# Income Volatility and the PSID: Past Research and New Results

by Robert Moffitt and Sisi Zhang (2018) *American Economic Review*

James J. Heckman
University of Chicago

Econ 350, Winter 2021
This draft, February 23, 2021 7:23pm

THE UNIVERSITY OF CHICAGO

# I. Why the PSID Has Been So Valuable for Studying Income Volatility

# II. A Review of PSID Research on Income Volatility

# Table 1: PSID Studies of Permanent-Transitory Volatility with No Calendar Time Trends

| Study | Sample | Method | Findings |
|---|---|---|---|
| Benus and Morgan (1972) | Families in first four PSID waves, 1968-1971 with same family head who works in all years | Decomposition of head labor income into average, trend, and instability | Higher average income is correlated with higher trend and lower instability |
| Benus (1974) | Families in first five PSID waves, 1968-1972 with same family head who works in all years | Instability in head labor earnings and total family income measured as variance of deviation of trend from regression residuals | Instability higher for those with low permanent income, farmers and the self-employed, younger heads, and those in areas of high unemployment; instability of total family income largely driven by head labor income, little offset from other income sources except transfers |
| Mirer (1974) | Families in 1967-1969 | Instability of total family income measured as standard deviation of residuals from a regression with a year trend | Instability negative related to expected income, instability largely driven by head labor income with spouse labor income playing little role |
| Lillard and Willis (1978) | Prime-age working male heads, 1967-1973 | Error components model for earnings with random permanent effect and AR(1) transitory effect | Permanent component explains 73 percent of residual variable. Significant AR(1) component and high degree of mobility |
| Hall and Mishkin (1982) | Families 1969-1975 | Error components model of total after-tax family income decomposed into deterministic portion, unit root, and stationary transitory component | Significant variances of unit root and transitory components with evidence for MA components of latter |
| MaCurdy (1982) | Prime-age white married working male heads, 1967-1976 | Error components model for earnings with random permanent effect and ARMA transitory effect | Low-order ARMA fits the data |
| Abowd and Card (1989) | Prime-age working male heads, 1969-1979 | Error components model for earnings with unit root permanent effect and MA(2) in transitory effect changes | Nonstationary unit root and MA(2) model fits the data best |

# Table 1: PSID Studies of Permanent-Transitory Volatility with No Calendar Time Trends, Cont'd

| Study | Sample | Method | Findings |
|---|---|---|---|
| Carroll (1992) | Families with prime-age heads, 1968-1985 | Error components model for labor income with a unit root and a transitory error | Variances of permanent and transitory shocks approximately equal |
| Baker (1997) | Prime-age working male heads, 1967-1986 | Error components model of earnings with tests for random growth versus random walk | Rejects random walk in favor of random growth |
| Geweke and Keane (2000) | Prime-age working male heads, 1968-1989 | Error components model with non-Gaussian shocks for earnings with random permanent effect and autoregressive transitory effect | Most cross-sectional earnings differences are explained by transitory shocks but lifetime differences explained but individual heterogeneity |
| Meghir and Pistaferri (2004) | Prime-age working male heads, 1968-1993 | Error components model for earnings allowing ARCH effects in permanent and transitory shocks | Strong evidence for ARCH effects |
| Guvenen (2009) | Prime-age working male heads, 1968-1993 | Error components model for earnings with focus on testing for heterogeneous income profiles model | Finds support for heterogeneous income profiles |
| Bonhomme and Robin (2010) | Working male heads, 19787-1987 | Nonparametric estimates of the density of permanent and transitory earnings in an error components model | Densities are non-Gaussian, with higher modes and fatter tails |
| Browning et al. (2010) | Prime-age white male working high school heads, 1968-1993 | Error components model for earnings with features to incorporate additional types of heterogeneity | Data show more heterogeneity than that using simpler models |
| Hryshko (2012) | Prime-age working male heads, 1968-1997 | Error components model for earnings with new tests for unit root process versus heterogeneous profile process | New tests provide support for the unit root process |
| Arellano et al. (2017) | All families 1999-2009 | Allows nonparametric first-order Markov process for persistent component of total family earnings | Finds strongest persistence among high-earnings households experiencing large positive shocks and among low-earnings households experiencing large negative shocks. |

# Table 2: PSID Studies of Volatility with Focus on Calendar Time Trends

| Study | Sample | Method | Findings |
|---|---|---|---|
| **Permanent-Transitory Decomposition** | | | |
| Gottschalk and Moffitt (1994) | White male heads, 1970-1987 | WA method applied to earnings* | Equally large increases in the permanent and transitory variance from 1970-1978 to 1979-1987 |
| Moffitt and Gottschalk (1995) | White male heads, 1970-1987 | Error components model of individual earnings with unit root permanent effect and ARMA transitory effect | Same as 1994 paper |
| Gittleman and Joyce (1999) | Families, 1968-1991 | WA method applied to total family income | Both permanent and transitory components grew (former slightly greater than latter), from 1967-1979 to 1980-1991 |
| Haider (2001) | White male heads, 1967-1991 | Error components model with heterogeneous growth component | Equal split of growth of permanent and transitory effects but transitory did not grow after 1982 |
| Hyslop (2001) | Married couples, 1979-1985 | Error components model allowing husband and wife permanent and transitory components to be correlated | Permanent and transitory variances of men rose equally over the period while permanent variances of women did not rise but transitory variances did |
| Moffitt and Gottschalk (2002) | Male heads, 1969-1996 | Same error components model as Moffitt and Gottschalk (1995) | Permanent variance rose over the whole period but transitory variance declined in the 1990s |
| Keys (2008) | Male and female heads and families, 1970-2000 | WA method applied to head earnings and family income | Permanent and transitory variances of male earnings rose from 1970 to 1990 but usually flattened out in the 2000s. Permanent variances for female heads fell and their transitory variances rose a small amount. Permanent and transitory variances of family income rose. |
| Gottschalk and Moffitt (2009) | Individual earnings and family income, 1970-2004 | WA method for male earnings and family income, percentile point method for women, | Male transitory variance rose from the 1970s to the late 1980s, flattened out and rose starting in the late 1990s. No clear trend in variance for women. Strong upward trend for transitory variance of family income. |

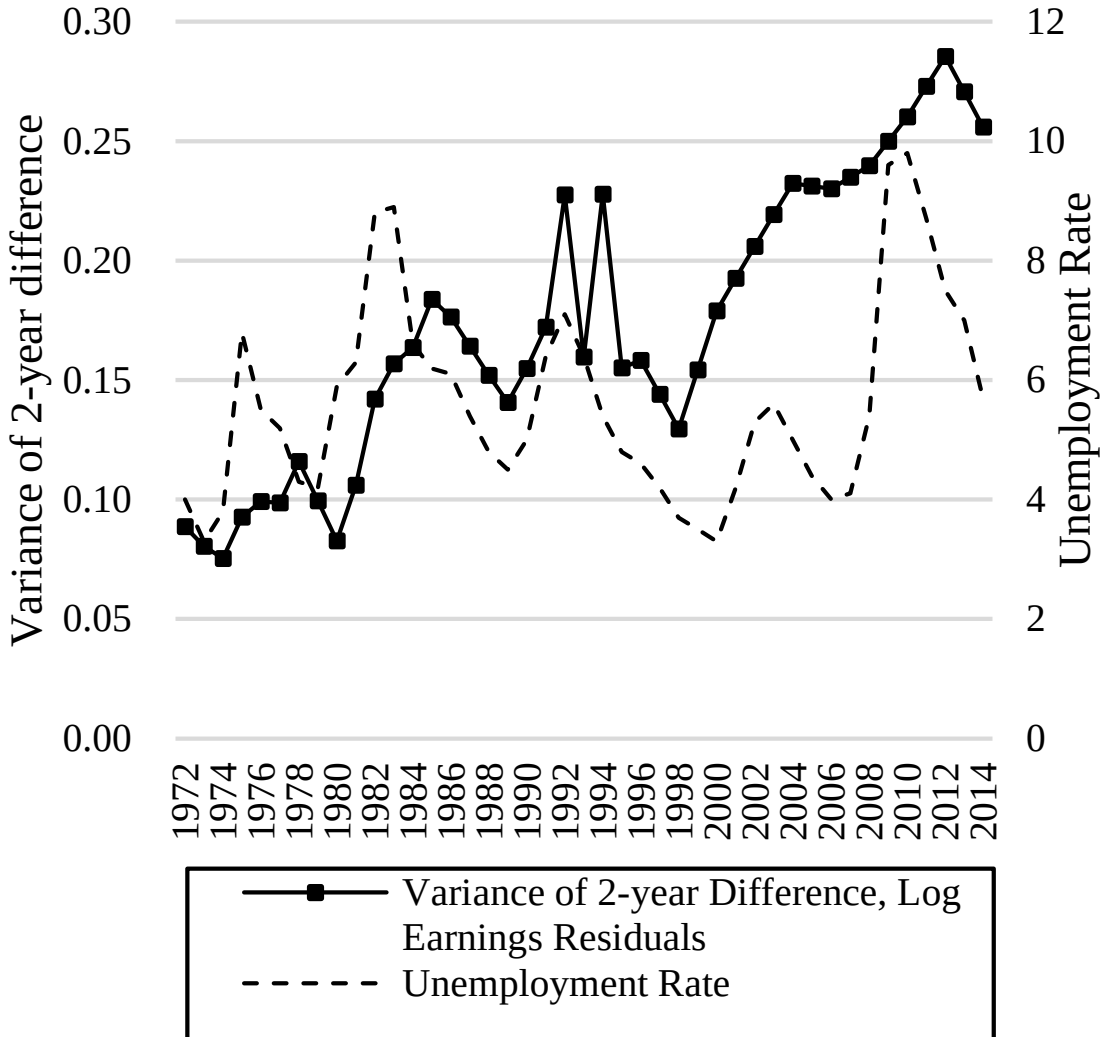
# Table 2: PSID Studies of Volatility with Focus on Calendar Time Trends, Cont'd

| Study | Sample | Method | Findings |
|---|---|---|---|
| Heathcote et al. (2010) | Heads and spouses, 1967-2006 | Error components model of earnings with unit root in permanent component | Upward trends in permanent and transitory variances, differ somewhat by estimation method |
| Moffitt and Gottschalk (2012) | Male heads, 1970-2005 | Error components model of earnings together with WA and nonparametric method | Transitory variance increased from the 1970s to the mid-1980s, then remained at this level through 2005. |
| Jensen and Shore (2015) | Male heads,1968-2009 | Error components model of earnings with evolving permanent effect and correlated transitory effect that captures heterogeneity in permanent and transitory variances | Variances have not risen for most of the population but have risen strongly for those with high past volatility levels |
| **Gross Volatility** | | | |
| Dynarski and Gruber (1997) | Male heads, 1970-1991 | Variance of residuals from a first-difference regression of earnings | Variance rises over time, punctuated by business cycles |
| Shin and Solon (2011) | Male heads 1969-2006 | Standard deviation of 2-year change in earnings residuals | Variance rose in the 1970s, peaked in 1983, declined through approximately 1997, rose thereafter |
| Dynan et al. (2012) | 1967-2008 | Standard deviation of 2-year arc percent change | |
| | Male heads | Labor earnings | Strong increase from 1970 to 1985, followed by slower trend upward punctuated by periods of decline |
| | Female heads and spouses | Labor earnings | Sharp decline through early 1990s, slower rate of decline thereafter |
| | Household | Combined Head and Spouse Labor Earnings and Income | Steady upward trend interrupted by decline in late 1980s and early 1990s (combined head and spouse labor earnings) and slow trend upward except for a large jump upward in the early 1990s (household income) |

*Note:* WA method = Window Averaging Method. Within a fixed interval of years, the variance of the permanent component is calculated as the variance of average earnings and the variance of the transitory component is calculated as the variance of the deviations of actual earnings from average earnings.

# III. Some New Results

# Figure 1: Variance of 2-Year Difference in Log Earnings Residuals

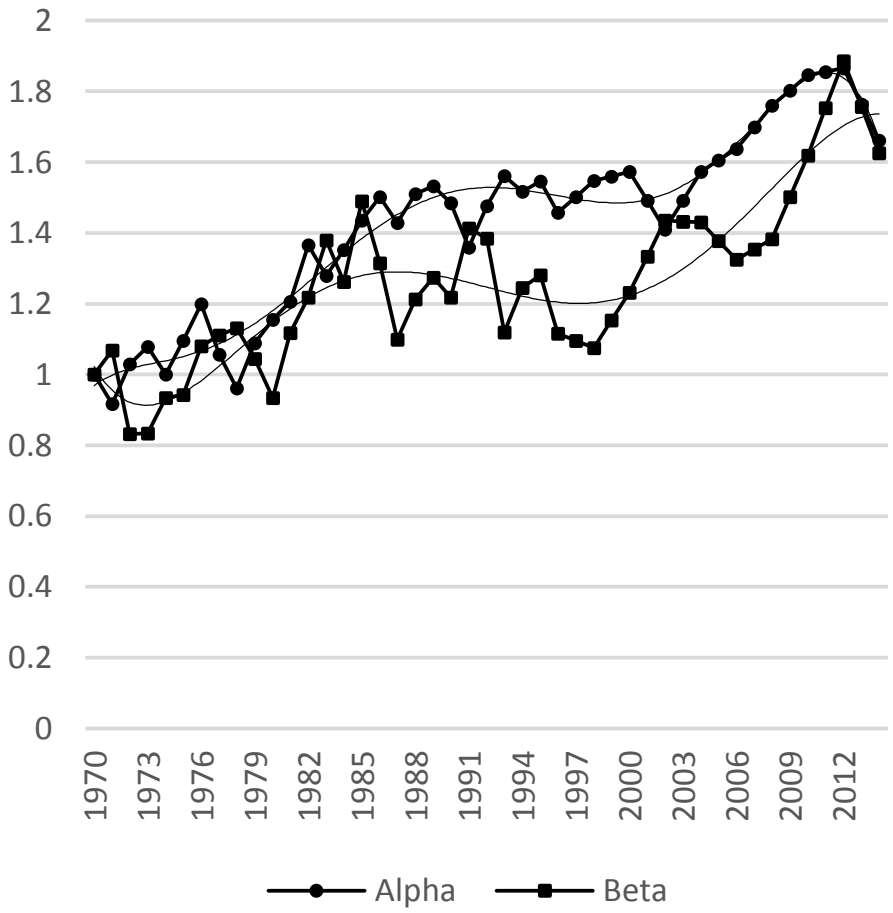


- Figure 1 shows the trend in gross volatility (defined as the variance of the two-year change in log earnings regression residuals) to have followed the same three-phase pattern found in past work, rising from the 1970s to the mid- 1980s, exhibiting a stable trend around significant fluctuations from the mid-1980s to the mid-2000s, and rising thereafter.

## Three Models:

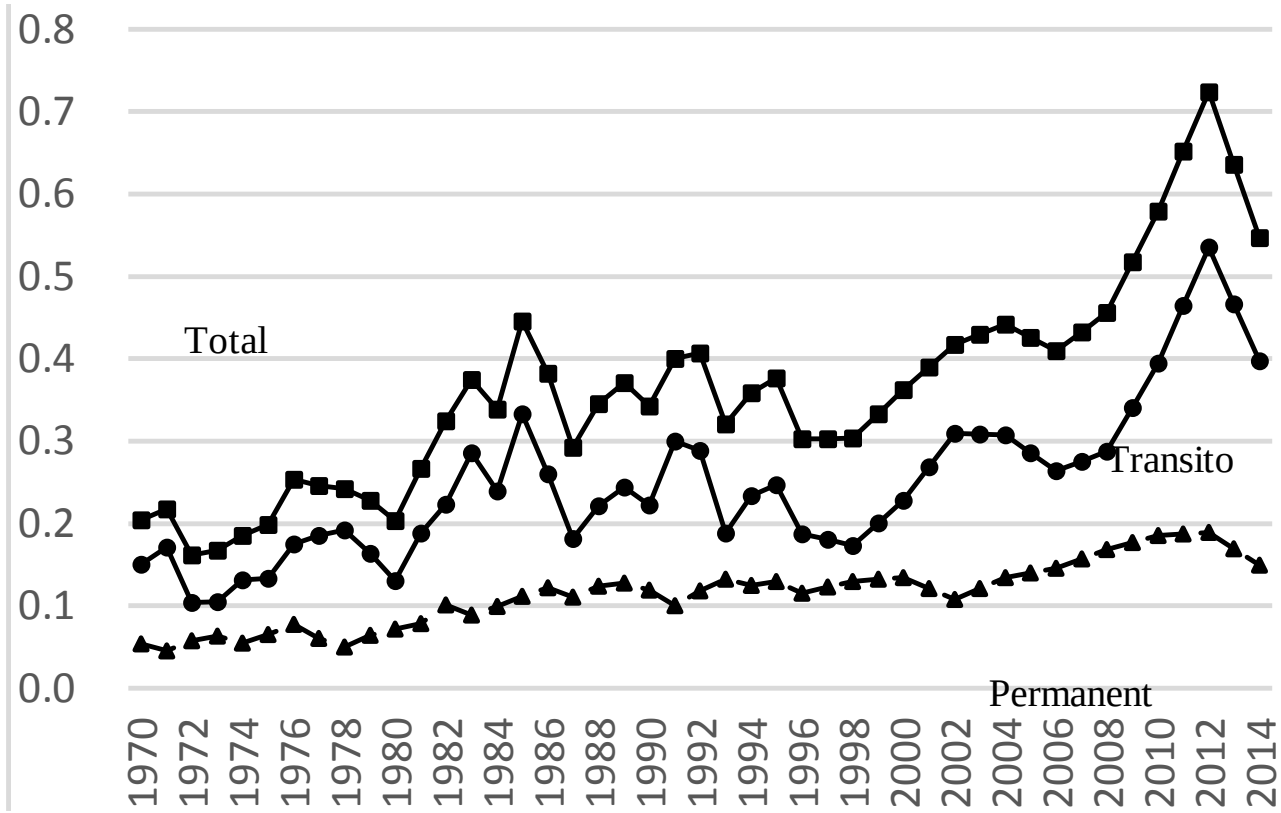
1. $y_{iat} = a_t \mu_{ia} + \beta_t v_{ia}$
2. $\mu_{ia} = \mu_{i0} + \sum_{s=1}^{a} \omega_{is}$
3. $v_{ia} = \varepsilon_{ia} + \sum_{s=1}^{a-1} \psi_{a,a-s} \varepsilon_{is}$ for $a \geq 2$ and with $v_{i1} = \varepsilon_{i1}$.

## Figure 2: Estimates of Alpha and Beta (From Model (1) Above)




- Figure 2 shows the estimation results for $a_t$ and $\beta_t$, both normalized to 1 in the initial year.

Figure 3: Fitted Permanent, Transitory, and Total Variance of Log Earnings Residuals, Age 40-49



- Figure 3 shows the predicted values of the total variance of male earnings residuals as well as that of the permanent and transitory components for men 40-49 (other ages have different levels but the same trend patterns).

# Table 3: Non-PSID Studies of U.S. Volatility with Focus on Calendar Time Trends

| Study | Sample | Method | Findings |
|---|---|---|---|
| **Gross Volatility** | | | |
| Bania and Leete (2009) | SIPP Households from 1991-1992 and 2001 panels | Calculates coefficient of variation of monthly household income over 12-month periods | Volatility rose over time mostly for low income households |
| Sabelhaus and Song (2010) | Social Security individual earnings data, 1980-2005 | Gross volatility calculated as the variance of changes in log earnings | Volatility fell over the period. |
| Dahl et al. (2011)* | Social Security individual earnings data, 1984-2005 | Volatility measured as dispersion of arc earnings changes greater than 50 percent between years | Volatility declined in late 1980s and then more gradually through 2005 |
| Ziliak et al. (2011) | Matched CPS data, 1973-2009 | Volatility measured as standard deviation of arc earnings change | Male volatility rose from the early 1970s to the mid 1980s, was at same level by 2009. Female volatility declined over the entire period. |
| DeBacker et al. (2013) | Tax returns merged with male primary or secondary earner W-2 data, 1987-2009 | Standard deviation of percent change in earnings for men | Fluctuations in several year intervals around a stable trend |
| Celik et al. (2012) | LEHD (UI earnings records) in 12 states,1992-2008, compared to CPS, SIPP, and PSID. Men only. | Standard deviation of change in log earnings residuals | LEHD shows little or no change in volatility, 1992-2008. PSID and CPS show rising volatility from 1970s to early 1980s, subsequent declines, and then resumption of increase starting in early 2000s (PSID) and 2006 (CPS). SIPP shows declines, 1984-2006. |
| Hardy and Ziliak (2014) | Matched CPS data, 1980-2009 | Variance of arc percent change of household income | Volatility doubled over the time period, most pronounced among top incomes |

# Table 3: Non-PSID Studies of U.S. Volatility with Focus on Calendar Time Trends, Cont'd

| Study | Sample | Method | Findings |
|---|---|---|---|
| **Permanent-Transitory Decomposition** | | | |
| Sabelhaus and Song (2010) | Social Security individual earnings data, 1980-2005 | Permanent variance identified change in variance of change in log earnings by lag length. | Both permanent and transitory variances fell over the period. |
| DeBacker et al. (2013) | Male primary or secondary earner W-2 data merged with IRS tax return data, 1987-2009 | Two WA methods plus error components model applied to earnings and household income | Permanent variance of male earnings rose but transitory was stable around fluctuations. Transitory variance of household income rose by a modest degree. |
| Hryshko et al. (2017) | Married couples in matched SSA-SIPP data, 1980-2009 | WA method for estimating transitory variance of earnings | Husband volatility fell 1980-2000 then rose, small net positive. Couple earnings volatility fell more, net decline. |

* The authors also conducted an analysis of household income volatility using matched SIPP-SSA data from 1985 to 2005, finding stability over that period.

# Appendix

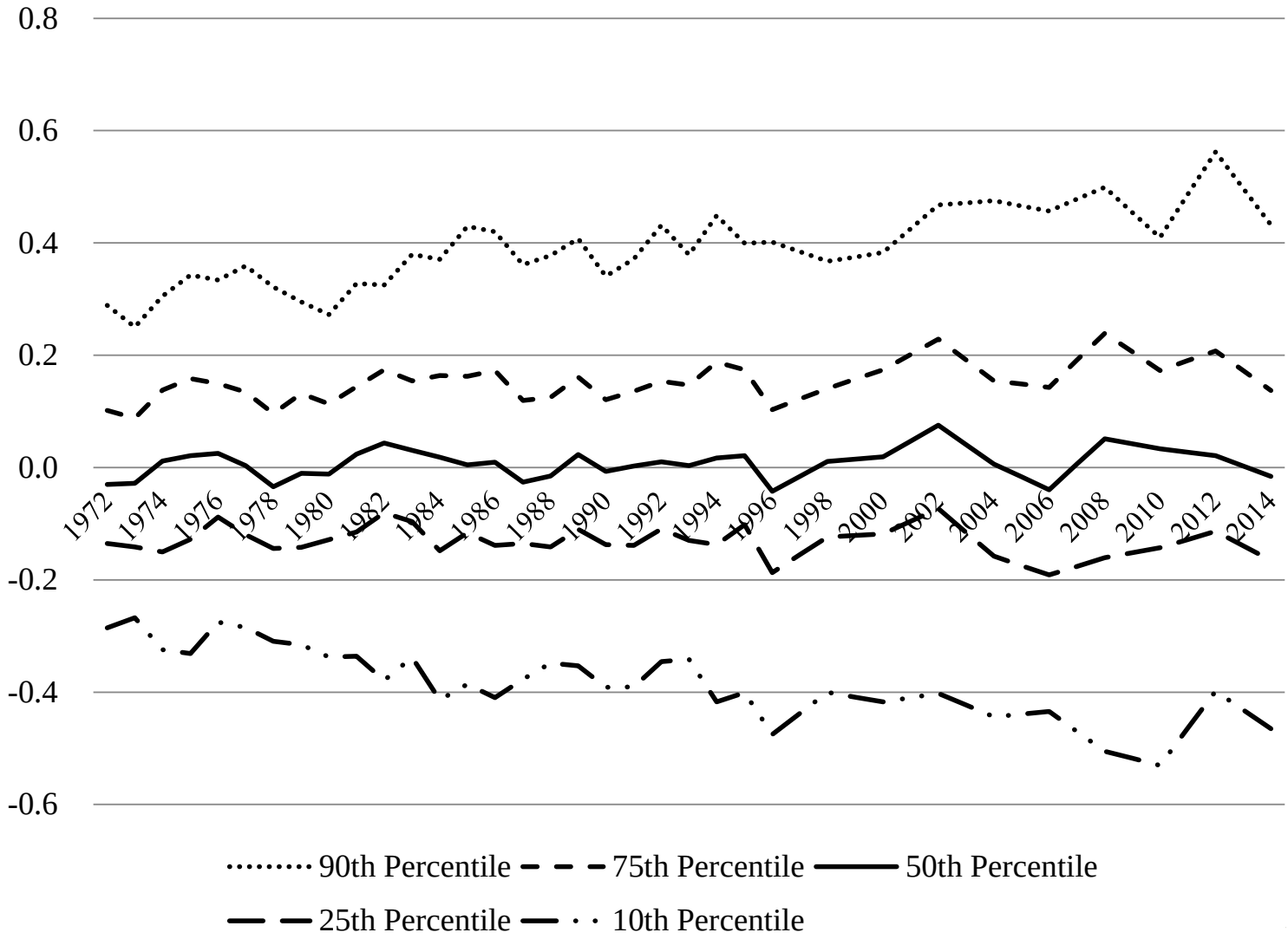
# I. The Usefulness of the PSID in the Study of Income and Economic Volatility

# II. A Review of PSID Research on Income Volatility

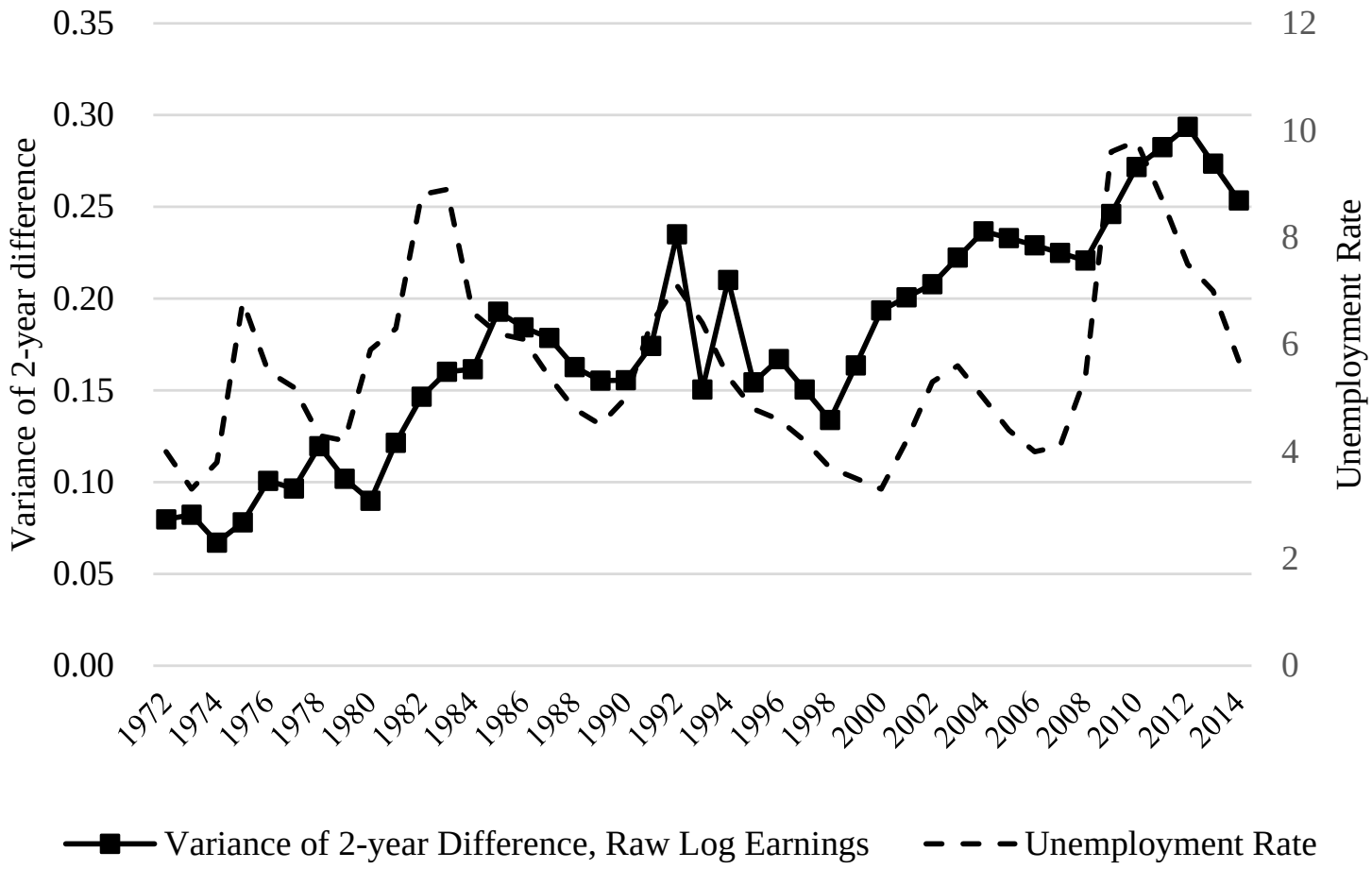
# Calendar Time Trends

# III. Some New Results on Trends in Male Earnings Volatility

# Figure 4: Percentiles of 2-Year Difference in Male Log Earnings Residuals



## Figure 5: Variance of 2-Year Difference in Raw Male Log Earnings



Letting $y_{iat}$ be the log earnings residual for individual $i$ at age $a$ in year $t$, our model is

$$y_{iat} = a_t \mu - ia + \beta_t v_{ia} \tag{1}$$

where $\mu_{ia}$ is the permanent component for individual $i$ at age $a$, $v_{ia}$ is the transitory component for individual $i$ at age $a$, and $a_t$ and $\beta_t$ are calendar time shifters for the two components.

Define a permanent shock $\omega_{is}$ to be one for which $\partial \mu_{ia} / \partial \omega_{ia} = 1$
The only function $f$ which satisfies this condition is the unit root process:

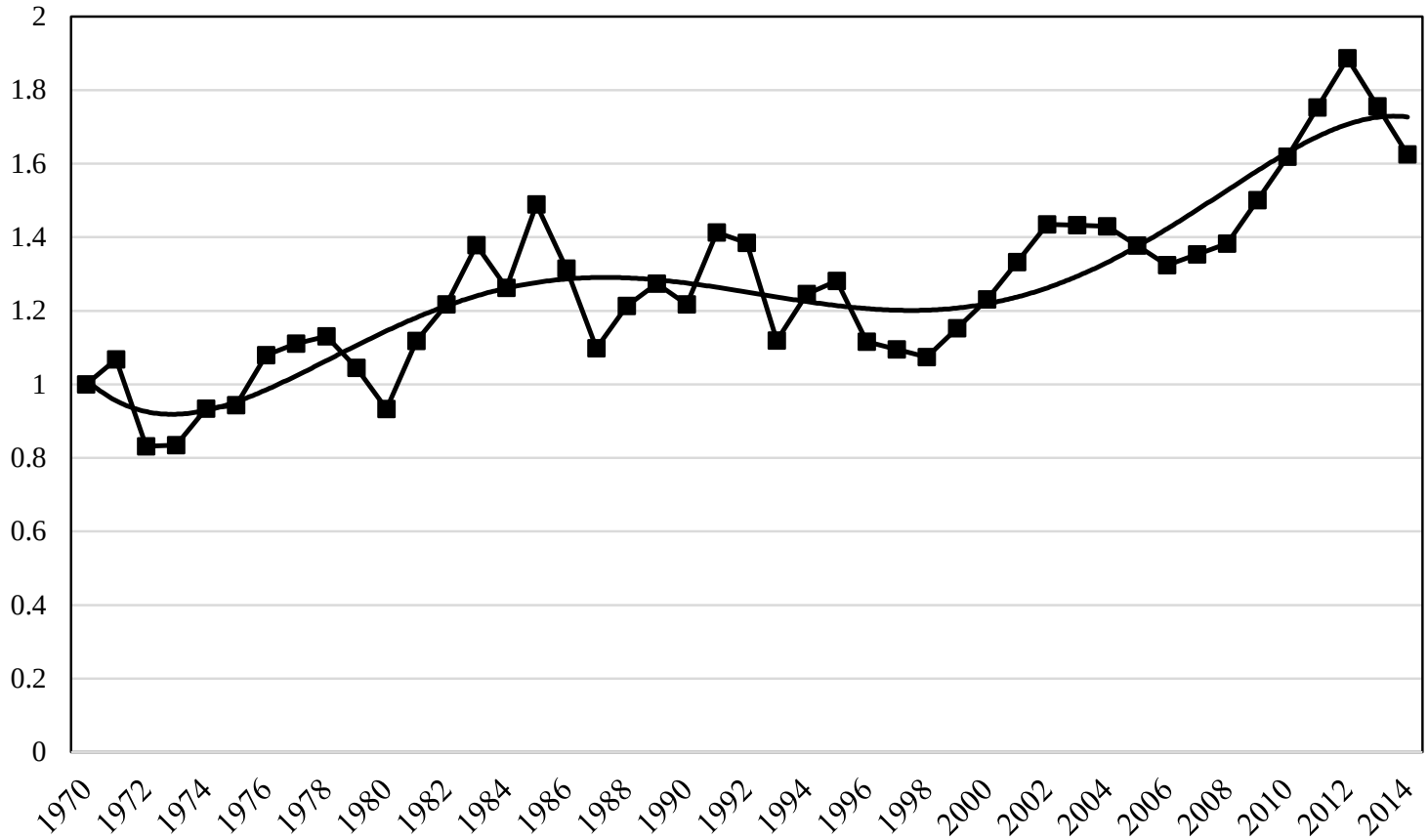
$$\mu_{ia} = \mu_{i0} + \Sigma_{s=1}^{a} \omega_{is} \tag{2}$$

Specify the transitory component:

$$v_{ia} = \varepsilon_{ia} + \sum_{s=1}^{a-1} \psi_{a,a-s} \varepsilon_{i,a-s} \tag{3}$$

Allow the impact coefficients of transitory shocks, the T(T+1)/2 – T parameters $\psi_{a,a-s}$ to be unconstrained

## Figure 6: Extended Semiparametric (ESP) Model Estimates of Alpha



## Figure 7: Extended Semiparametric (ESP) Model Estimates of Beta

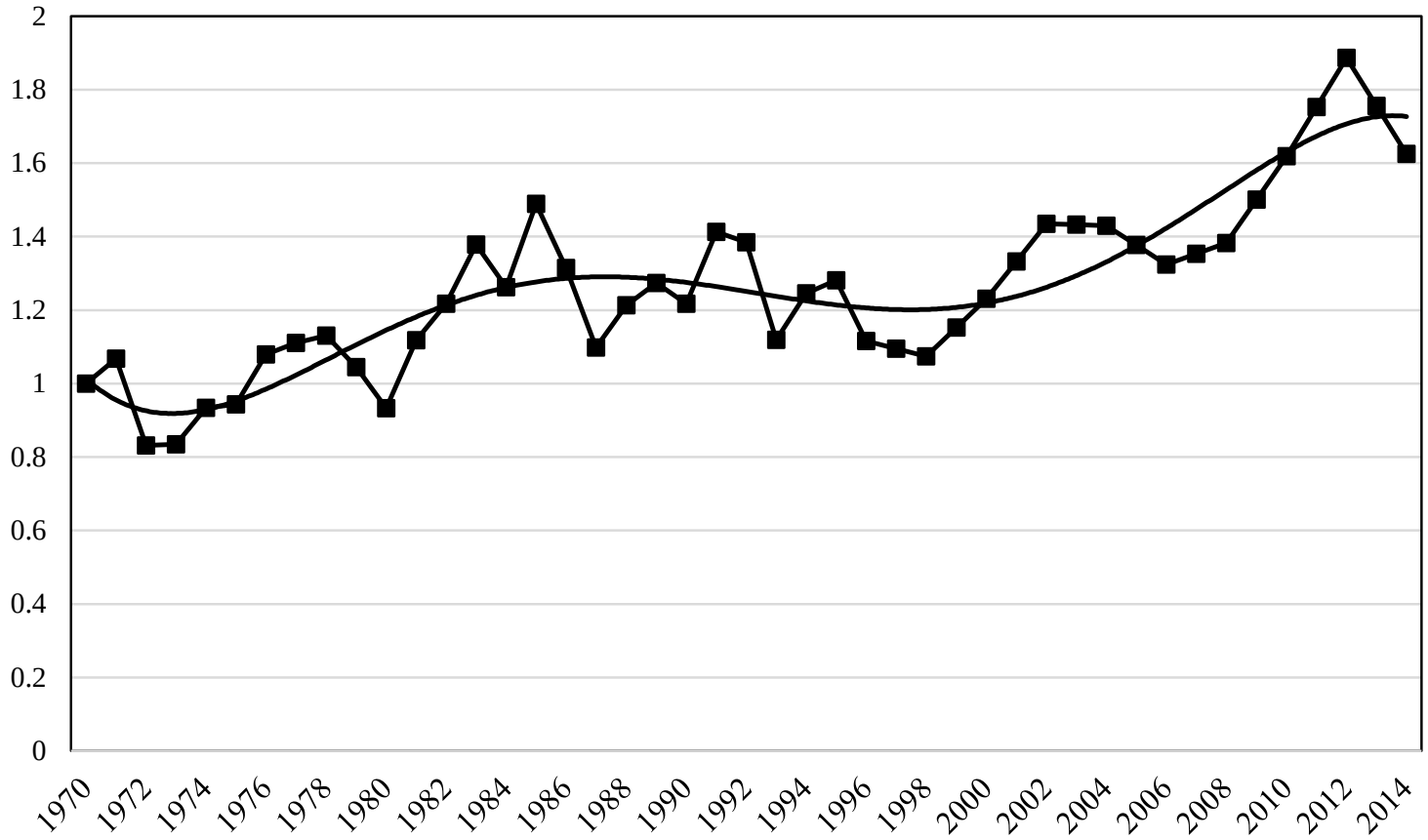
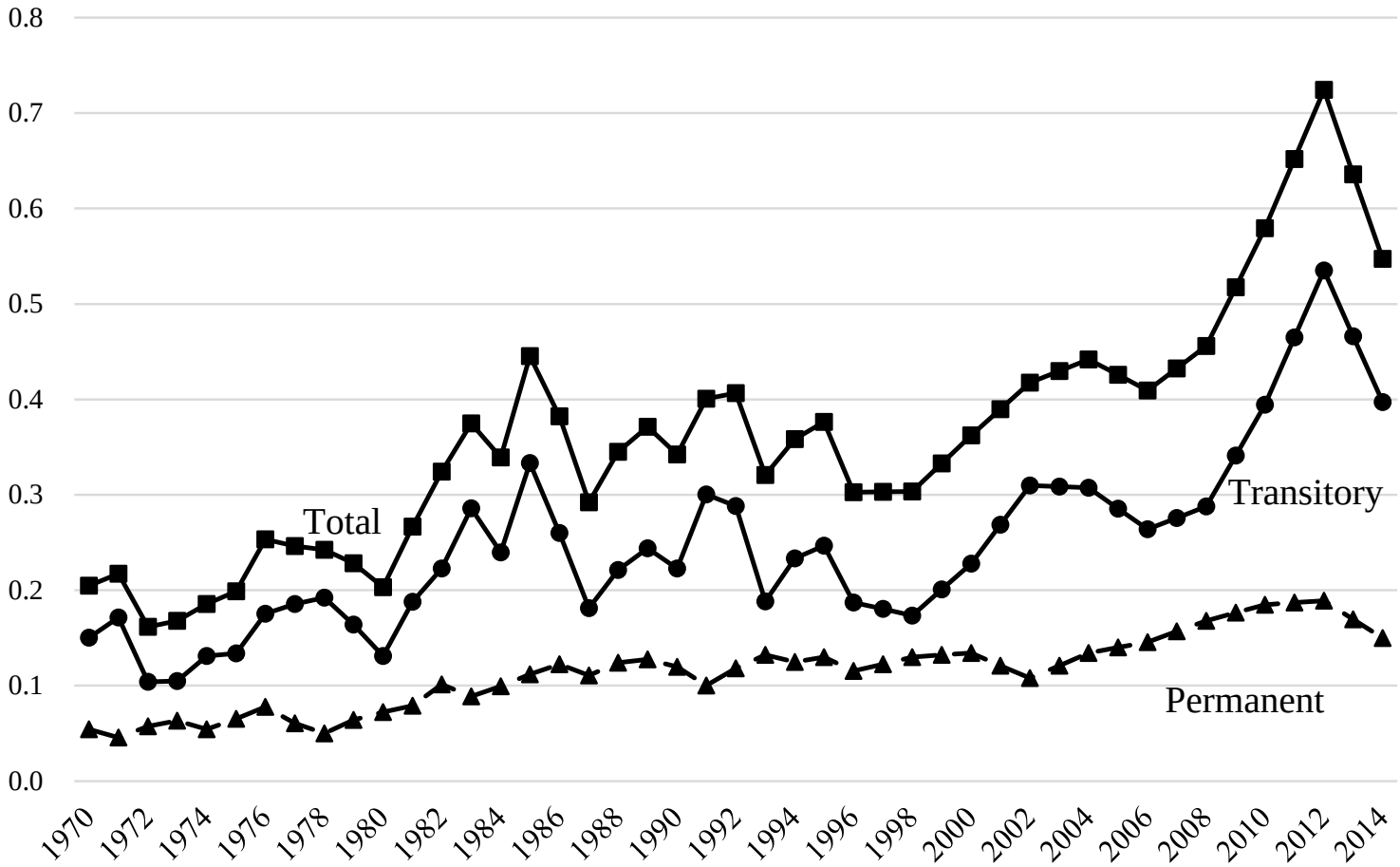
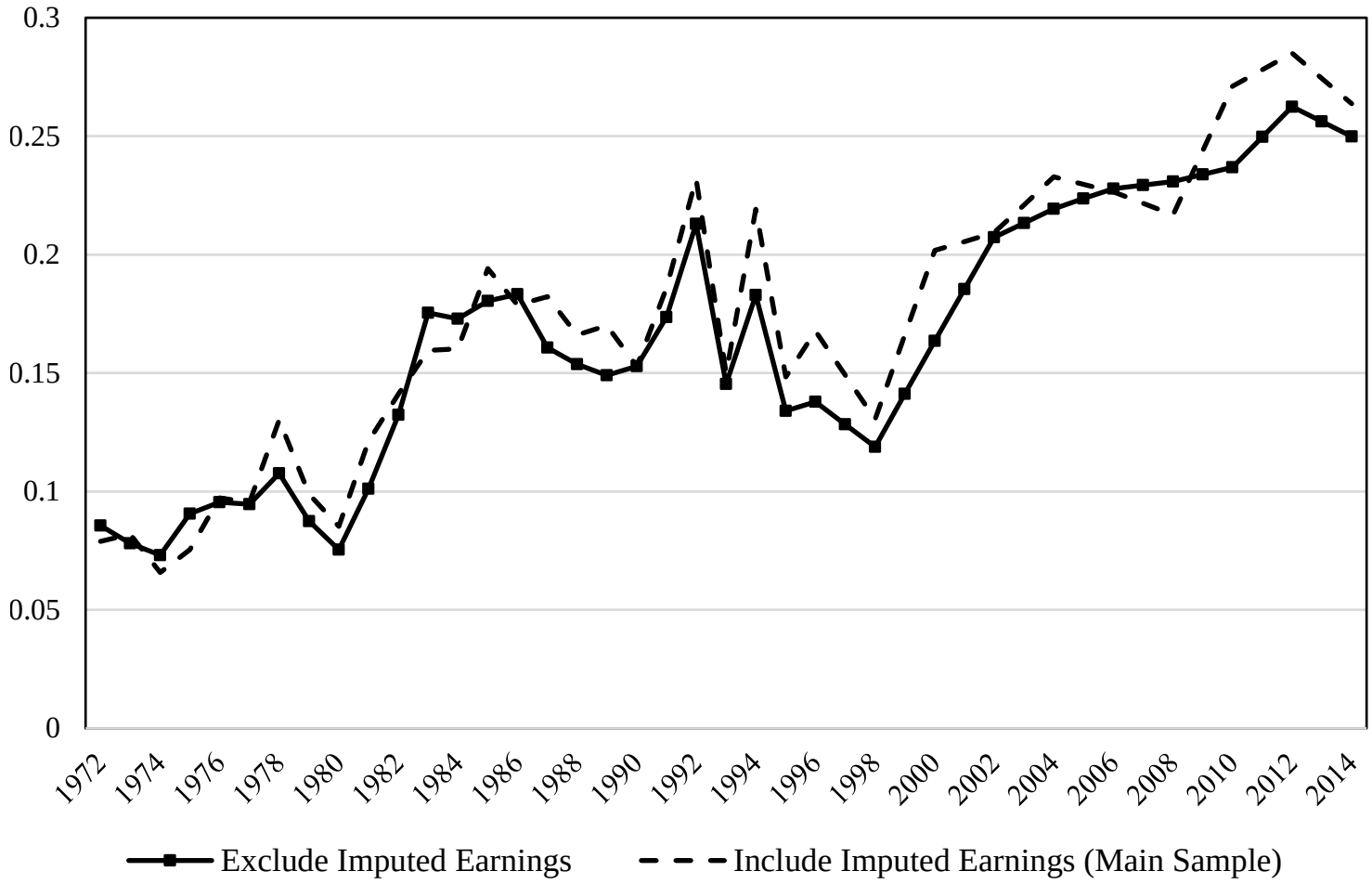


Figure 8: Fitted Permanent, Transitory, and Total Variance of Log Earnings Residuals, Age 40-49, ESP Model



# IV. Sensitivity Tests: Imputation and Window Averaging

Figure 9: Variance of 2-Year Difference of Log Earnings Residuals, Including and Excluding Imputed Observations



A traditional ANOVA definition of the transitory variance within a window of T observations is

$$\frac{1}{N(T-1)}\Sigma_{i=1}^{N}\Sigma_{t=1}^{T}(y_{it}-\bar{y}_i)^2 \tag{4}$$

However, because $y_{it}-\bar{y}_i=\frac{1}{T}\Sigma_{\tau\neq t}^{T}(y_{it}-y_{i\tau})$, the WA method is based on the variance of pairwise differences between each $y$ and the others within the window.

Figure 8 shows estimates of equation (4) using a 9-year window for our male head data set 1970-2014, plotted against the year in the center of the window. The levels of the estimated variances is quite a bit below those of the transitory variance in Figure 6 (exact numbers in Appendix Table 3) which is to be expected since the WA method averages over years and hences damps down the year-to-year variances from the ESP model.

Figure 10: Window Averaging (WA) Estimate of Transitory Variance, 9-year Window