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Recent Trends in Household Income Dynamics for the United States, Germany and Great Britain

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Abstract

This paper examines the recent trends in household income volatility in the United States, Germany and Great Britain, and compares household income volatility with individual income volatility. I estimate a formal error components model using the Cross-national Equivalence File from 1979 to 2004. I find that household income volatility, measured by the transitory variance of household income, accounts for more than half of the total income variance for all three countries. Despite the differences in the total household income variances among the three countries, the permanent variances converges since the late 1990s.

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1. Introduction

Rising inequality in individual earnings and household income has been an important economic feature in the United States over the past several decades as well as in many other advanced industrial countries (Levy and Murnane 1992, and Gottschalk and Smeeding 1997). Such an increase in the cross-sectional income inequality could arise either from an increase in the dispersion of permanent income, or a larger income fluctuations from year to year (income volatility). In this paper I apply a formal error components model to examine the following questions: How much of the household income inequality reflects income volatility rather than the dispersion of permanent income and how has this changed over time? How does household income volatility differ from individual income volatility? Are these trends in the United States different from other advanced industrial countries?

It is important to distinguish between the dispersion in permanent income and income volatility to understand the causes of the growing cross-sectional income inequality. For labor earnings dynamics, rising dispersion in permanent income is usually attributable to a skill-biased technological change or increased trade with developing countries (Katz and Autor 1999), while rising earnings volatility are more related to the instability of the labor market (Moffitt and Gottschalk 2002). For household income dynamics, permanent income dispersion and income volatility may be attributable to many other economic and social factors because they involve income sources and decisions of more than one person. The causes of the dispersion in permanent household income may also be affected by marital sorting. If higher educated women become more likely to marry higher educated men, this could enlarge the income gap between rich and poor households. The causes of household income volatility, on the other hand, are subject to changes in family structure and joint decisions (household labor supply, joint job search, family formation and dissolution, etc.) of household members. For instance, the "added worker effect'" literature (Lundberg 1985 and Stephens 2002) have found that married women are more likely to participate in the labor market when their husbands become temporarily unemployed. Such intra-household insurance could reduce household income volatility. On the other hand, changes in family structure, such as the recent increase in cohabitation and divorce, a decline in first age at marriage (Stevenson and Wolfers 2007) would probably increase household income volatility. The descriptive analysis of the trends in household income dynamics with a comparison in individual income dynamics is an important initial step to understand the causes of permanent income dispersion and income volatility.

Although most studies of income inequality implicitly focus on explaining the permanent income dispersion, recent studies have found that earnings volatility plays an important role in explaining the rising cross-sectional income inequality. Earlier work by Gottschalk and Moffitt (1994) decompose the cross-sectional earnings variance into a permanent and a transitory component. They find that the income volatility, using the classical definition of the variance for a transitory component of earnings, accounts for about one third to one half of the total variance of male earnings and such transitory variance also has increased over time. Male earnings dynamics have been well studied in the United States (Haider 2001, Moffitt and Gottschalk 2002, 2008, among many others). These studies have shown that earnings volatility increased substantially in the 1980s and then remained at this new higher level through 2004. Permanent earnings dispersion also increased over time and accelerated its increase in the early 2000s.

There are fewer studies on household income dynamics (Hacker 2006, Bollinger and Ziliak 2007, Bania and Leete 2007, Dynan, Elmendorf and Sichel 2008, and Dahl, Deleire and Schwabish 2008). Most of these studies only estimate either income volatility or permanent income dispersion, but not both. In this paper I apply the latest method in Moffitt and Gottschalk (2008) to estimate a formal error-component model of life cycle income dynamics with calendar time shifts for household income using panel data. Estimation of such model identifies how permanent and transitory variance in household income or earnings evolves over time and over the life cycle.

This paper also compares income dynamics in the United States with two other industrial countries: Germany and Great Britain. A few studies have explored the income dynamics in industrial countries other than the United States. An increase in both permanent and transitory variances in earnings dynamics are also found in Germany (Burkhauser et al. 1997), Canada (Baker and Solon 2003, Beach et al. 2003, 2008), Great Britain (Dickens 1996), and Sweden (Gustavsson 2004). However, due to the lack of comparable data sets, comparisons in income dynamics among these industrial countries are rarely examined. Given their similarities in income level and economic development but differences in educational and wage-setting institutions as well as public welfare or family structure, such cross-national comparisons could provide important benchmarks of how income inequality and volatility in the United States differs from or is similar to other industrial countries, and how different social policies cope with income volatility or permanent income dispersion. Gottschalk and Smeeding (1997) use Luxembourg Income Study (LIS) to examine cross-sectional inequality in earnings and family income up to the early 1990s. LIS contains comparable income measures from repeated cross-sectional data, but it is not feasible for the study of income volatility, which requires longitudinal data sets. To the best of my knowledge, Cross-national Equivalence File (CNEF) is the only available longitudinal data file that contains equivalently constructed income variables in the United States and other industrial countries. I use the latest CNEF from 1979 to 2006 which consists of comparable income measures from longitudinal data sets in the United States (the Michigan Panel Study of Income Dynamics), Germany (German Socio-Economic Panel) and Great Britain (British Household Panel Study). From CNEF I can examine how the trends in household income volatility and permanent income dispersion in the United States differ from other advanced industrial countries.

Estimation of a formal error components model shows the following results: First, transitory variance accounts for more than half of the total variance in household income, about 56-78 percent in the United States, 67-85 percent in West Germany and 51-68 percent in the Great Britain. Second, despite the differences in cross-sectional income inequality among the three countries, the permanent household income dispersion converges since the late 1990s, while the household income volatility does not converge.

2. Model Specification of Income Dynamics

I use a formal error components model to estimate the permanent and the transitory variance in income dynamics. There is a large literature on the formulations of such models (Lillard and Willis 1978, MaCurdy 1982, Abowd and Card 1989, and MaCurdy 2007 for a review). These

studies suggest that the permanent component evolves over the life cycle, and the transitory component is serially correlated, usually represented by a low-order ARMA process. I specify a model similar to Moffitt and Gottschalk (2008) which contains all above features:

$$\begin{aligned} y_{iat} &= \alpha_t \mu_{ia} + v_{iat} \\ \mu_{ia} &= \mu_{i,a-1} + \omega_{ia} \\ v_{iat} &= \rho v_{i,a-1,t-1} + \beta_t \varepsilon_{ia} + \theta(\beta_{t-1}\varepsilon_{i,a-1}) \end{aligned} \tag{1}$$

where y_{iat} is the log income residuals after a first-stage regression, for individual or household *i* at age *a* in calendar year *t*. It is composed of a permanent component $\alpha_t \mu_{ia}$,where α_t is loading factor, and a transitory component v_{iat}. Random walk ω_{ia} arrives randomly and it is not mean-reverting. The transitory shock evolves with an ARMA (1,1) process which is typically found in the literature, fading out at the rate ρ and deviating from that smooth fade-out rate by θ in the next period. The transitory shock is mean-reverting.

Assume $E(\mu_{ia})=E(\omega_{ia})=E(\varepsilon_{ia})=0$. These three residuals are all independent from each other. Assume all forcing errors to be i.i.d. except ε_{ia}, as transitory shocks are likely to be greater at younger ages. Two other assumptions include: μ evolves over the life cycle but not with calendar time, and the transitory shock ε is a function of *a* and *t*. Although all the parameters in the model could shift with calendar time, I follow the literature and only allow calendar time shifts appear in the loading factor of the permanent component α_t and the forces of the transitory component β_t.

I estimate the model using minimum distance estimation developed by Chamberlain (1984). The parameters are estimated by minimizing the sum of squared deviations between the observed elements in the variance-covariance matrix and the predicted elements implied in the theoretical model, with an identity weighting matrix. Let $s_{im} = y_{ij}y_{ik}$, where y_{ij} and y_{ik} are the log income residuals for each age-year cell *j* and *k*, and where *m*=1, ..., *M* indexes the individual moments for the products of residuals *j* and *k*. Denote θ as the set of unknown parameters. I choose θ to minimize the sum of squared residuals:

$$\text{Min} \sum_{i=1}^{N} \sum_{m=1}^{M} [s_{im} - f(\theta, j, k)]^2 \tag{2}$$

Such a formal error components model has several advantages over other estimation methods used in the income dynamics literature. Gottschalk and Moffitt (1994) and Beach et al. (2003, 2008) use a random effects model, which does not account for serial correlation in the transitory component. Another method is an approximate nonparametric method applied in Moffitt and Gottschalk (2002, 2008) and Hacker (2006). It defines covariance of income between ``long'' periods as the permanent variance, and defines the difference between variance and covariance as the transitory variance. Such method is an approximate method and is not able to estimate the serial correlation parameter of the shocks. In addition, if the transitory component is serially correlated, then the effects of past transitory shocks are never equal to zero. Therefore, a long lag is needed to get a good approximation.

3. Data

This paper uses the Cross National Equivalent File (CNEF) prepared by the Department of Policy Analysis and Management at Cornell University. I use the 1980-2006 CNEF data, which consists of equivalently defined income variables from the Michigan Panel Study of Income Dynamics (PSID) 1979-2002, the German Socio-Economic Panel (GSOEP) 1983-2004, and the British Household Panel Survey (BHPS) 1990-2000.[1] I only include the West Germany sample in GSOEP because data for East Germany (former German Democratic Republic) before 1990 is not available.[2] All years are referred to the income years. PSID skipped interviews every other year staring interview year 1998, so the last four observations are for income years 1996, 1998, 2000 and 2002. All three data sets are longitudinal so that I observe income over time for the same household or same individual.

CNEF constructed equivalently defined income variables across countries. The codebook of CNEF provides a description of how each variable is created, the algorithm used to create each variable from the original panel data, and it also provides a reliability code which tells the degree of cross-national comparability, with "1" represents completely comparable. All income variables I use in this paper are completely comparable between three countries.

The household income variable used in this paper is post-tax and transfer annual household income. It is the sum of the total household income from the labor earnings of all household members, asset flows, private retirement income, private transfers, public transfers, and social security pensions net of total household taxes.[3] The total household income is divided by an equivalence scale which is adjusted based on household size to account for economies of scale of household members compared to single individuals.[4] Similar adjustment can also be found in other studies, such as Gottschalk and Moffitt (2009) and Hacker (2006). Adjusting for household size is important for understanding permanent inequality, one main component of income dynamics. Economic well-being is worse in a household with 8 individuals than a household with same household income but only has 2 individuals.

I follow household heads aged between 20 and 59 with positive household income. Household income is adjusted for inflation using the consumer price index in each country, and set year 1996 as base year. I include every observation for each household that meet these restrictions, hence households might drop out and reappear in the sample over time. I also trim the top and

[1] In addition to above three data sets I use, CNEF also includes the Household Income and Labor Dynamics in Australia (HILDA) 2001-2005, the Swiss Household Panel (SHP) 1999-2005, and the Canadian Survey of Labor and Income Dynamics (SLID) 1993-2005. HILDA and SHP are too short to identify the transitory variance as it requires observing income changes for sufficient long time. The access to SLID data is partly restrictive.

[2] Therefore, for those individuals who moved from East Germany to West Germany at some point, I only observe their income after they moved.

[3] Total household taxes include income taxes of the head, partner and other family members, as well as payroll taxes of the head and partner. The PSID data do not provide information on payroll taxes. They are calculated by bracketing labor income and applying the average payroll tax rate for that bracket as reported by the Social Security Bulletin, Annual Statistical Supplement, 1990, page 33.

[4] I use general official United States Equivalence Weight that is computed based on household size. This equivalence scale is available in CNEF data.

bottom 1 percent of the household income within year-age group (20-29, 30-39, 40-49, 50-59) cell to reduce noise. At the top distribution, data from all three countries are top-coded to ensure confidentiality. Treating the top-coded income as true income will reduce cross-sectional variances. At the bottom distribution, some households report very low income such as $1 per year, which may not be accurate. These observations distort estimates of inequality based on the variance of log income, as log income goes to minus infinity when income goes to zero.

One commonly used procedure that addresses both measurement issues is to truncate data by deleting the top and bottom 1 percent of the distribution, which drops almost all the top-coded observations and problematic small income (Moffitt and Gottschalk 2002, 2008). When interpreting our results, I only capture income dynamics in the middle 98 percent of the distribution. Our final sample includes 5,239 households with a total of 115,022 household-year observations in the United States, 4,248 households with 88,312 observations in West Germany; and 3,672 households with 37,571 observations in the Great Britain. Summary statistics are presented at Table 1.

4. Household Income Dynamics in the United States, West Germany and Great Britain

A variance-covariance matrix is formed based on residuals from regressions of log earnings on household head's age, age square, a dummy for whether he is married and the number of children in the household. A separate regression is run for each year.[5] This first stage regression controls for the changes in the mean household income, thus the analysis in the next section examines the within group variances. I calculate the covariance between income at age a and a' and between year t and year t', indexed with year, age and lag length.

I then estimate the income dynamics model in equation (1) and compute the permanent and transitory variances, in each year, for each age group. Table 2 presents the estimated α of household income dynamics, Table 3 presents the estimated β and Table 1.4 presents estimates of other parameters. These time-varying coefficients of α and β are the main driving force of the trends in permanent variance and transitory variance, respectively. The transitory shocks in household income are significantly serially correlated at a rate of 0.78 in the United States, 0.76 in West Germany and 0.70 in the Great Britain.

Figure 1 plots the actual and predicted cross-sectional variances in log household income in three countries, taking an average across the four age groups. The predicted variances from the model match empirical variance from the data very well. The United States has the highest overall inequality among all three countries, and West Germany has the lowest inequality for the past two decades. Household income inequality in the United States increased since the 1980s, declined in the late 1990s and then rose up again in the 2000s. This trend is consistent with other studies such as Gottschalk and Smeeding (1997) Figure 4 and Nichols and Zimmerman (2008). In West Germany, income inequality gradually increases over time, with the largest jump around the reunification in 1990. In Great Britain household income inequality does not change much in the 1990s.

[5] The first stage regression does not include education variable, as in the Great Britain education information is missing from BHPS.

Figure 2 plots the permanent variance and transitory variance in each year, taking an average across four age groups. The top figure plots the permanent variance for three countries. In the United States, the permanent variance steadily increased through the 1980s, gradually decreased since the mid 1990s. In West Germany, the permanent variance mildly increased through the late 1990s, then leveled off afterwards. The permanent variance in Great Britain rose in the early 1990s then declines.

Despite the large difference among three countries in the 1980s, the permanent dispersion of household income converges since the late 1990s. In addition, the permanent dispersion does not increase since the mid 1990s in all three countries. The rank for the three countries in terms of permanent household income dispersion changes over time. West Germany always has the lowest permanent income dispersion, while the Great Britain has higher permanent income dispersion than the United States for most of the sample period (1992 to 1999). The bottom figure in Figure 2 shows the evolution of household income transitory variances. Unlike the permanent variances, the transitory variances do not have a clear convergence pattern in these three industrial countries. Transitory variance goes up in the long run but is subject to cyclical changes in the United States and West Germany. In the Great Britain it goes up more steadily. Such income volatility seems to be more dramatic in the United States than in European countries, especially after the 1990s.

I also examine how much of the overall cross-sectional inequality is attributable to income volatility rather than the permanent dispersion. Figure 4 compares the total variance, the permanent variance and the transitory variance in the United States. Figure 5 and 6 present trends in three variances in West Germany and Great Britain. The transitory variance accounts for at least half of the overall inequality, about 56 to 78 percent in the United States, 67 to 85 percent in West Germany and 51 to 68 percent in Great Britain. For the same period of 1990-2000, transitory variance accounts for 70 percent of total variation in the United States, 73 percent in the West Germany and 58 percent in the Great Britain. Trends in transitory variance are mostly coincides with trends in overall inequality, when comparing with Figure 1. This is a pattern that is consistently found in other studies for the United States. Moffitt and Gottschalk (2008) plot the transitory variance against the unemployment rate. They find that transitory variances are largely cyclical, thus it is more difficult to sort out the trend in the transitory variance, especially when there is a cycle at the end of the period. In my study of household income dynamics, the trends in transitory variance are also cyclical.

5. Conclusion

In this paper I examine the recent trends of household income dynamics in the United States, West Germany and Great Britain, using CNEF 1979-2006 file. I estimate a formal error-components model as in Moffitt and Gottschalk (2008), to study how permanent variances and transitory variances change over time and how these trends differ in three countries. I find that the permanent household income dispersion converges among three countries in the late 1990s, while transitory variance displays a more cyclical pattern. Household income volatility accounts for more than half of the overall cross-sectional inequality in all three countries. These findings deserve further investigation with formal economic models of household behavior.

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Table 1: Descriptive Statistics

	Mean	Std Dev	Min	Max
			United States	
Log household income	9.80	0.785	-1.05	15.03
Age of head	40.0	10.38	20	59
Married	0.55	0.50	0	1
Number of children	0.91	1.14	0	9
Family size	2.71	1.48	1	14
			West Germany	
Log household income	9.65	0.638	0.63	2.81
Age of head	41.0	10.65	20	59
Married	0.54	0.50	0	1
Number of children	0.61	0.92	0	10
Family size	2.51	1.34	1	17
			Great Britain	
Log household income	9.26	0.693	-0.80	2.39
Age of head	41.0	10.39	20	59
Married	0.68	0.47	0	1
Number of children	1.12	1.53	0	16
Family size	2.82	1.36	1	11

Note: Log household income is divided by equivalence of scale;
Means taken before trimming and over all household-year observations

Table 2: Estimates of Alphas in the Error Components Model of Log Household Income

	United States		West Germany		Great Britain	
Year	Coef	Std Err	Coef	Std Err	Coef	Std Err
Alpha's						
1980	1.027	0.054				
1981	1.058	0.061				
1982	1.192	0.075				
1983	1.238	0.080				
1984	1.277	0.092	1.027	0.183		
1985	1.317	0.100	1.005	0.192		
1986	1.313	0.099	1.095	0.201		
1987	1.364	0.101	1.210	0.256		
1988	1.429	0.102	1.198	0.358		
1989	1.487	0.110	1.223	0.390		
1990	1.493	0.114	1.369	0.315		
1991	1.522	0.120	1.505	0.414	1.190	0.091
1992	1.497	0.122	1.534	0.397	1.145	0.086
1993	1.465	0.122	1.535	0.417	1.244	0.113
1994	1.443	0.127	1.660	0.457	1.249	0.149
1995	1.425	0.119	1.513	0.408	1.194	0.142
1996	1.237	0.103	1.463	0.453	1.164	0.151
1997			1.668	0.407	1.145	0.145
1998	0.814	0.086	1.539	0.406	1.065	0.114
1999			1.404	0.464	1.007	0.123
2000	0.907	0.088	1.398	0.389	1.020	0.268
2001			1.634	0.478		
2002	0.928	0.096	1.638	0.439		
2003			1.781	0.457		
2004			1.539	0.380		

Table 3: Estimates of Betas in the Error Components Model of Log Household Income

	United States		West Germany		Great Britain	
Year	Coef	Std Err	Coef	Std Err	Coef	Std Err
Beta's						
1980	1.116	0.287				
1981	1.396	0.436				
1982	1.471	0.433				
1983	1.534	0.466				
1984	1.535	0.437	0.893	0.284		
1985	1.500	0.452	0.738	0.224		
1986	1.558	0.434	0.640	0.207		
1987	1.421	0.425	0.612	0.207		
1988	1.368	0.388	0.483	0.176		
1989	1.575	0.453	0.631	0.271		
1990	1.384	0.400	0.570	0.204		
1991	1.668	0.478	0.522	0.201	0.958	0.227
1992	2.008	0.627	0.757	0.293	1.085	0.314
1993	2.616	0.747	0.732	0.248	0.921	0.297
1994	2.334	0.723	0.770	0.326	0.951	0.352
1995	1.797	0.657	0.721	0.345	0.892	0.264
1996	2.278	0.585	0.734	0.281	0.914	0.340
1997			0.816	0.313	1.013	0.314
1998	2.706	0.686	0.807	0.296	1.111	0.444
1999			1.023	0.337	1.164	0.298
2000	2.176	0.556	0.767	0.242	1.360	0.810
2001			0.816	0.261		
2002	3.060	0.775	0.812	0.255		
2003			0.806	0.272		
2004			0.767	0.310		

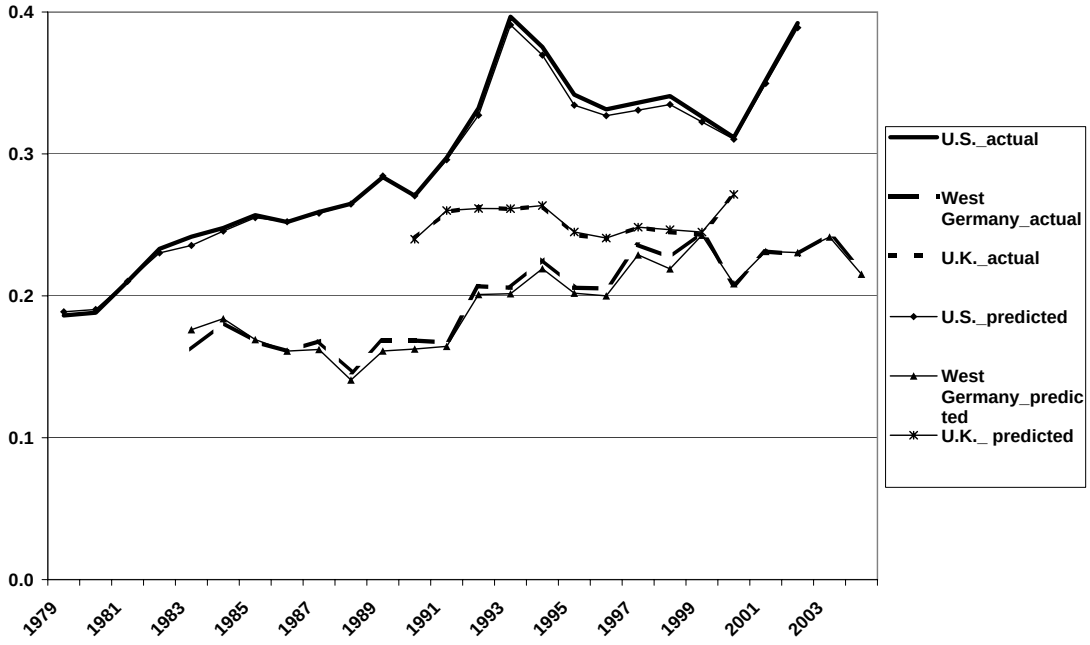

Figure 1: Actual and predicted cross-sectional variance in log household income in the United States, West Germany and Great Britain

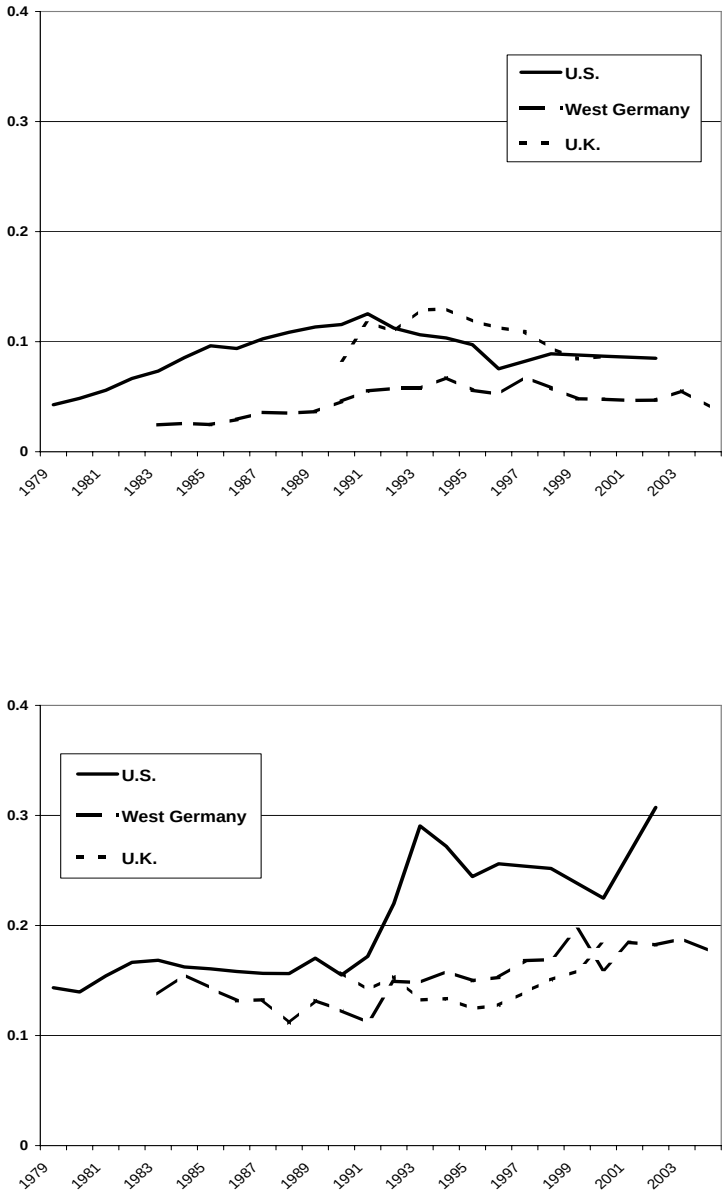

Figure 2: Trends in the permanent variance (top) and transitory variance (bottom) of log household income in the United States, West Germany and Great Britain

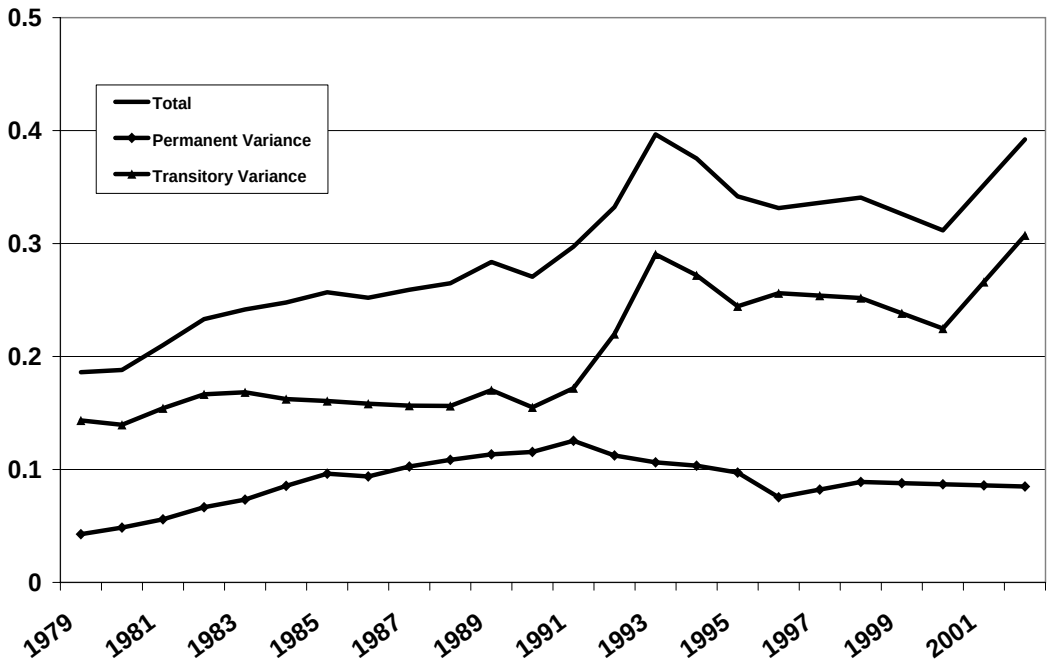

Figure 3: Total variance, permanent variance and transitory variance of log household income in the United States, 1979-2002

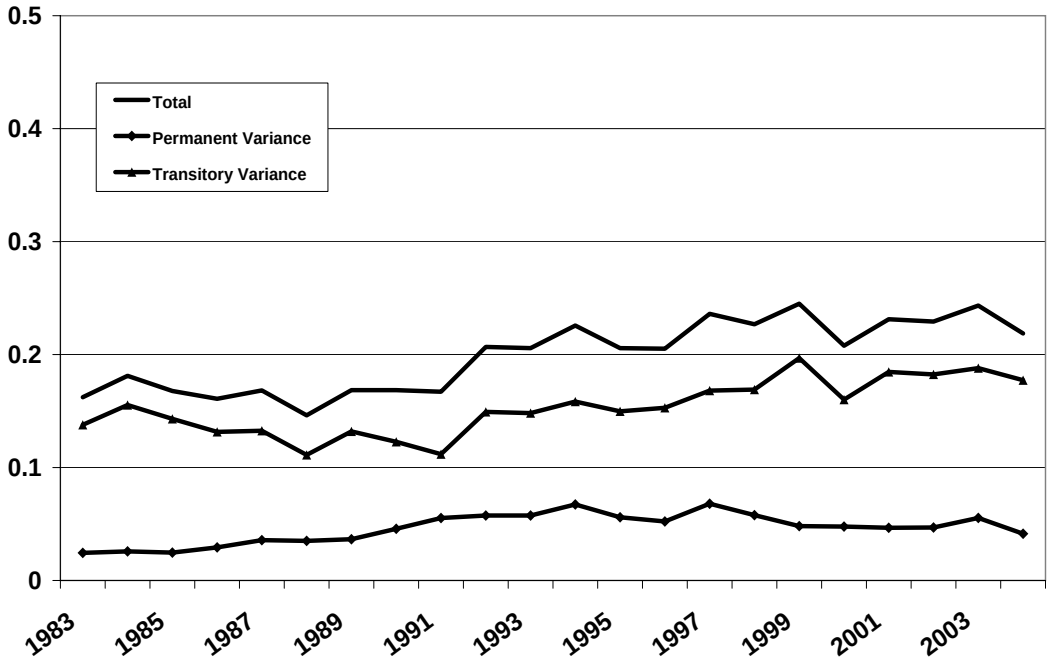

Figure 4: Total variance, permanent variance and transitory variance of log household income in West Germany, 1983-2004

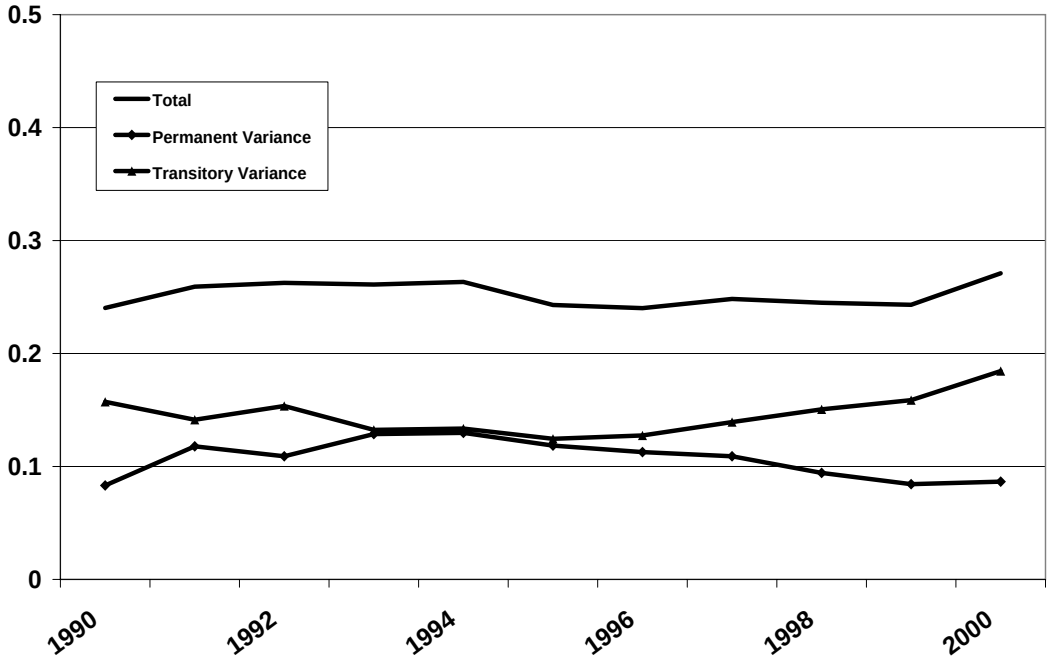

Figure 5: Total variance, permanent variance and transitory variance of log household income in Great Britain, 1990-2000

Table 4: Estimates of Other Parameters in the Error Components Model of Log Household Income

	United States		West Germany		Great Britain	
Year	Coef	Std Err	Coef	Std Err	Coef	Std Err
$\sigma^2_{\xi 1}$	0.086	0.022	0.152	0.042	0.116	0.023
$\sigma^2_{\mu 1}$	0.058	0.008	0.021	0.010	0.094	0.015
ρ	0.779	0.028	0.757	0.048	0.697	0.110
θ	-0.433	0.031	-0.375	0.050	-0.349	0.126
$\sigma^2_{\omega} * 100$	0.001	0.000	0.000	0.000	-0.001	0.001
γ_0	0.054	0.073	-0.055	0.028	0.034	0.072