Rodgers (1991: 540). In [3], account is taken of the fact that individual characteristics affect the level of income-to-needs. For example, living in a lone-parent household would typically lead to a lower level of income-to-needs (negative β). Suppose $X_{i,t}$ only includes dummies for lone-parent households, one could estimate persistent poverty among the T-

year lone-parents by evaluating the cumulative standard normal distribution at $-\left(\bar{\mu}+\hat{\beta}\right)/\hat{\sigma}_{\mu}$.

Some authors have pointed to the drawbacks of error component models to study household income dynamics and poverty persistence. Jenkins (1999: 20) argues that these models better be used for the purpose they were originally designed, i.e. the study of earnings dynamics, and regrets the absence of "explicit or obvious link between the variance component specifications and the underlying labour market and household formation process". Comparing the poverty spells approach to the variance-components model Stevens (1999: 582) favours the first approach because it tends to replicate better the observed distribution of time spent in poverty following from the tabulation method. Nevertheless, it is believed that this methodology is quite in line with what Lillard and Willis (1978: 1007) had in mind when they argued in favour of a more complete analysis of poverty, considering household income and variations in household composition over time.
One problem associated with the study of household income dynamics, and this problem is not specific to the type of approach used here, is that household formation dynamics are a driving force behind income changes. In other words household formation and household decomposition are endogenous to the dynamics of income changes over time. Hence, it would be incorrect to consider such processes as exogenous in [1]. Yet, recognising that household formation and household decomposition might be used as a strategy to escape (long-term) poverty, we have tried to build these events into the model.
When the researcher is aiming at modelling processes that require information on the time prior to the start of the panel, it would be required to correct for initial conditions.[1] At this stage, however, initial conditions were not taken into account. The minimum distance method has been used for the estimation of the model. Details are presented in Appendix 1.

5 THE DATA

For our analyses, a seven-year panel data set for the Netherlands, Germany and the UK has been constructed (see also Appendix 2). All results, except those in Section 6, are based on a balanced data set containing only respondents who have taken part to the survey in all seven years. The data for the Netherlands are from the Dutch Socio-economic Panel (SEP). This panel started off in 1984 and is still running at the

[1] Recall that in the model, y_{it} is a function of μ_i, ε_{it}, ρ and δ_{it-1}.

moment. Initially, interviews were carried out twice a year in April and October, but in 1990 it was decided to switch to annual interviews. Previous to 1990, respondents were asked for their net personal incomes the month before interview. These data have been multiplied by twelve to produce a yearly income. From 1990 onward, however, respondents are asked for their gross income in the previous year. Paid taxes have been estimated and subtracted in order to produce a net yearly income. This change in income measurement has slightly increased the inequality of the distribution of household income.
Like in the two other data sets, household income is obtained by summing individual income of persons living in the same household. The Dutch income data cover the seven-year period 1988-1994.

The German data come from the German socio-economic panel, as made available through the PSID-GSOEP equivalent file. It began in 1984 in West Germany and, after reunification, was extended to cover the whole of Germany in 1990. The 1990 through 1996 waves of the data have been used containing retrospective income data for the year previous to interview. It means that use is made of net household income data for Germany running from 1989 to 1995. [2]

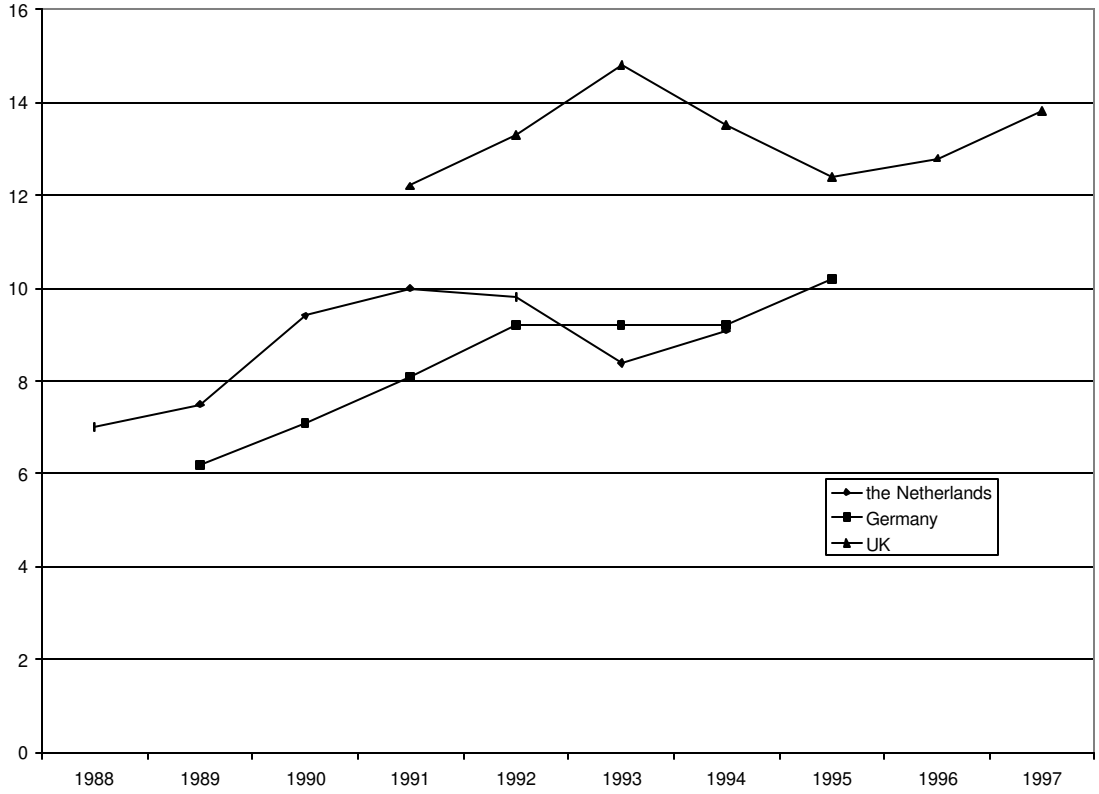
The UK data are from the British Household Panel Survey (BHPS). In the BHPS, respondents are asked to report on their gross income. The gross income variables refer to the period of one year back, up to August of the current year, the date of interview. Gross incomes have been converted into net incomes, which are supplied as a supplement to the BHPS data (cf. Bardasi, Jenkins & Rigg 1999). Net household income for the UK for the years 1991 through 1997 has been used.

6 SINGLE YEAR POVERTY[3]

Before moving on to the estimation of the panel regression model, some cross-sectional figures on poverty for the Netherlands, Germany and the UK are briefly presented. The proportion of poor for the three countries is depicted in Figure 1.

[2] The eastern sample, for which no income data is available in the 1990 and 1991 waves, is excluded from the German balanced data set used for the estimation of the error component model.
[3] The results in this section are computed on an unbalanced data set and weighted using cross-sectional weights.

Figure 1: Poverty incidence in the Netherlands, Germany and the UK, 1988-1997



Source: SEP (1988-1995); PSID-GSOEP (1990-1996); BHPS (1991-1997); unbalanced panel.

In all three countries, single year poverty appears to have increased during the seven-year period. Overall, poverty incidence is highest in the UK. Poverty incidence is lowest in Germany at the beginning of the observation period, but is catching up with the poverty rate in the Netherlands. Towards the end of the period, Dutch and German poverty rates are about the same. To get an idea of the distribution of poverty within the population, Table 1 shows the poverty rate in a number of sub-groups for the last common available year for the three countries (1994). Looking at the table, some striking differences appear within countries, but also across countries. Living in a female headed household, for example, very much increases the probability of being poor, but more so in the UK than in Germany or the Netherlands. A part of this group consists of single elderly households (widows) who are more likely to be poor because they often have to live from a small public pension without additional income sources. These female headed households furthermore consists mainly of students or young people with normally quite good income prospects, because of which their poverty situation is rather short-term. Single

elderly have a below average poverty risk in the Netherlands which must be attributed to the rather high level of pension benefits, consisting of a basic pension that in most cases is supplemented with a private pension, which is higher than the poverty threshold used in this study. However, their poverty risk is higher than average in Germany and highest in the UK. Lone-parents display a higher poverty risk than average in all three countries. Yet, they seem to be better off in the Netherlands compared to Germany and the UK. In all three countries, the poverty rate among persons living in a household with a head not in gainful employment is about twice the average.

Table 1: Single year poverty statistics for some population groups, 1994 (% poor persons)

	the Netherlands	Germany	UK
Total	9.1	9.2	13.5
Gender of household head			
- Male	8.6	6.3	8.6
- Female	12.8	14.9	21.3
Household type			
- Single non elderly	11.8	16.4	22.5
- Single elderly	3.1	10.2	29.2
- Couple, no child	8.2	3.7	2.8
- Couple with child(ren)	9.0	6.8	11.1
- Elderly couple	9.8	3.7	6.0
- Lone parent	17.6	45.2	49.4
- Other	15.0	8.1	9.2
Employment status of household head			
- Employed	2.9	3.9	4.5
- Not employed*	21.2	18.8	25.9

* Unemployed or inactive.

Source: SEP (1995); PSID-GSOEP (1995); BHPS (1994); unbalanced panel.

7 ESTIMATION RESULTS[4]

7.1 Population in persistent poverty

The first model that is estimated does not control for socio-economic characteristics of the person and its household. This was done in order to get an overall estimate of household income mobility and persistent poverty. The results of this first estimation are presented in Table 2. The permanent income-to-needs level is lower and is also more unequally distributed in the UK than in the Netherlands or Germany. This confirms our second expectation. The carry-over effect of transitory shocks in income (auto regressive parameter) is lower in the Netherlands than in the two other countries. This can possibly be explained by reference to the more egalitarian welfare state arrangements in the Netherlands due to which these shocks tend to be evened out by the tax and social security system. Random shocks are found to be smallest in Germany, which partly confirms our third expectation. The German earnings-related social insurance system links benefits quite closely to previous income for which reason there is more income stability and smaller random shocks. The random shocks were expected to be highest in the UK. However, these turn out to be equally high in the Netherlands as in the UK. This can possibly be explained by the change in income measurement in the Netherlands at the start of the 90s, which affected the level and the distribution of household income (see Section 5).

The model estimate of the individual effect variance reveals that in the Netherlands, 47 per-cent of the variance in income-to-needs can be attributed to permanent income differences. The rest can be attributed to temporary differences in income. The proportion of income variance that is due to permanent income is 56 and 58 per-cent for Germany and the UK, respectively.[5] Thereby, the permanent component of income inequality is found to be larger in Germany and the UK than in the Netherlands. This points to a relatively more 'open' institutional structure in the Netherlands that permits people to restore their original income positions easier than in the two other countries. Ramos (1999) who estimated a similar model for individual earnings in the UK found a lower

[4] The results in this section are weighted using longitudinal weights in order to correct for panel selectivity.

[5] From equation A1 in Appendix 1, one can see that the relative importance of permanent income variance in total income inequality can be computed as $\sigma^2_\mu / \sigma^2_y$. While σ^2_μ is given in Table 2, σ^2_y is reported in Table A1.

degree of persistency of income inequalities: one fourth of overall earnings inequality could be attributed to permanent earnings disparities. This is somewhat surprising since household income is expected to be less stable than earnings. Our finding might be explained by the fact that household income is corrected for needs which are relative in time and space. Changes in income over the years would account for the temporary component in the model. Howerver, as needs change together with income this effect is, to some extent, evened out.

Matching our first expectation it turns out that persistent poverty is highest in the UK, which in the paper is considered to belong to the liberal regime type. It is more than twice as higher in the UK than it is in the two other countries. Permanent poverty proves to be at rather low levels in the Netherlands and Germany sharing a rather low percentage of permanent poverty (2%).

Table 2: Estimation results for the Netherlands, Germany and the UK, no covariates, 1988-1997 (standard error of the estimates)[*]

	The Netherlands (1988-1994)	Germany (1989-1995)	UK (1991-1997)
Mean ln income-to-needs ratio	.720	.767	.687
Individual effect variance ($\hat{\sigma}_{\mu}^{2}$)	.123	.128	.185
	(.004)	(.005)	(.004)
Random shock ($\hat{\sigma}_{\upsilon}^{2}$)	.094	.065	.091
	(.003)	(.002)	(.002)
Auto-regressive parameter ($\hat{\rho}$)	.449	.520	.543
	(.017)	(.020)	(.015)
χ^2	577.3	470.5	230.2
Df	25	25	25
Estimate of proportion in persistent poverty (%)			
	2.0	1.6	5.5

* Mean log income-to-needs obtained from first stage pooled cross-sections regression. Other parameters obtained from minimum distance estimation as explained in Appendix 1.

Source: SEP (1988-1995); PSID-GSOEP (1990-1996); BHPS (1991-1997); balanced panel.

Household and labour market dynamics are likely to influence the level of persistent income and its distribution. Therefore, population estimates of persistent poverty, controlling for household characteristics, on the one hand, and labour market status, on the other, are presented in the next sections.

7.2 Controlling for household composition

An alternative model was specified and estimated in which account was taken of the effect of household structure and composition on the level of permanent income. In equation [1], dummies were introduced to control for lone-parent household, single elderly male, single elderly female, male headed household with children and female headed household with children. The results are shown in Table 3. The calculation of the persistent poverty rate is made under the assumption that the persons had the same household characteristics during the whole period.

Comparing the estimation results with those in Table 2, it is shown that the estimates are rather stable. The inclusion of covariates, as expected, results in reduction of the individual effect variance because covariates account for part of the income fluctuation, but does not affect the other parameters significantly.

With respect to long-term poverty, lone-parents are clearly worst off. The persistent poverty rates for lone-parent households are much larger than for the other household types. There are obvious reasons that might explain the worse position of this group. First of all, the time needed for childcare limits the time available for work and therewith the opportunity to earn additional income, especially when there is poor supply of child-care relief services like in the Netherlands. Secondly, the lack of employment opportunities that fits the work-leisure preferences of this group might be held responsible as well. Persistent poverty among single elderly women as well as men is larger than average in all countries, but more so in the UK. Note the relative worse position of single elderly women who in the UK have a four to five times higher risk on permanent poverty than single women have in the two other countries. Perhaps more surprising is the high rate of persistent poverty for female headed households with children in the Netherlands compared to the other two countries. Obviously, they have few chances to escape from poverty through household formation events ([re]marriage) or labour market events (acquiring a long-hours paid job) and therefore are deemed to stay

into poverty until children has grown up. The evidence indeed shows that remarriage rates in the Netherlands are rather low as are the opportunities to childcare relief.

Table 3: Estimation results for the Netherlands, Germany and the UK, controlling for household composition, 1988-1997 (standard error of the estimates)[*]

	The Netherlands (1988-1994)	Germany (1989-1995)	UK (1991-1997)
Mean ln income-to-needs ratio			
- Single elderly man	.647	.802	.461
- Single elderly woman	.549	.517	.256
- Couple, male head, children	.654	.749	.672
- Couple, female head, children	.403	.661	.624
- Lone parent	.253	.180	.109
Individual effect variance ($\hat{\sigma}_{\mu}^{2}$)	.109	.112	.141
	(.004)	(.004)	(.004)
Random shock ($\hat{\sigma}_{\upsilon}^{2}$)	.095	.064	.091
	(.003)	(.002)	(.002)
Auto-regressive parameter ($\hat{\rho}$)	.442	.509	.545
	(.016)	(.019)	(.014)
χ^2	566.2	441.3	234.2
Df	25	25	25
Estimate of proportion in persistent poverty (%)			
- Single elderly man	2.5	0.8	11.0
- Single elderly woman	4.8	6.1	24.8
- Couple, male head, children	2.3	1.3	3.7
- Couple, female head, children	11.0	2.4	4.8
- Lone parent	22.2	29.5	38.6

* Mean log income-to-needs obtained from first stage pooled cross-sections regression. Other parameters obtained from minimum distance estimation as explained in Appendix 1.

Source: SEP (1988-1995); PSID-GSOEP (1990-1996); BHPS (1991-1997); balanced panel.

7.3 Controlling for labour market status

The labour market status was measured by introducing dummy variables for the employment status of the household head. The results are presented in Table 4 and should

be interpreted in comparison to the base model in Table 2. Not surprisingly, unemployment increases the probability of being poor. This effect is however small in Germany for male heads. Again, it might be explained by the way social insurance links social security income to previous earnings. For female headed households, not being at work means more often earning no additional income. They have to make a living with incomes that are on average lower than what they would have earned under the social insurance regime. Hence, they are more prone to persistent poverty than male-headed households who would be more often employed.

Table 4: Estimation results for the Netherlands, Germany and the UK, controlling for employment status, 1988-1997 (standard error of the estimates)[*]

	The Netherlands (1988-1994)	Germany (1989-1995)	UK (1991-1997)
Mean ln income-to-needs ratio			
- Male head, not employed[#]	.563	.648	.495
- Female head, not employed[#]	.432	.462	.348
Individual effect variance ($\hat{\sigma}_{\mu}^{2}$)	.114	.119	.147
	(.004)	(.004)	(.004)
Random shock ($\hat{\sigma}_{\upsilon}^{2}$)	.095	.062	.095
	(.003)	(.002)	(.002)
Auto-regressive parameter ($\hat{\rho}$)	.398	.497	.482
	(.015)	(.019)	(.015)
χ^2	566.0	469.5	272.4
Df	25	25	25
Estimate of proportion in persistent poverty (%)			
- Male head, not employed[#]	4.8	3.0	9.8
- Female head, not employed[#]	10.1	9.1	18.2

*Mean log income-to-needs obtained from first stage pooled cross-sections regression. Other parameters obtained from minimum distance estimation as explained in Appendix 1.

Unemployed or inactive.

Source: SEP (1988-1995); PSID-GSOEP (1990-1996); BHPS (1991-1997); balanced panel.

8 CONCLUSION

In this paper, a model-based approach to long-term poverty is applied in order to derive population estimates of persistent poverty in three typical European welfare states: the Netherlands (social democratic welfare state), Germany (corporatist welfare state) and the UK (in the liberal tradition). Persistent poverty is indeed shown to be largest in the UK (around 5.5 per-cent), with Germany and the Netherlands having similar but much smaller proportions of their population in persistent poverty (around 2 per-cent). The permanent income-to-needs level turns out not only to be lower in the UK than in Germany and the Netherlands, but also more unequally distributed. It is shown that a larger part of overall British and German (56 to 58 per-cent) income inequality is due to permanent income differences than is the case in the Netherlands (47 per-cent). The results follow largely the expectations derived from Esping-Andersen's theory of welfare regimes. Although it is true that additional research effort is needed to improve this type of modelling, the primary results are promising. We found some clear and from a theoretical viewpoint coherent differences across the three welfare regimes. Further evidence shows that temporary income shocks tend to be lowest in Germany but less long lasting in the Netherlands. The Netherlands appear a more open society in terms of the opportunities people have to restore their original positions. Viewing labour market status, the findings confirm that living in a household with a head not at work makes it much more likely to be persistently poor. That holds a fortiori for households with a not working female head, likely because their labour market position is still worse compared to male heads of households. Looking at household structure, persistent poverty among lone-parents appears to be quite large in all three countries corroborating and stressing the results of many poverty studies. In the UK, remarkably, single elderly are also more likely persistent poor than is on average the case.

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APPENDIX 1: ESTIMATION PROCEDURE[6]

To date, there is no statistical software with ready to use routines to estimate the type of models presented in Section 4. Therefore, following the same methodology as Abowd and Card (1989) and Dickens (2000), the parameters of the model are estimated by fitting the theoretical covariance structure to the empirical second moments (minimum distance estimation). These calculations have been performed in two steps on a balanced data set (see Appendix 2). In a first stage, a pooled cross-sections regression was estimated. In a second step, the residuals of the first stage regression were used in the estimation of the minimum distance function as explained below.

Given a balanced sample (N x T), define the vector $u_i^{'} = \left(u_{i,1},...,u_{i,T}\right)$, the vector of error derived from a first stage pooled cross-sections regression. The constant term in the pooled cross-sections regression equals the income-to-needs ratio averaged over time and individuals ($\overline{\mu}$). The error term $u_{i,t}$ corresponds to the variance of μ_i and $\delta_{i,t}$ in equations [1] and [2].

The covariance matrix M can be written as: $M = \frac{1}{N}\sum_i u_i u_i^{'}$. M is symmetric and has T(T+1)/2 distinct elements. Define m_i a column vector containing the distinct elements of the individual cross products $u_i u_i^{'}$, $m_i \sim N\left(m, V\right)$ where m is a column vector of the elements from M and V is the fourth moments matrix: $V = \frac{1}{N}\sum_i \left(m_i - m\right)\left(m_i - m\right)^{'}$.

Given the model represented by equations [1] and [2], the theoretical covariance matrix accounting for the AR(1) process equals:

$$E\left(u_{i,t}u_{i,s}\right) = \sigma_{\mu}^2 + \sigma_{\varepsilon}^2 \frac{\rho^{|t-s|}}{1-\rho^2} = f\left(\sigma_{\mu}^2, \sigma_{\varepsilon}^2, \rho\right). \qquad [A1]$$

$E\left(u_{i,t}u_{i,s}\right)$ can be represented by a column vector $f\left(b\right) = f\left(\sigma_{\mu}^2, \sigma_{\varepsilon}^2, \rho\right)$. Following the minimum distance estimation method, the parameters are obtained by minimising the

[6] We are grateful to Lorenzo Cappellari from the Catholic University of the Sacred Heart of Milan for his help and STATA program used for our estimations (see Cappellari 1999).

quadratic form $\left(m - f(b)\right)' A\left(m - f(b)\right)$ with respect to b, where A is some suitable weighting matrix. Taking A as the identity matrix, as suggested in Altonji and Segal (1994), the method is equivalent to non-linear least squares estimation. The standard errors of the estimated parameters are then given by: $\left(G'G\right)^{-1} G'VG\left(G'G\right)^{-1}$, where G is the gradient matrix evaluated at the estimated value of b: $G = \frac{\delta f(b)}{\delta b}\Big|_{b=\hat{b}}$.

Note that because we estimate the model at the individual level, assigning standardised household income to each person within the same household, the observations are not truly independent while they are assumed to be in the model. This might result in an underestimation of the standard error of our estimates.

Given the number of estimated parameters (p), a test of correct model specification against the alternative hypothesis of unrestricted covariance structure is given by:

$$N\left(m - f\left(\hat{b}\right)\right)' V^{-1}\left(m - f\left(\hat{b}\right)\right) \sim \chi^2_{\left(\frac{T(T+1)}{2} - p\right)}.$$

The model was estimated separately for the three countries.

APPENDIX 2: DESCRIPTION OF THE DATA

The data for the Netherlands are from the Dutch Socio-economic Panel (SEP). The German data come from the German socio-economic panel, as made available through the PSID-GSOEP equivalent file. The UK data are from the British Household Panel Survey (BHPS). The panel regression model was estimated using a balanced panel data set. Because the model was found to be quite sensitive to a small number of extreme values, some cases have been removed: sample members with logarithm of income-to-needs ratios below -3 or above +3 were excluded from the analysis, as well as respondents whose variance of log income-to-needs excludes 2. These restrictions exclude most of the respondents for which large measurement error of income can be expected. This selection is similar to that performed by Duncan and Rodgers (1991).

Table A.1 summarises the main features of the balanced data sets used for estimation of the error component model.

Table A.1: Main features of the balanced panel

	The Netherlands (SEP)	Germany (PSID-GSOEP)	UK (BHPS)
Time period	1988-1994	1989-1995	1991-1997
N each year	5,423	5,751	6,382
Median net standardised household income	*f* 42,218	DM 48,665	£ 8,061
Mean income-to-needs	.720	.767	.687
(variance; σ^2_y)	(.259)	(.227)	(.320)

Source: SEP (1988-1995); PSID-GSOEP (1990-1996); BHPS (1991-1997); balanced panel.

Given the seven years of data, we dispose of 28 unique moments to perform the minimum distance estimation. The covariance matrices of the polled cross-sections residuals used in the minimum distance estimation (see Appendix 1) are shown in the next three tables.

Table A.2: Covariance matrix of polled cross-sections residuals for the Netherlands

	1988	1989	1990	1991	1992	1993	1994
1988	0.221						
1989	0.133	0.225					
1990	0.130	0.153	0.259				
1991	0.123	0.147	0.183	0.252			
1992	0.111	0.137	0.163	0.176	0.288		
1993	0.108	0.125	0.153	0.165	0.182	0.236	
1994	0.105	0.127	0.148	0.158	0.168	0.183	0.226

Source: SEP (1988-1995); balanced panel.

Table A.3: Covariance matrix of polled cross-sections residuals for Germany

	1989	1990	1991	1992	1993	1994	1995
1989	0.184						
1990	0.140	0.212					
1991	0.124	0.156	0.220				
1992	0.112	0.143	0.158	0.221			
1993	0.102	0.122	0.134	0.159	0.230		
1994	0.091	0.113	0.119	0.140	0.165	0.242	
1995	0.079	0.101	0.107	0.122	0.143	0.156	0.223

Source: PSID-GSOEP (1990-1996); balanced panel.

Table A.4: Covariance matrix of polled cross-sections residuals for the UK

	1991	1992	1993	1994	1995	1996	1997
1991	0.316						
1992	0.242	0.322					
1993	0.222	0.253	0.323				
1994	0.204	0.228	0.257	0.311			
1995	0.191	0.212	0.231	0.253	0.317		
1996	0.179	0.196	0.216	0.227	0.249	0.301	
1997	0.173	0.195	0.210	0.216	0.226	0.241	0.325

Source: BHPS (1991-1997); balanced panel.

OSA-Working papers

No.	Author(s)	Title
WP2000-1	Jan Boone & Jan C. van Ours	Modeling financial incentives to get unemployed back to work
WP2000-2	Michèle Belot & Jan C. van Ours	Does the recent success of some OECD countries in lowering their unemployment rates lie in the clever design of their labour market reforms?
WP2000-3	Jan Boone & Lans Bovenberg	Optimal labour taxation and search
WP2000-4	Didier Fouarge & Ruud Muffels	Persistent poverty in the Netherlands, Germany and the UK A model-based approach using panel data for the 1990's