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The COVID-19 Shock and Income Inequality: A Panel Data Analysis of Permanent and Transitory Effects in Japan and the U.K.

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Abstract

This study examines the impact of the COVID-19 shock on labor market risk in Japan and the U.K. using panel data, focusing on whether the changes in income inequality are permanent or temporary. This analysis produced three key findings. First, a negative and significant covariance between the random effect and random growth parameter indicates lower initial earnings are associated with higher earnings growth rates. Second, the transitory component of inequality increases in 2021 in some cases, supporting the validity of income maintenance policies for affected households. Third, as cohorts age, the transitory component of inequality grows, necessitating temporary public support policies to address gaps in older adult income systems caused by temporary income shocks.

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The COVID-19 Shock and Income Inequality: A Panel Data Analysis of Permanent and Transitory Effects in Japan and the U.K.

1. Introduction

This study examines the impact of the COVID-19 shock on labor market risk in Japan and the U.K. using panel data, focusing on whether the changes in income inequality are permanent or temporary. Effective policy depends on the relative magnitude of the permanent and temporary phenomena. For example, job training suits households with significant permanent income fluctuations, while income maintenance policies are needed for households with large temporary income fluctuations (Meghir and Pistaferri, 2011).

This study decomposes income changes into permanent and transitory shocks using univariate earnings data. An empirical study on individual earnings dynamics using Japanese panel data was conducted by Abe and Inakura (2007), who analyzed the dynamic characteristics of male earnings and working hours. They estimated a pure random walk model, a pure measurement error model, a mixed random walk and measurement error model, and a general MA(2) model. Abe and Inakura (2008) analyzed a linear income process where permanent income follows a random walk, quantitatively measuring the permanent components of earnings in Japan. Okubo (2015) estimated a profile heterogeneity model, with evidence supporting its applicability to the Japanese male income process.

This paper is organized as follows: Section 2 details the data and estimation methodology; Section 3 presents empirical results for Japan; Section 4 presents empirical results for the U.K.; and Section 5 concludes the paper.

2. Empirical Analysis

2.1 Data

The Japanese Household Panel Survey (JHPS/KHPS) was used in this study. This panel survey collects data on adult men, women, and their spouses across the country. The KHPS was first used in 2004 and received responses from approximately 4,000 respondents and their spouses; new survey targets were added in 2007 and 2012. The JHPS began being used in 2009 and received responses from approximately 4,000 respondents and their spouses; new survey targets were added in 2019. In 2014, the (former) JHPS and (former) KHPS, which had been conducted and managed as separate surveys, were integrated and renamed the “Japanese Household Panel Survey (JHPS/KHPS).”

For the UK, the *Understanding Society: UK Household Longitudinal Study* was used. This survey was launched in 2009, incorporating the British Household Panel Survey (BHPS). It covers all regions and countries in the UK, and the first wave sample comprised approximately 40,000 households.

2.2 Statistical models

The following models were used:

(1) AR(1), random growth model

$$y_{i,t} = g(\theta_t^0, X_{i,t}) + p_t f(\alpha^i, \beta^i, X_{i,t}) + \lambda_t v_{i,t}$$

(2) AR(1), random walk model

$$y_{i,t} = g(\theta_t^0, X_{i,t}) + p_t u_{i,t} + \lambda_t v_{i,t}$$

(3) ARMA(1,1): no growth heterogeneity or AR (1): no growth heterogeneity

$$y_{i,t} = g(\theta_t^0, X_{i,t}) + p_t f(\alpha^i) + \lambda_t v_{i,t}$$

Here $y_{i,t}$ is inflation-adjusted earnings of individual i and in year t. $g(\theta_t^0, X_{i,t})$ captures the "life cycle" components of earnings common to all individuals, modeled as a quadratic polynomial in "potential" experience, h. The individual-specific "life cycle" components of earnings is given by $f(\alpha^i, \beta^i, X_{i,t}) \equiv \alpha^i + \beta^i h_{it}$, where α and β reflect the differences in the amount of on-the-job training that individuals receive in the early career stages. For example, individuals may accept low initial income from jobs that require considerable skills development because they expect their income to rise steadily in the future. The variances of α^i and β^i are σ_α^2 and σ_β^2, respectively. Their covariance is denoted as $\sigma_{\alpha\beta}$, representing the relationship between the random effect and the random growth parameter.It is expected that α and β are negatively correlated.

$u_{i,t} = u_{i,(t-1)} + w_{i,t}$ follows a random walk process. The variance of $w_{i,t}$ is given by σ_w^2. $v_{i,t} = \rho v_{i,t-1} + \theta\epsilon_{i,t-1} + \epsilon_{i,t}$ follows either an AR(1) or ARMA(1,1) process. The variance of $\epsilon_{i,t}$ is given by σ_ε^2. p_t, λ_t are the time-varying factor loadings. As panel datasets often cannot observe individuals at the beginning of their careers, the initial variance

σ_{v1}^2 is included as an extra parameter (MaCurdy, 1982). The permanent components of inequality are represented by $p_t f(\alpha^i, \beta^i, X_{i,t}) + p_t u_{i,t}$, while $\lambda_t v_{i,t}$ is the transitory component of inequality.

Model (1) was applied to the following samples: individuals born between 1959 and 1975, those born before 1960 in Japan, the full sample, university graduates, non-university graduates, individuals born after 1974, and individuals born between 1959 and 1975 in the U.K. Model (2) was used for the full sample and non-university graduates in Japan. Model (3) was applied to university graduates, individuals born after 1974 in Japan, and those born before 1960 in the U.K.

The logarithm of residuals from a first-stage regression of earnings on "potential" experience and "potential" experience squared of the worker is the sum of a permanent component and a transitory component. I predict that the permanent and transitory components of inequality will change over time. Estimation follows a generalized method of moments for the covariance structure of earnings. For finite samples, it is preferable to use an identity matrix rather than an optimal weighting matrix (Altonji and Segal, 1996; Clark, 1996), with the parameters estimated using nonlinear least squares.

The criteria for sample selection were: (i) male head of household and (ii) under 65 years of age. Finally, the measure of "potential" experience is defined as h = age - number of years in school - 6.

3. Estimation Results in Japan

Table 1 summarizes the estimation results for the entire sample, as well as educational background. The coefficients are significant at the 1% level, and the sign conditions are satisfied. The transitory shock has a moderate persistence due to the size of ρ.

Table 1. Estimation results in Japan

	Full sample	University graduate sample	Non-university graduate sample
σ_α^2	0.0481518***	0.0707258***	0.0204435***
ρ	0.4722199***	0.5135877***	0.4637231***
σ_{v1}^2	0.163556***	0.2221649***	0.1322833***
σ_ε^2	0.045022***	1.173977***	0.0474754***
σ_w^2	0 .002017***		0.0024192***

Note: Significant level: ***p<0.01, **p<0.05, *p<0.1. Factor loadings are present in all estimates but are not shown.

Table 2 summarizes the estimation results by cohort. The coefficients are significant at the 1% level except σ_β^2 for individuals born before 1960; the sign conditions are satisfied. The estimated ρ indicates moderate persistence of transitory shock. $\sigma_{\alpha\beta}$ is negative for cohorts born between 1959 and 1975 and those born before 1960; this suggests that early low income in the labor market leads to higher income growth rates.

Table 2. Estimation results by cohort in Japan

	Born after 1974	Born after 1959 and before 1975	Born before 1960
σ_α^2	0.0137617***	0.2579519***	0.4189513***
ρ	0.4054886***	0.4081424***	0.6684234***
σ_{v1}^2	0.3317282***	0.0698556***	0.1785284***
σ_ε^2	0.0831172***	0.0139986***	0.0313322***
σ_β^2		0.0001212***	0.0000883*
$\sigma_{\alpha\beta}$		-0.0048845***	-0.0066539***

Note: Significant level: ***p<0.01, **p<0.05, *p<0.1. Factor loadings are present in all estimates but are not shown.

Figures 1 through 6 graphically illustrate the predicted permanent (Perm 1) and transitory (Temp 1) components of inequality in Japan. *Predicted_total 1* and *actual_total 1* compare actual and predicted inequality. In the sample born before 1960, the transitory income shocks were larger than the permanent income shocks for most years. In the university graduate sample, and those born between 1959 and 1975, the transitory shock to earnings increases in 2021. Transitory income support is expected to benefit these households in 2021. As a cohort ages, the transitory component of inequality tends to increase.

Figure 1. Predicted permanent and transitory components in Japan (full sample)

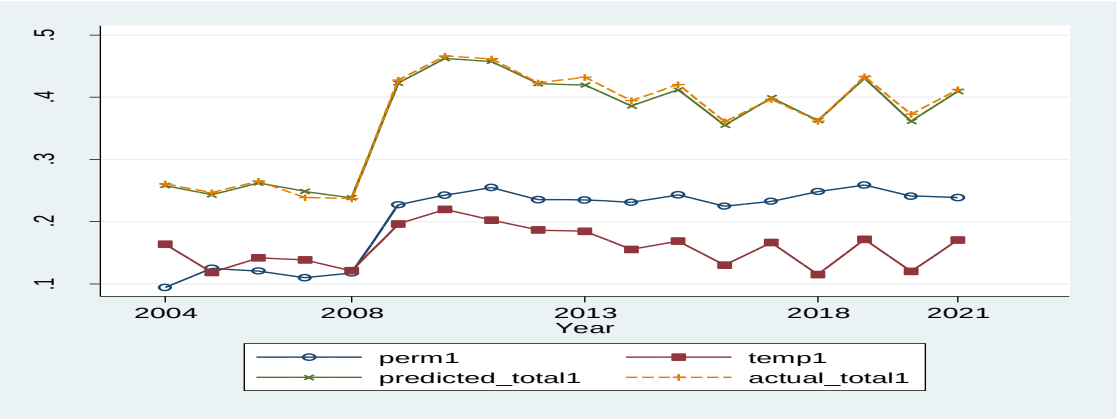


Figure 2. Predicted permanent and transitory components in Japan (university graduate sample)

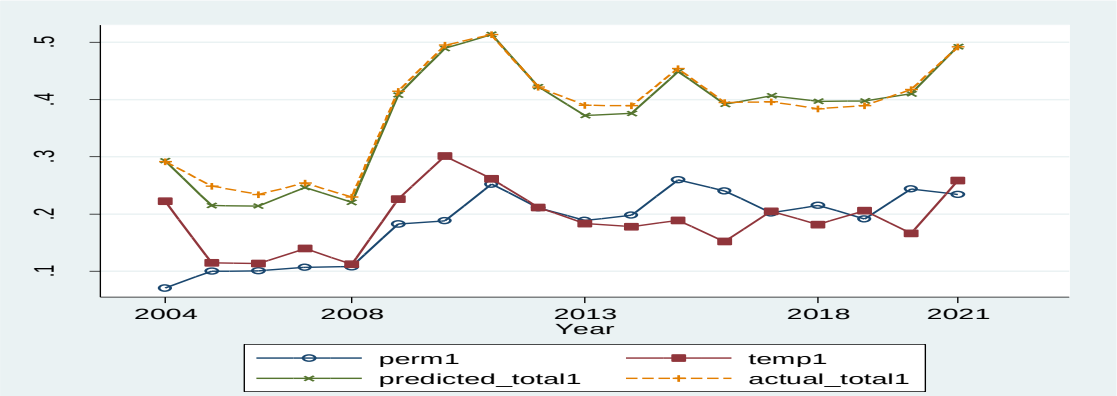


Figure 3. Predicted permanent and transitory components in Japan (non-university graduate sample)

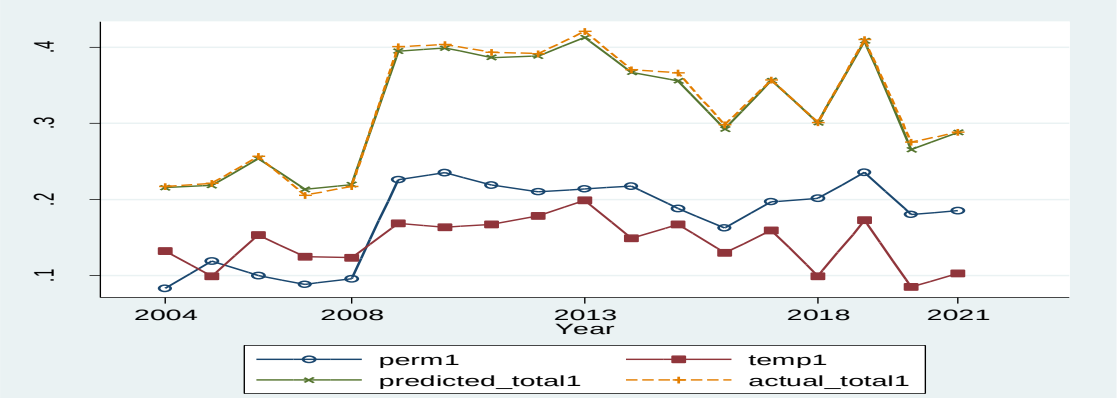


Figure 4. Predicted permanent and transitory components in Japan (sample born after 1974)

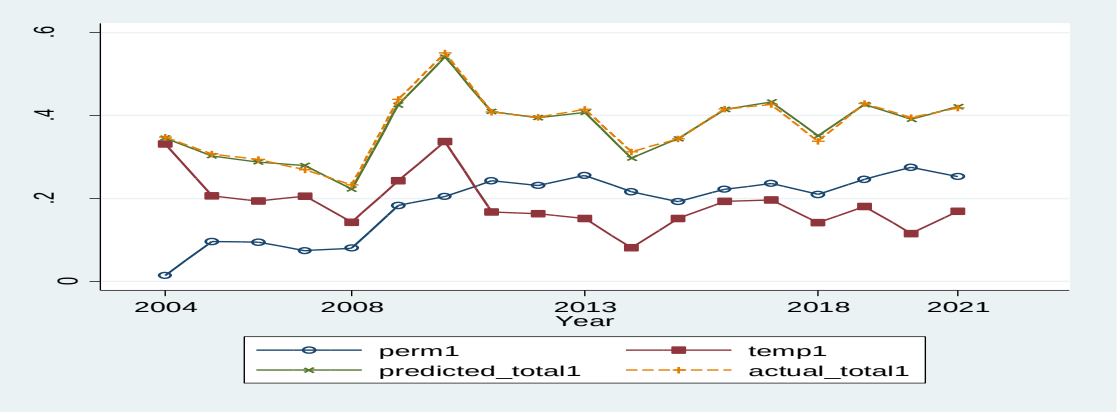


Figure 5. Predicted permanent and transitory components in Japan (sample born after 1959 and before 1975)

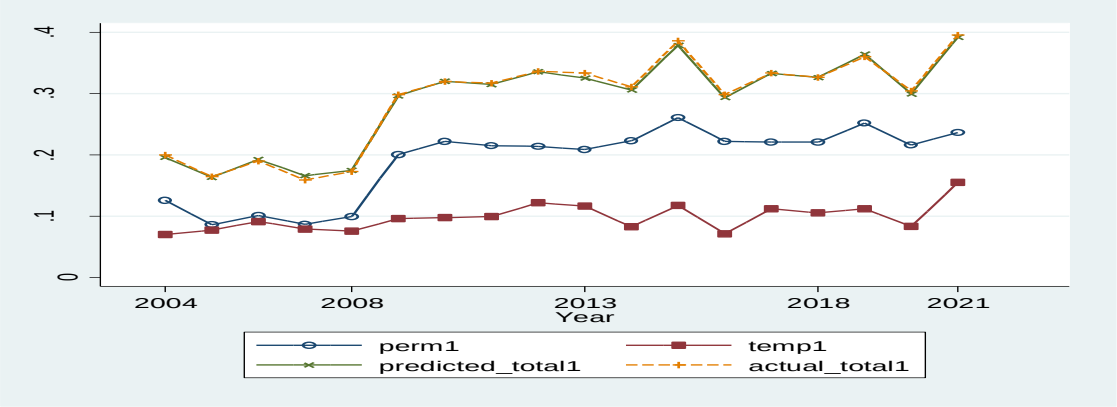
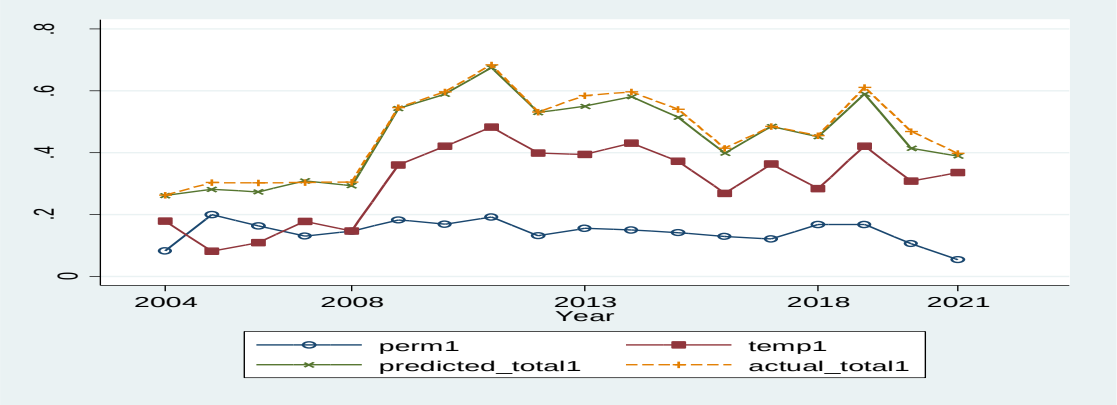


Figure 6. Predicted permanent and transitory components in Japan (sample born before 1960)



4. Estimation results in the U.K.

Table 3 summarizes the estimation results for the entire sample, as well as educational background. The coefficients are significant at the 1% level except σ_ε^2, and the sign conditions are satisfied. The transitory shock has moderate persistence due to the size of ρ. As $\sigma_{\alpha\beta}$ is negative, having a low income early in the labor market leads to a high income growth rate.

Table 3. Estimation results in U.K.

	Full sample	university graduate sample	non-university graduate sample
σ_α^2	0.9336908***	0.7637845***	0.8625228***
ρ	0.2554623***	-0.0860649***	0.2633644***
σ_{v1}^2	0.1229024***	0.1308269***	0.1038307***
σ_ε^2	0.3037715***	3.167658	0.2275318
σ_β^2	0.0009813***	0.0012022***	0.0008172***
$\sigma_{\alpha\beta}$	-0.0281164***	-0.0279627***	-0.0247266***

Note: Significant level: ***p<0.01, **p<0.05, *p<0.1. Factor loadings are present in all estimates but are not shown.

Table 4 summarizes the estimation results by cohort. The coefficients are significant at the 1% level except σ_{v1}^2 and σ_ε^2 and the sign conditions are satisfied. As $\sigma_{\alpha\beta}$ is negative in samples born after 1974, and between 1959 and 1975, the high income growth rate is associated with low income early in the labor market.

Table 4. Estimation results by cohort in U.K.

	born after 1974	born after 1959 and before 1975	born before 1960
σ_α^2	0.2650424***	0.8312578***	0.340793***
ρ	0.233749***	0.2468361***	0.9232426***
σ_{v1}^2	0.1211727***	0.1071032***	0.0092837**
σ_ε^2	0.2488049***	0.2015158***	0.0066974**
σ_β^2	0.0010512***	0.0006879***	
$\sigma_{\alpha\beta}$	-0.0116432***	-0.0214079***	
θ			-0.4872553***

Note: Significant level: ***p<0.01, **p<0.05, *p<0.1. Factor loadings are present in all

estimates but are not shown.

Figures 7 through 12 graphically illustrate the predicted permanent and transitory earnings components in the U.K. In the sample born before 1960, the transitory income shocks were larger than the permanent income shocks for most years. In the university graduate sample and cohorts born after 1974 and before 1960, the transitory shock to earnings increases in 2021. Transitory income support is expected to be effective in these households in 2021. As a cohort ages, the transitory component of inequality tends to increase.

Figure 7. Predicted permanent and transitory components in the U.K. (full sample)

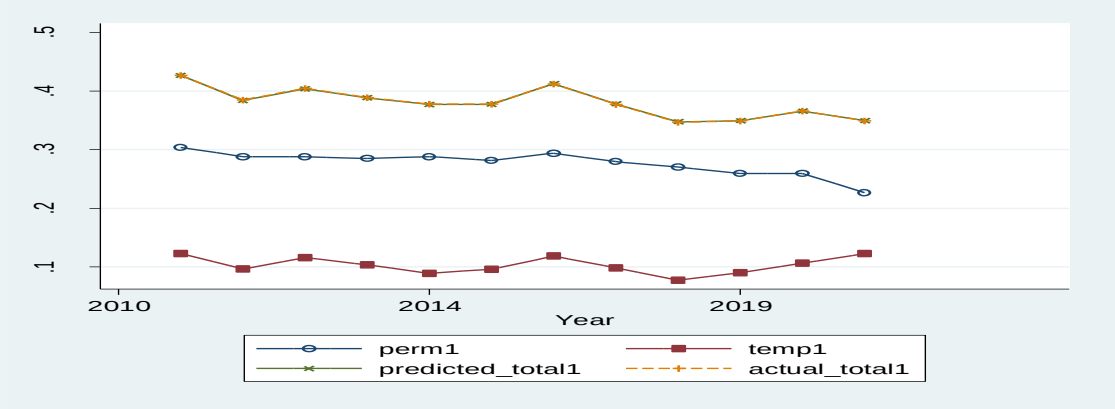


Figure 8. Predicted permanent and transitory components in the U.K. (university graduate sample)

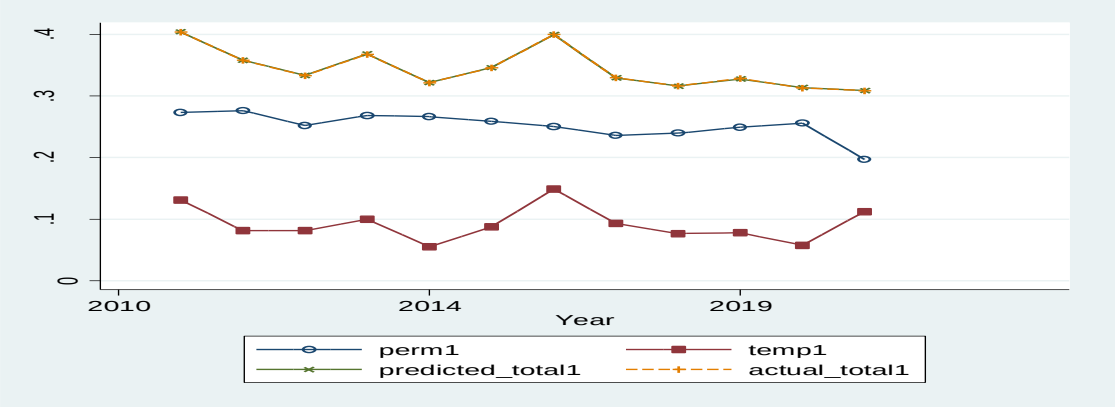


Figure 9. Predicted permanent and transitory components in the U.K. (non-university graduate sample)

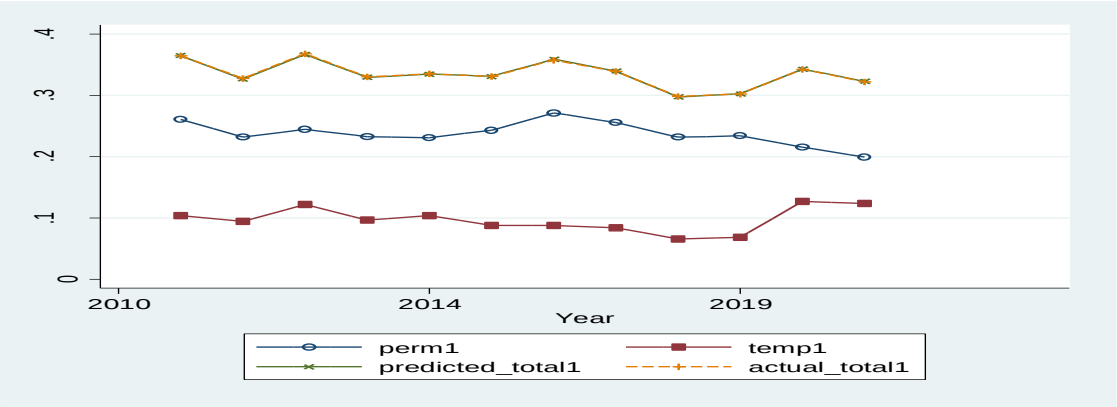


Figure 10. Predicted permanent and transitory components in the U.K. (sample born after 1974)

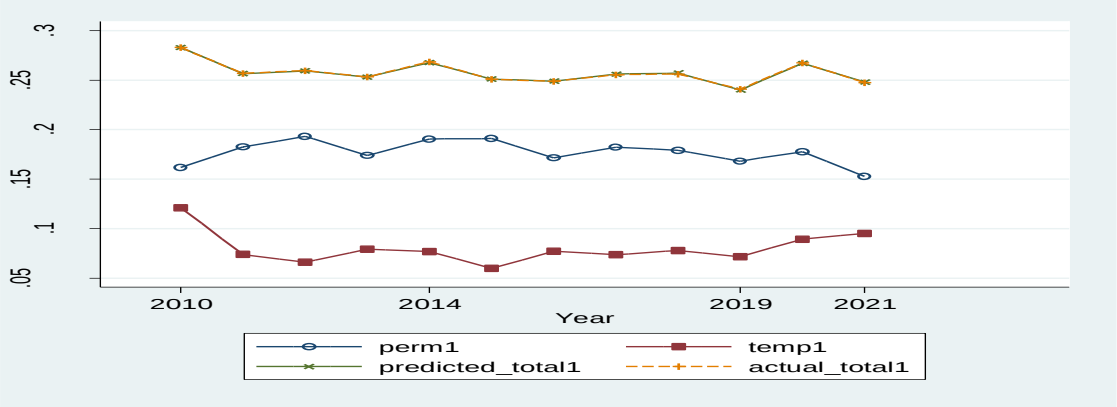


Figure 11. Predicted permanent and transitory components in the U.K. (sample born after 1959 and before 1975)

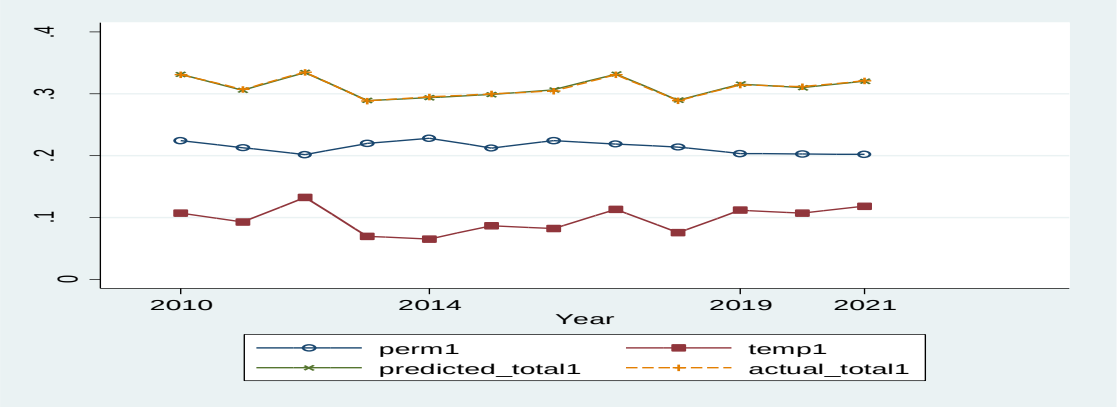
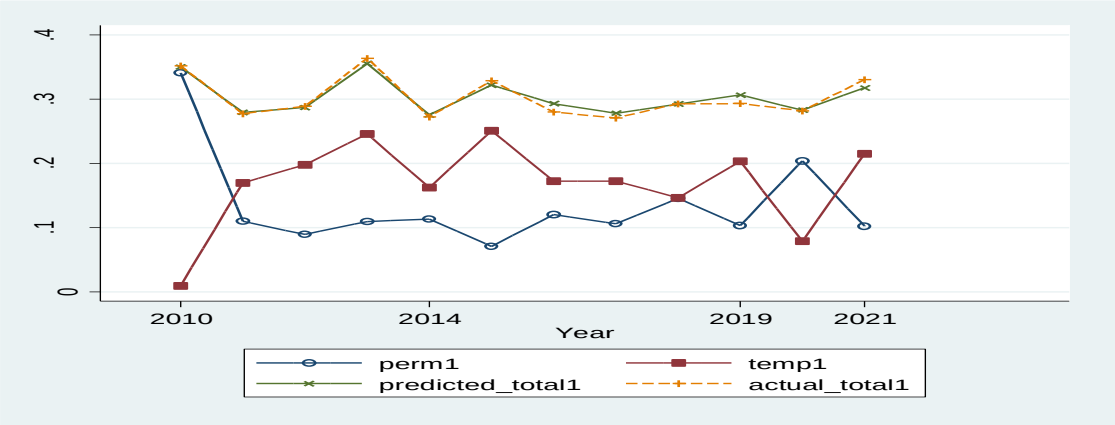


Figure 12. Predicted permanent and transitory components in the U.K. (sample born before 1960)



5. Conclusion

This analysis yields three key findings. First, the covariance between the random effect and random growth parameter is negative and significant, indicating that individuals with lower initial earnings experience higher earnings growth rates. Second, the transitory component of inequality will increase in 2021 in some cases, justifying the income maintenance policies for these households. Third, the transitory component of inequality tends to increase as the cohort ages. Temporary public support policies to help older adults overcome temporary income shocks are necessary to address gaps in their income systems.

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