Trends in the Transitory Variance of Male Earnings in the U.S., 1991-2003: Preliminary Evidence from LEHD data[1]

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data providers, or of the Board of Governors of the Federal Reserve System or its staff. Some or all of the data used in this paper are confidential data from the LEHD Program. The U.S. Census Bureau supports external researchers' use of these data through the Research Data Centers (see www.ces.census.gov). For other questions regarding the data, please contact Jeremy S. Wu, Manager, U.S. Census Bureau, LEHD Program, 4700 Silver Hill Rd., Suitland, MD 20233, and USA. (Jeremy.S.Wu@census.gov)

Abstract

Trends in the Transitory Variance of Male Earnings

in the U.S., 1991-2003: Preliminary Evidence from the LEHD

We estimate the trend in the transitory variance of male earnings in the U.S. from 1991 to 2005 using an administrative data set of Unemployment Insurance wage reports, the Longitudinal Employer-Employer Dynamics data set (LEHD), and compare the findings to those of Moffitt and Gottschalk (2008) obtained from the Michigan Panel Study of Income Dynamics (PSID). Despite substantial differences between the LEHD and the PSID in the levels of cross-sectional variances of male earnings, the changes over time in transitory variances obtained from estimating two of the models in Moffitt and Gottschalk are quite similar in the two data sets. Specifically, over the 1991-2003 period, transitory variances fell slightly, and then rose slightly, returning in 2003 to the same approximate level they had obtained in 1991. Overall, the analysis of the LEHD data confirms the findings based on the PSID that the transitory variance did not show a trend net of cycle over this period.

A substantial literature has developed on estimates of various measures of trends in earnings and income instability in the U.S. and some other countries. Virtually all of the U.S. studies have employed the Michigan Panel Study of Income Dynamics (PSID), a longitudinal household survey of families begun in 1968 (Gottschalk and Moffitt, 1994; Moffitt and Gottschalk, 1995, 2008; Dynarski and Gruber, 1997; Cameron and Tracy, 1998; Haider, 2001; Hyslop, 2001; Moffitt and Gottschalk, 2002; Dynan et al., 2008; Jensen and Shore, 2008; Shin and Solon, 2008).[1] Those studies which focus on computing the classical transitory variance of earnings have virtually all shown increases for men, although many have found increases that were concentrated primarily in the 1980s. For example, the recent study of Moffitt and Gottschalk (2008) found that the transitory variance of male earnings stopped growing sometime in the late 1980s or early 1990s, and exhibited no further trend through 2004.

A concern with all studies using the PSID is measurement error, mostly arising from errors in reported earnings[2]. The PSID has traditional earnings questions which ask respondents to report earnings over the previous calendar year and, as noted in the review paper by Bound et

[1] One study (Dahl et al., 2008) used an administrative data set, the Continuous Wage Benefit History data which have reports of Social Security earnings. They found results in contrast to the PSID but the difference may have been a result of a difference in the measure of instability used. See Moffitt and Gottschalk (2008) for a discussion.

[2] Errors may also arise from imputation procedures used by the survey organization to deal with missing answers (don't knows and refusals) and seemingly extreme value answers (outliers). The effect of these sources of error can be dealt with by excluding imputed earnings, though this raises potential selection issues, and by trimming the data.

al. (2001), measurement error is known to occur in this case, including the PSID. Moreover, measurement error is known to be non-classical, both correlated with observable characteristics, serially correlated (usually mean reverting).. However, the magnitude of the resulting impacts on estimates of the covariance structure of earnings equations may not be large (Pischke, 1995; Brown et al., 2001). Gottschalk and Huynh (forthcoming) show that this is a result of large but offsetting effects of the non-classical attributes of measurement error in both earnings and lagged earnings.

A consideration relevant to our goal of estimating trends in the transitory variance of earnings is that measurement error may affect only our estimated levels of that variance and not its trend, if the character of measurement error has not changed over time. Unfortunately, the PSID made several changes to its procedures in the early 1990s, when it shifted from "paper and pencil" telephone interviewing to computer-assisted telephone interviewing in 1993, which could be expected to affect measurement error (Kim et al., 2000). Around the same time, the PSID changed its method of imputation for missing or outlying earnings values, moving from using a set of discretionary rules for individual items to a more conventional hot-deckprocedure. The early 1990s is an important period for trends in earnings dynamics, for it is in that period that Moffitt and Gottschalk (2008) determine that the upward trend in the transitory variance stopped growing, with some ambiguity as to the exact date because of a recession that occurred in the US at that time. While one could argue that the fact that the transitory variance exhibited no further trend from the early 1990s to 2005 is valid if PSID procedures remaining unchanged over that time, the PSID change in procedures does affect a comparison of that period with earlier

periods.[3]

In this paper, we estimate U.S. permanent and transitory variances with an administrative-record data set, the Longitudinal Employer-Household Dynamics (LEHD) data set, which is based upon the universe of all employer reports of quarterly earnings for the Unemployment Insurance system. Such reports are generally thought to be less contaminated by measurement error than survey reports, so the variance estimates on such data should be indirectly informative of the impact of measurement error on PSID-based estimates. The LEHD data are only available since 1991, however, and they have some other non-comparabilities with the PSID and other issues, which we discuss below.

We first inspect the raw LEHD data and find that it shows marked differences in cross-sectional means and variances of log earnings compared to the Current Population Survey (CPS) and the PSID, differences that are difficult to explain. However, we also find that trends in the raw mean and variance of log earnings closely mirror those in the PSID and the CPS. We then apply two of the methods for the estimation of transitory variances developed by Moffitt and Gottschalk (2008) to the LEHD data. Our results show that, while the levels of transitory variances estimated are again different from those estimated with PSID data, the trends are quite similar in the two data sets for the 1991-2003 overlap period.

In the remainder of this research note, we first describe the LEHD data and compare it to the PSID. We then briefly summarize the estimation procedures developed by Moffitt and Gottschalk (2008), describe how we apply them to the LEHD data, and report our results. A

[3] Gouskova and Schoeni (2007) compared cross-sectional estimates of the distribution of PSID and CPS income reports over this period and argue that the two exhibit the same trends and

short summary concludes.

The Longitudinal Employer-Household Dynamics Data Set

As described in more detail in Abowd et al. (2004, 2006), the Longitudinal Employer-Household Dynamics program is a program at the U.S. Bureau of the Census that encompasses several different administrative and linked administrative-survey data sets. Here, we use the LEHD data set consisting of the wage data available from state-level unemployment insurance (UI) programs, originating from employer reports to state agencies for purposes of determining entitlement to UI benefits. These data contain uncapped quarterly earnings for employees covered by state unemployment insurance systems, estimated to cover over 95 percent of private sector employment. Although coverage laws vary slightly from state to state, state, UI programs generally do not cover federal employees, most agricultural workers, many churches and non-profits, and the self-employed.[4] These administrative earnings records can be linked across quarters to create individual work histories. The gender and date of birth of individuals are available from links to the Census NUMIDENT file (a version of the Social Security Administration transaction file)

The LEHD program is of fairly recent origin, but agreements between the U.S. Census Bureau have been negotiated for 44 states as of this writing. However, most state data do not extend far back in time. For this reason, we select only five large states for our analysis, those

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that, therefore, the PSID procedural changes had no effects on the trends.

[4] The LEHD program is currently integrating administrative data sources on the self-employed and federal workers, however those data were not yet available at the time of this analysis.

whose data are available back to 1991[5]. The most recent data are from 2003. We restrict our sample to male workers age 23-62 in any year in the sample, for comparability with the work of Moffitt and Gottschalk (see below). We also exclude those who have only one quarter of LEHD earnings . These include seasonal workers with very low earnings whose earnings are unlikely to be reported in the PSID and whose inclusion in the LEHD has a large impact on the variance of log earnings (further work on this is underway). For some analyses, we additionally trim the top and bottom 1 percent of the earnings distribution, as described below (again, for comparability with Moffitt and Gottschalk,2008). None of the selected states have large metropolitan areas at the border of the state that would be conducive to a large number of cross-state transitions (and thus workers appearing and disappearing as they moved in and out of the state UI employment universe). The final sample is quite large, with between four and six million workers in any given year

There are some differences between this sample and the PSID sample used by Moffitt and Gottschalk. The most important difference is likely to be the exclusion of non-household-heads in the PSID, whose earnings are not consistently measured in that data set. The LEHD, on the other hand, contains all workers regardless of headship status. The LEHD does not have an indicator for headship status, so these workers cannot be identified. On a priori grounds, one might suspect that secondary workers in a household would have more variable earnings trajectories than those of heads. In addition to this, of course, the PSID includes the nation as a whole, and not just five states; the PSID sample sizes are too small for any substantial analyses on this subset of states. A minor difference is that the age range used by Moffitt and Gottschalk

[5] The states are Oregon, North Carolina, Washington, Illinois, and Wisconsin.

was 20-59, but excluding individuals identified as students; student status is not available in the LEHD, so the age range is shifted upwards by three years, to 23-62, to eliminate students in the 20-22 range.[6] Moffitt and Gottschalk did not exclude workers with only one quarter of earnings, but a sensitivity analysis to this is underway. Finally, Moffitt and Gottschalk analyzed residuals from a first-stage log earnings regression with independent variables for age, year, education, and race; the LEHD analyses reported here uses raw log earnings However, Moffitt and Gottschalk found small differences in their estimates of permanent and transitory variances of residual or raw PSID log earnings. While we do not believe that the use of raw earnings rather than residual earnings from the LEHD should cause differences in trends, this may explain lower variances in the PSID analysis[7].

Figures 1-3 show comparisons of the LEHD data to the CPS, the most widely used data set for studies of earnings inequality. This comparison allows us to determine whether the LEHD shows similar levels and trends in cross-sectional means and variances of log earnings. One major advantage of comparing the LEHD to the CPS, rather than the PSID, is that similar sample deletions (e.g., for the five states) can be imposed on these two data sets, thus minimizing the effects of sample composition.[8] For the CPS, we show figures for the nation as a whole and for the five states that appear in our LEHD sample. Sample sizes are necessarily smaller in the latter case. The CPS tabulations are for men 23-62, and are based on household reports of

[6] Moffitt and Gottschalk actually restricted their sample to those 30-59, but used lags of earnings for these individuals back to age 20. An analysis of sensitivity to this difference is also underway.

[7] We are in the process of redoing the analysis for both data sets using residuals from first stage regressions that condition only on age and year.

[8] The major remaining difference is that we cannot exclude workers with only one quarter

earnings in the last year taken from the March survey.[9] Both data sets are trimmed at the top and bottom 1 percent prior to tabulation .

Figure 1 shows that the LEHD log earnings means are considerably lower than those in the CPS. [10]However, the trends are roughly similar after 1996, with both means rising from 1996 through 2000 and declining after 2001, a recession year. The CPS shows a modest rise in earnings from 1992-1993 through 1996 while the LEHD is flatter over that period.

Figure 2 shows the variance of log male earnings in these two data sets. The variance is somewhat higher in the LEHD than in the CPS, which is consistent with the finding in Gottschalk and Huynh (forthcoming) that measurement error in earnings is non-classical, with higher earnings individuals underreporting their true values and lower earnings individuals over reporting them. This leads to an attenuation in the cross-sectional variance in survey data. While the levels are somewhat lower in the CPS than the LEHD, both data sets show relatively little increases in the variance, though both show a mild increase starting in 1999.

While the PSID covers a substantially different subpopulation, namely male heads, it is useful to contrast the mild increase in inequality in the 1990s found in the LEHD and CPS with the much larger increase over the period covered by the PSID. Figure 2b shows the variance of log earnings from 1970 to 2004 for the PSID and a CPS sample with sample cuts used to replicate the PSID. To facilitate comparisons with the LEHD and its CPS benchmark, we also replicate the two series shown in Figure 2a. While the PSID shows substantially lower variances

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of earnings from the CPS.

[9] While Federal workers are excluded from the LEHD, it is not possible to exclude these workers from the CPS since they are aggregated along with state and local workers into a single category.

than either the LEHD or the CPS benchmark of the PSID, all data sets show relatively little increases in the log variance during the 1990s compared to the early 1980s. This is consistent with this many other studies. There is, however, some difference in the timing of the recent mild increase in the log variance across data sets. The PSID shows a mild increase starting in 1996 while the LEHD and the CPS benchmark of the PSID both show increases in the log variance starting in 1998. The LEHD, however, moves less in both the downward and upward direction in terms of magnitude, than either the PSID or CPS.

To explore whether the LEHD and CPS variances reflect similar underlying trends in percentiles, Figures 3a and 3b show the 10^{th} and 90^{th} percentiles for the LEHD and its CPS benchmark. The LEHD shows no change in the P10 from 1990 to 1996, while the CPS declines through 1993 and then increases. The two series, however, show similar movements during the remaining period, 1996-2006. Both increase through 1998 and then decline.[11] Figures 3b also shows roughly similar patterns in the LEHD and CPS at the 90^{th} percentile over the full period, with both increasing by roughly 20 percent from 1990 to 2004.

We conclude that while there are some differences in the time series patterns of variances in the LEHD, CPS, and PSID, all three data sets show relatively flat profiles. The changes in all three data sets after 1991 are small compared to large increases in the log variance during the 1980s shown in our CPS and PSID samples, as well as found in many other studies, such as Card and Dinardo (2002).

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[10] All dollar figures in this paper are deflated with the 1996 CPI-U-RS.

[11] The CPS for all states, however, does not fall. This indicates that the very bottom of

Estimating Transitory Variances

Moffitt and Gottschalk (2008) estimated the trend in the variance of log annual earnings of men in the PSID using the autocovariance matrix of earnings indexed by age, year, and lag length. A typical element of this matrix consists of the covariance between earnings of men at ages a and a' between years t and t'. For sample size reasons, Moffitt and Gottschalk grouped the observations into three age groups--30-39, 40-49, and 50-59--and then constructed the variances for each age group in each year, as well as the autocovariances for each group at all possible lags (back to 1970 or age 20, whichever came first). The covariance between the earnings of the group in the given year and each lagged year was computed using the individuals who were in common in the two years. The top and bottom one percent of the residuals within age-education-year cells was trimmed to eliminate outliers and top-coded observations. The resulting autocovariance matrix represented every individual variance and covariance between every pair of years only once, and stratified by age so that life cycle changes in the variances of permanent and transitory earnings can be estimated. The resulting autocovariance matrix had 1,197 elements over all ages and all years, 1971-2004.

We follow these procedures exactly for the formation of the LEHD covariance matrix except that the four age groups are slightly older to minimize the impact of not being able to exclude students from the LEHD: 23-32, 33-42, 43-52, and 53-62. We apply the same trimming procedures. Because the LEHD only permits lags back to 1991 for each ten-year age group, the resulting covariance matrix only has 283 elements.

Moffitt and Gottschalk used three methods to estimate trends in transitory variances: a

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the distribution is somewhat different in the five states sampled by the LEHD.

structural error components model, an approximate nonparametric model, and a grouped model they called the "BPEA" method. We do not apply the third-method to the LEHD data because it requires the construction of nine-year windows of the data, and the LEHD time period (1991-2005) is too short to allow meaningful trend inference. However, we apply the first two methods exactly as described in Moffitt-Gottschalk (2008). We will not exposit those models here, but refer the reader to their 2008 paper.[12]

Figures 4-8 show the findings from the PSID reported by Moffitt and Gottschalk. Figure 4 shows that the year factor loading on the standard deviation of the permanent component (alpha) estimated from their parametric error components model fluctuated with no discernible trend from 1991 to 1996 but then rose sharply through 2004. The year factor loading on the transitory component (beta), our main object of interest, is shown in Figure 5. That variance declined from 1991 through approximately 1998 and then rose through 2002, falling again in 2004. Moffitt and Gottschalk interpreted this as evidence for no trend after 1991. Their interpretation is reinforced by Figure 6, which shows the unemployment rate as well. The pattern in the transitory variance is closely aligned with the unemployment rate after about 1990, implying that the fluctuations in the transitory variances were likely only cyclical.

Figure 7 shows the permanent, transitory, and total variances of log male earnings

[12] While the error components model fitted to the LEHD data is identical to that fitted to the PSID data, it deserves reemphasis that the LEHD have lags no more than 12 years (2003 back to 1991), whereas the PSID data have lags of up to 31 years (2004 back to 1971). Because the identification and estimation of the permanent variance, and therefore of the transitory variance as well, depends on identifying the permanent component from the long autocovariances, this could generate a difference. In addition, for the approximate nonparametric method, Moffitt and Gottschalk used lags of order 10 or higher, whereas we use lags of order 4 and higher for the LEHD approximate nonparametric method.

implied by the error components model, which are more convenient for interpretation of magnitudes of trends in the variances than the alpha and beta parameters. This figure shows that the total variance all of log earnings showed no significant trend between the mid-1980s and the late 1990s. The recent rise in the total variance primarily reflects changes in the permanent variance which started increasing in 1996. While the transitory variance fluctuates it shows no clear trend in the recent period.

Finally, Figure 8 shows the estimates of the transitory variance obtained from the approximate nonparametric method developed in Moffitt and Gottschalk (2008). While this method makes much weaker assumptions than the error components model, it shows very similar patterns. The transitory variance fluctuates with the business cycle but shows no clear trend after the early 1980s.

Estimates for the LEHD are shown in Figures 9-11. Figure 9 shows the estimates of alpha and beta from the parametric error components model.[13] While these LEHD series are considerably smoother than the series for the PSID shown in Figures 4 and 5, the estimated changes in both, especially that for beta, which drives the transitory component, are similar to those estimated for the PSID. Specifically, beta declines from 1991 to the late 1990s then rises sharply thereafter, returning in 2003 to about the same level it had been in 1991. As discussed above, this is qualitatively similar to the cyclical patterns shown for the PSID.

However, a major difference is in the magnitudes of the decline and fall, which are much smaller for the LEHD than for the PSID. This probably mirrors the smaller magnitudes of decline and rise in the overall variance noted in the discussion of Figure 2, and may arise from

the same source.

Figure 10 shows the fitted, or implied, permanent and transitory variances for the LEHD from the error components model. Not surprisingly, these permanent and transitory variances change less than those for the PSID. This reflects a flatter alpha and beta plots in figure 9. Another difference is that the PSID transitory variance (see Figure 7 above) ends up in 2003 slightly below its cyclical peak in 1991 whereas it ends up in 2003 slightly above its 1991 value in the LEHD. These differences are small, however.

Finally, Figure 11 shows the estimates of the transitory variance from the approximate nonparametric method. The LEHD estimates are quite similar to those obtained from the parametric error components model, as they were for the PSID as well. This confirms that our estimates are not being driven by the parametric assumptions in our error components model.

Summary

This preliminary investigation into whether the trends in transitory variances of male annual earnings estimated in the Panel Study of Income Dynamics are also found in an administrative data set, the Longitudinal Employer Household Dynamics data, reveal a rough consistency in the overlap period, 1991 to 2003. Specifically, transitory variances declined slightly in the first half of the period and then rose for what are likely to have been cyclical reasons, with no strong or apparent trend. However, the magnitudes of the fluctuations are much smaller in the administrative data than in the survey data. Indeed, the total variances move much less in the LEHD than in the PSID or a CPS sample with sample deletions similar to those used in the LEHD. We will explore possible explanations for this difference in future work.

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[13] The other parameters are shown in the Appendix.

Table A1
Estimated Parameters from
Error Components Model

	LEHD	PSID
V(mu_a0)	0.310	0.090
rho	0.638	0.847
theta	-0.400	-0.574
V(omega)	0.014	0.003
V(delta)	0.0001	0.0000
Cov(mu_delta)	-0.009	-0.002
Gamma_0	-0.033	-0.033
Pi_0	0.329	0.063
Pi_1	-0.0003	0.0020

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Figure 1:Mean Log Male Earnings in the CPS and LEHD 1990-2004

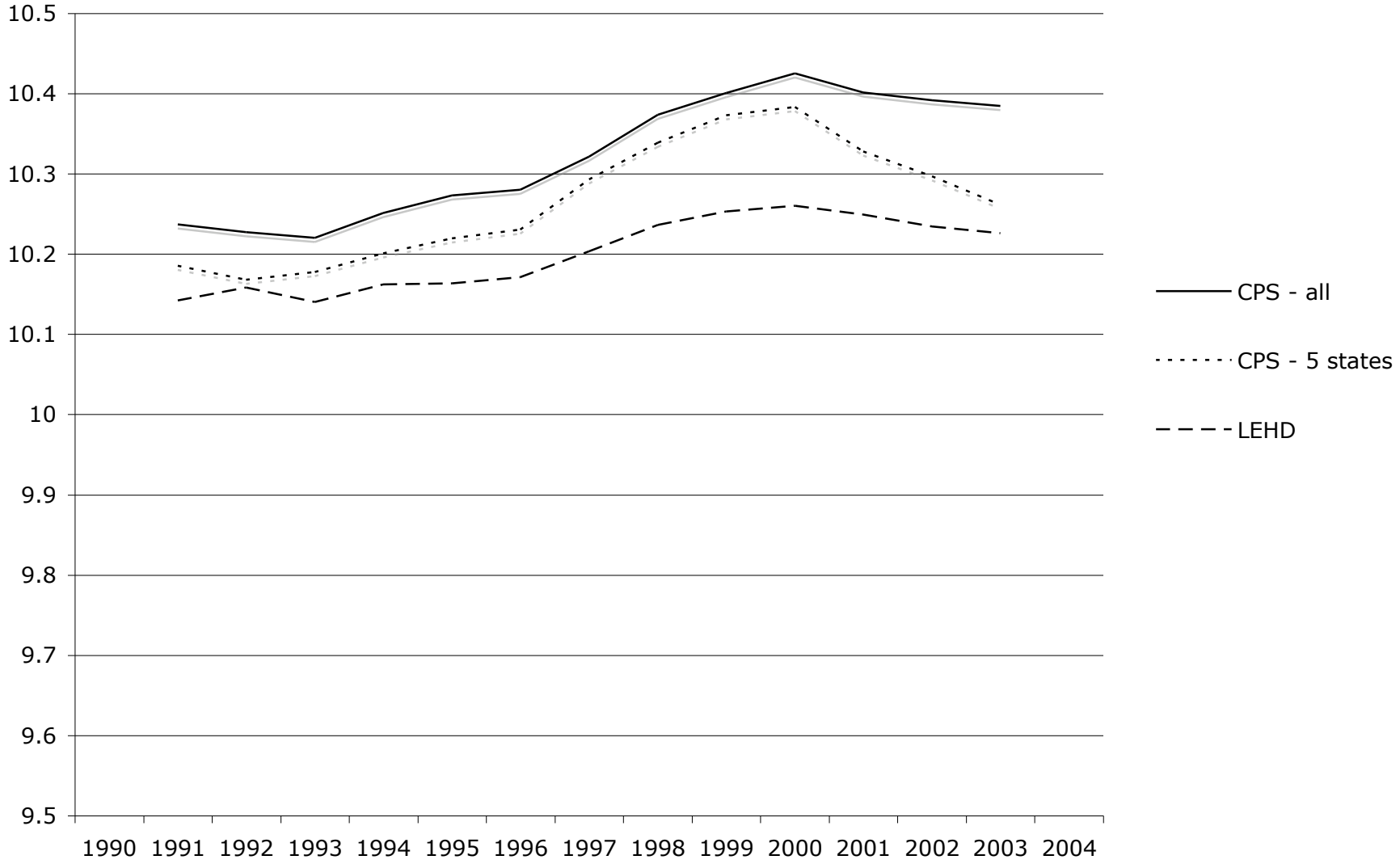


Figure 2a: Variance of Log Male Earnings in the CPS and LEHD 1990-2004

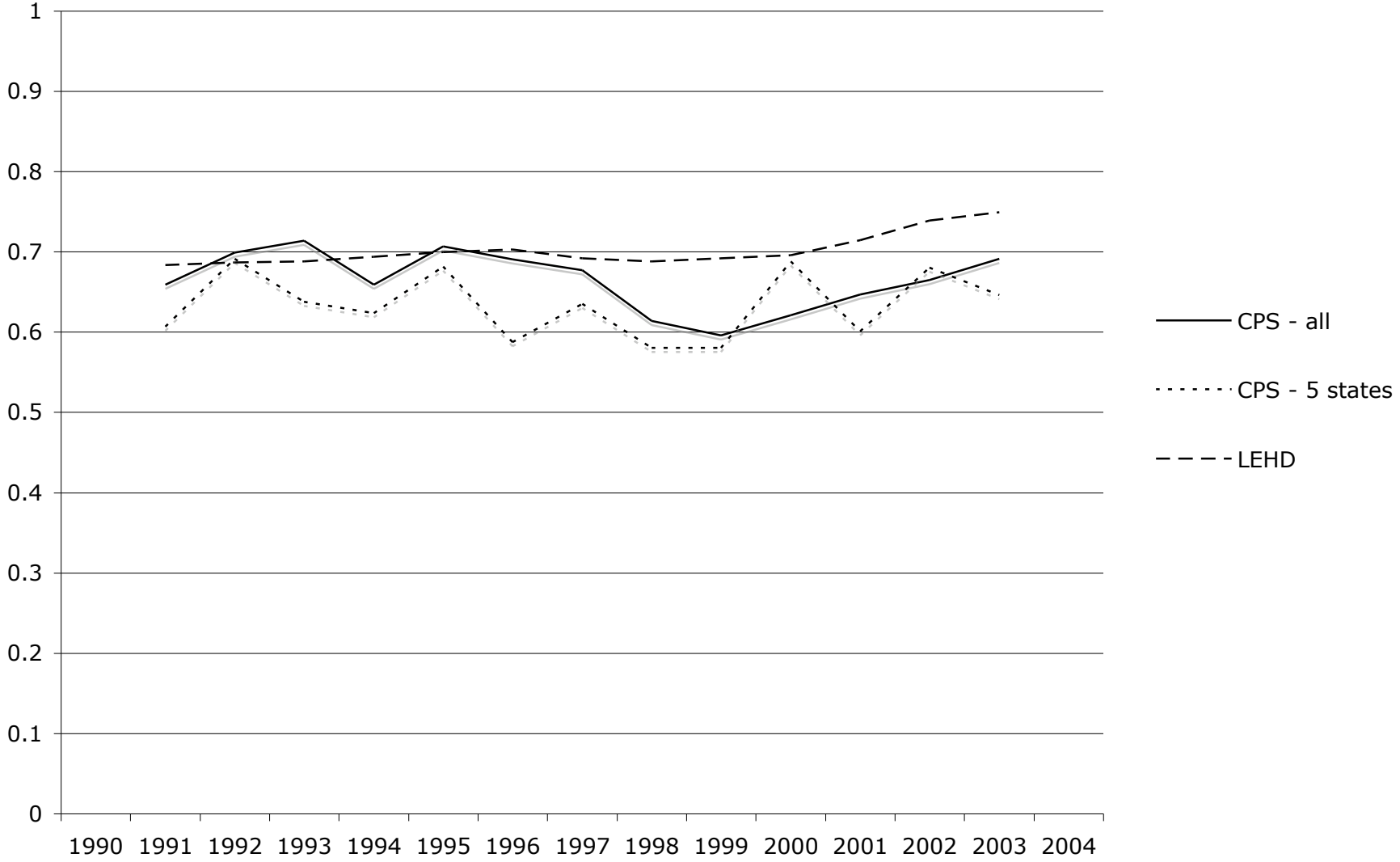


Figure 2b: Variance of Log Male Earnings in the CPS, LEHD and PSID 1970-2004

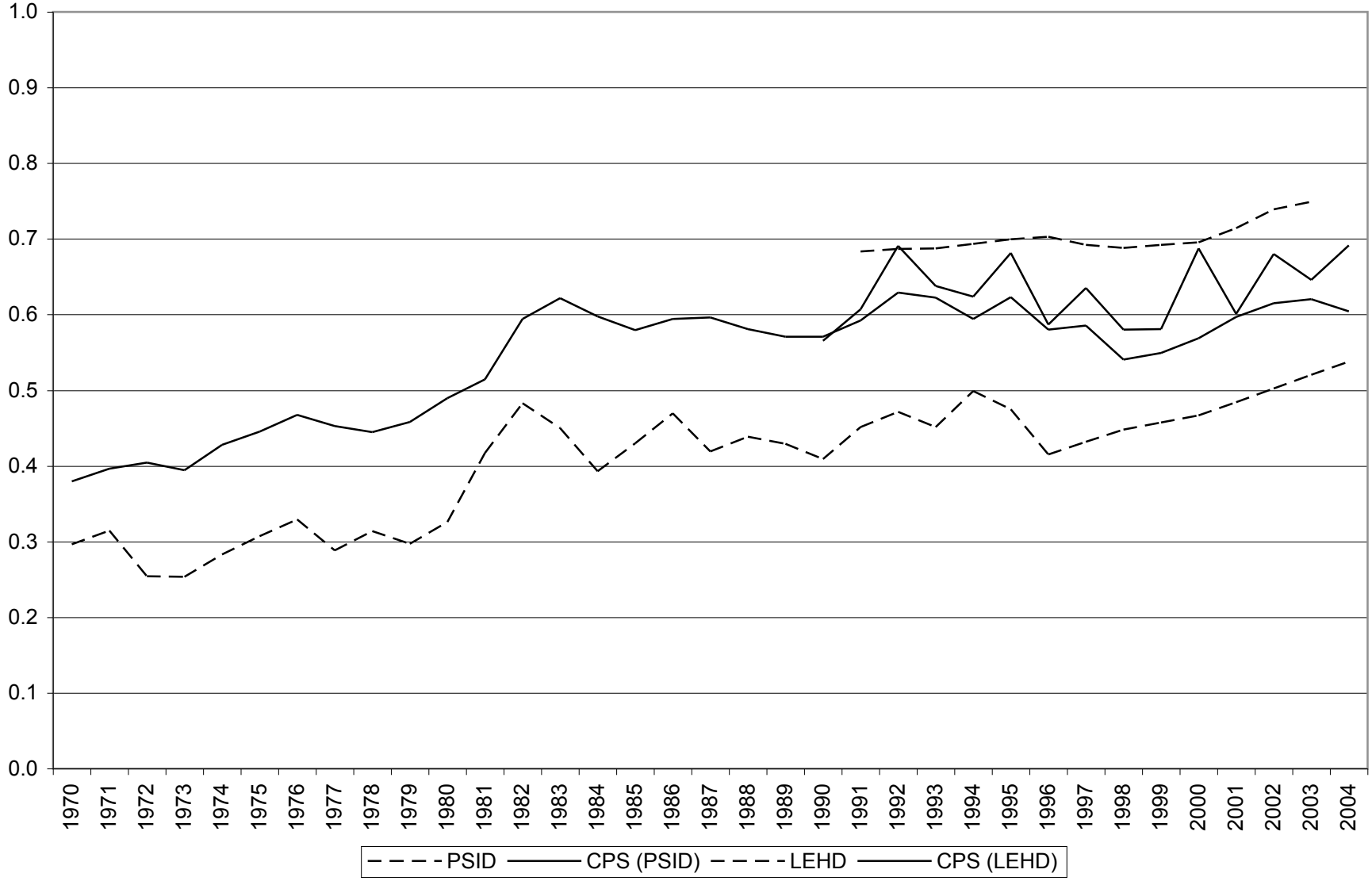


Figure 3a: Tenth Percentile of Log Male Earnings in the CPS, and LEHD 1990-2004

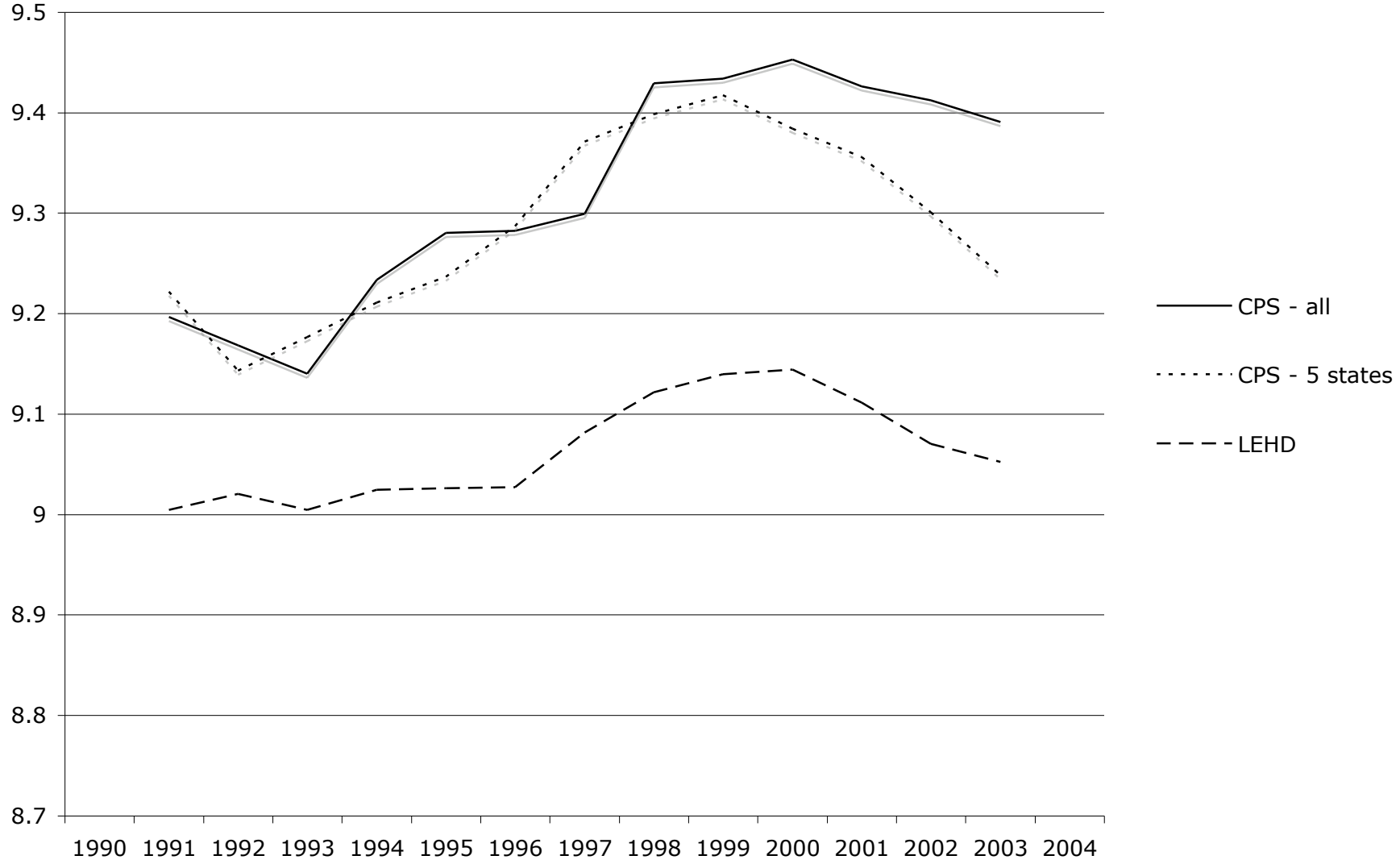


Figure 3b: Ninetieth Percentile of Log Male Earnings in the CPS, and LEHD 1990-2004

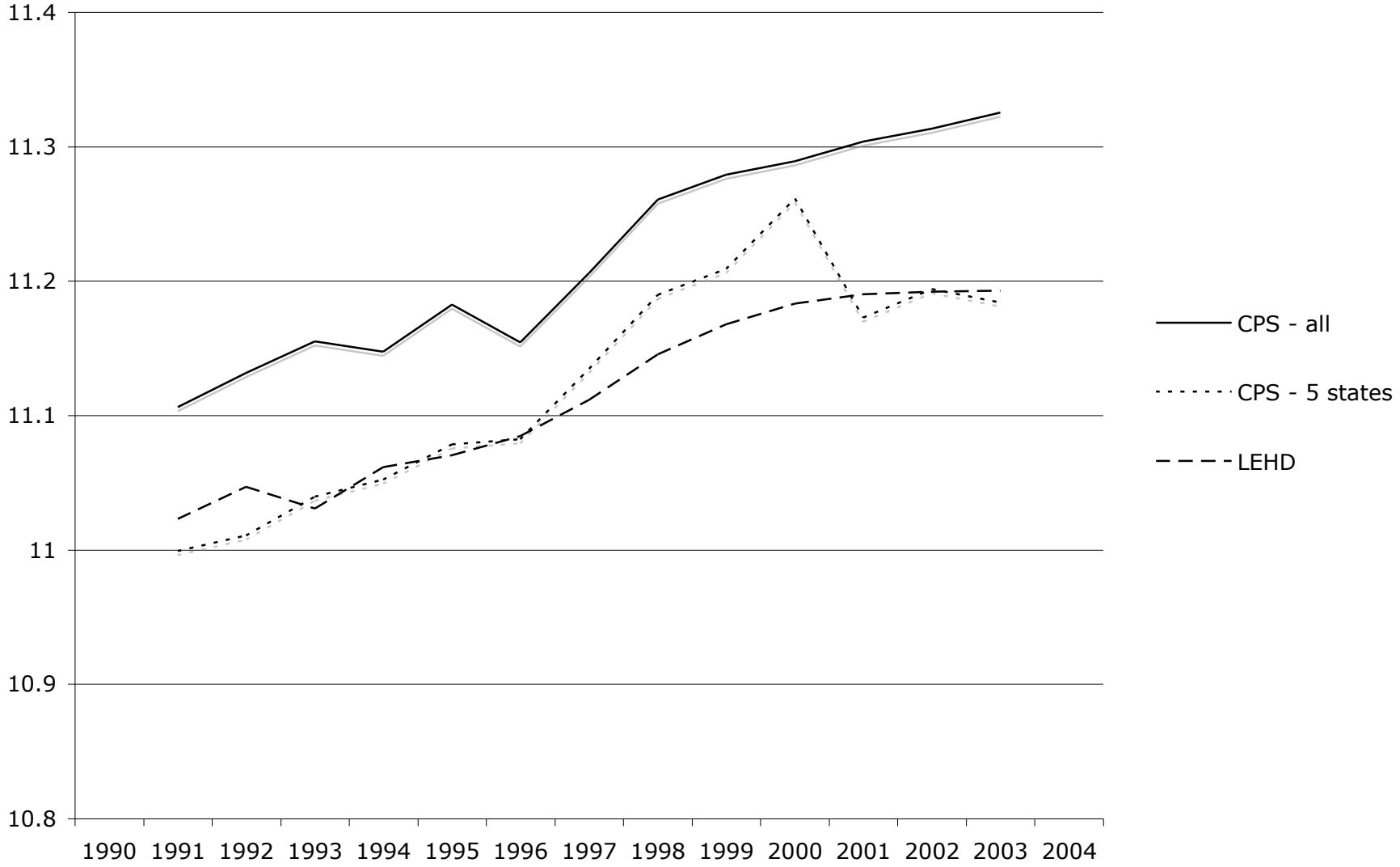
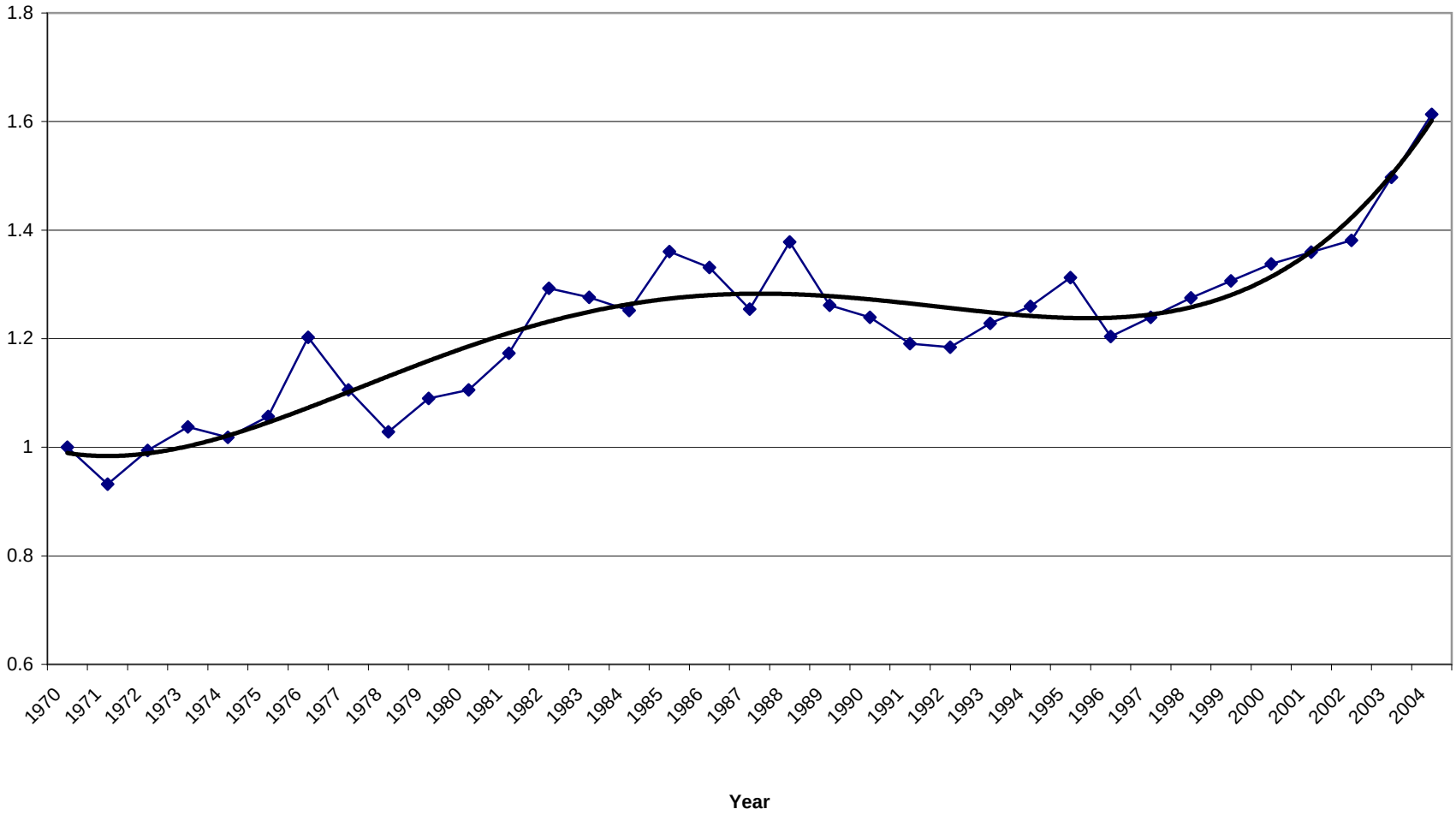


Figure 4: Error Components Model Estimates of Alpha: PSID



In this and subsequent figures, the four PSID non-interview years are interpolated from the two adjacent points. Trend line is fit from a fifth-order polynomial. Source: Moffitt and Gottschalk (2008)

Figure 5: Error Components Model Estimates of Beta: PSID

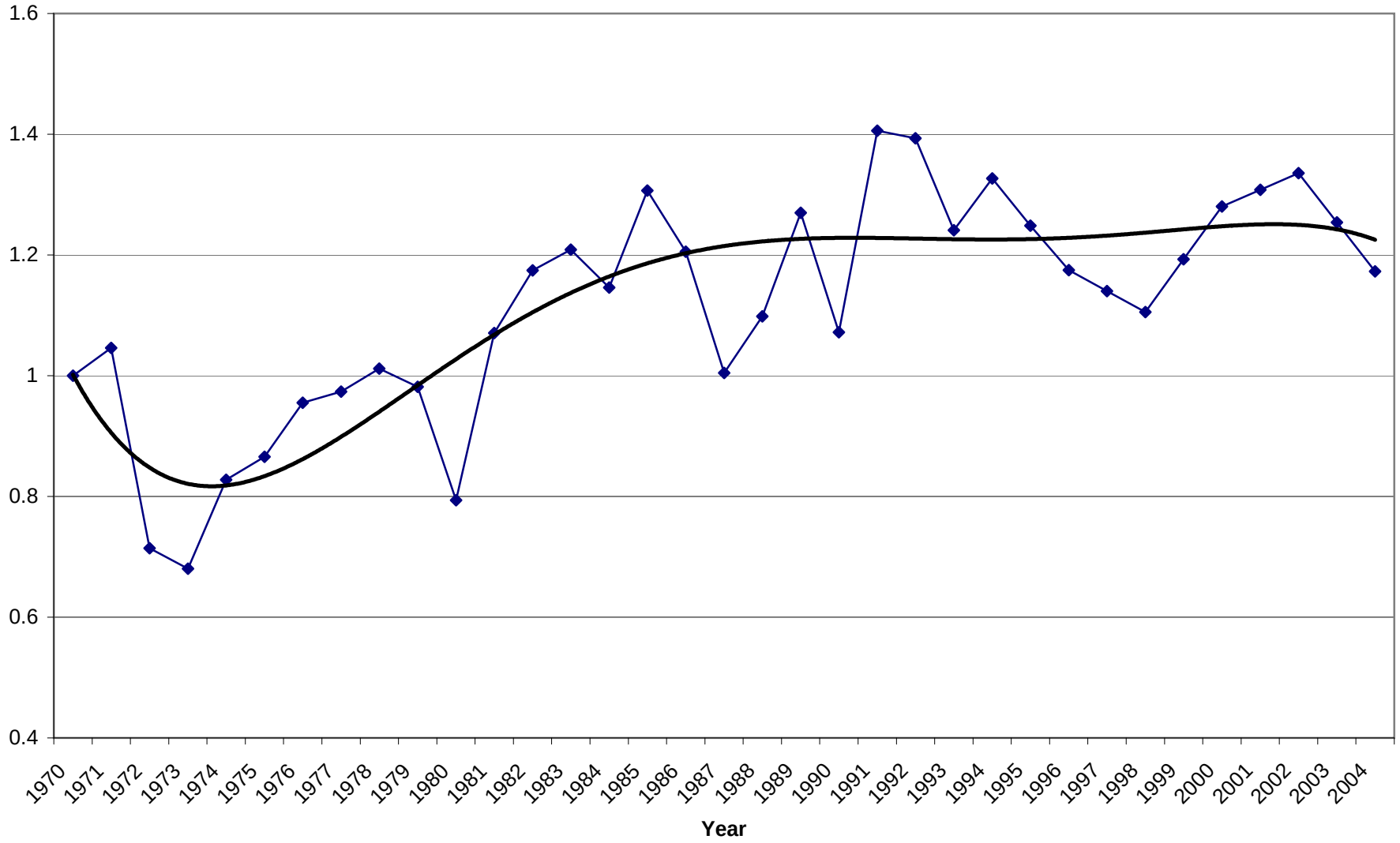


Figure 6: Transitory Variance for Age 30-39 with Unemployment Rate: PSID

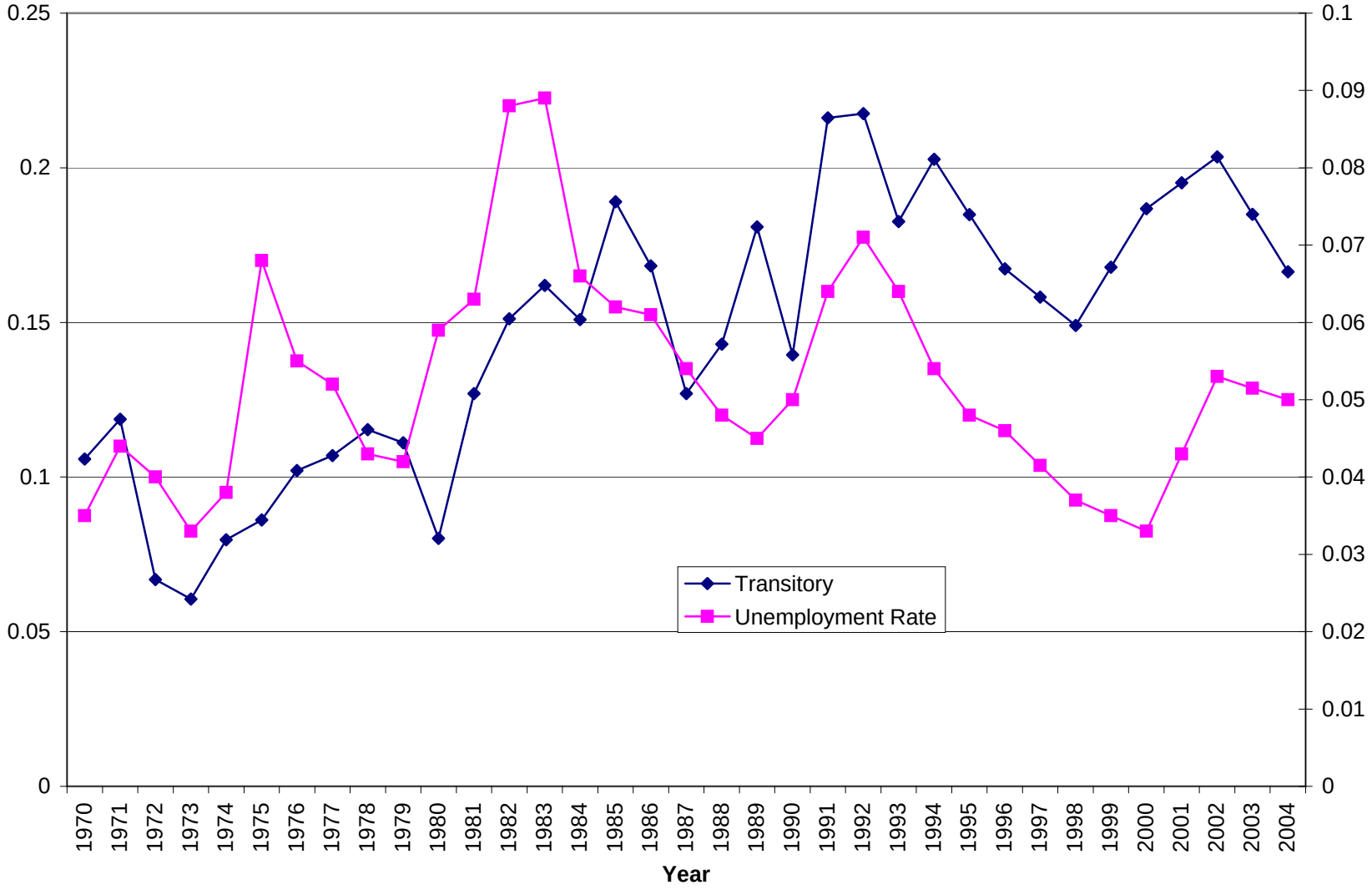


Figure 7: Fitted Permanent, Transitory, and Total Variances of Male Log Annual Earnings, Age 30-39: PSID

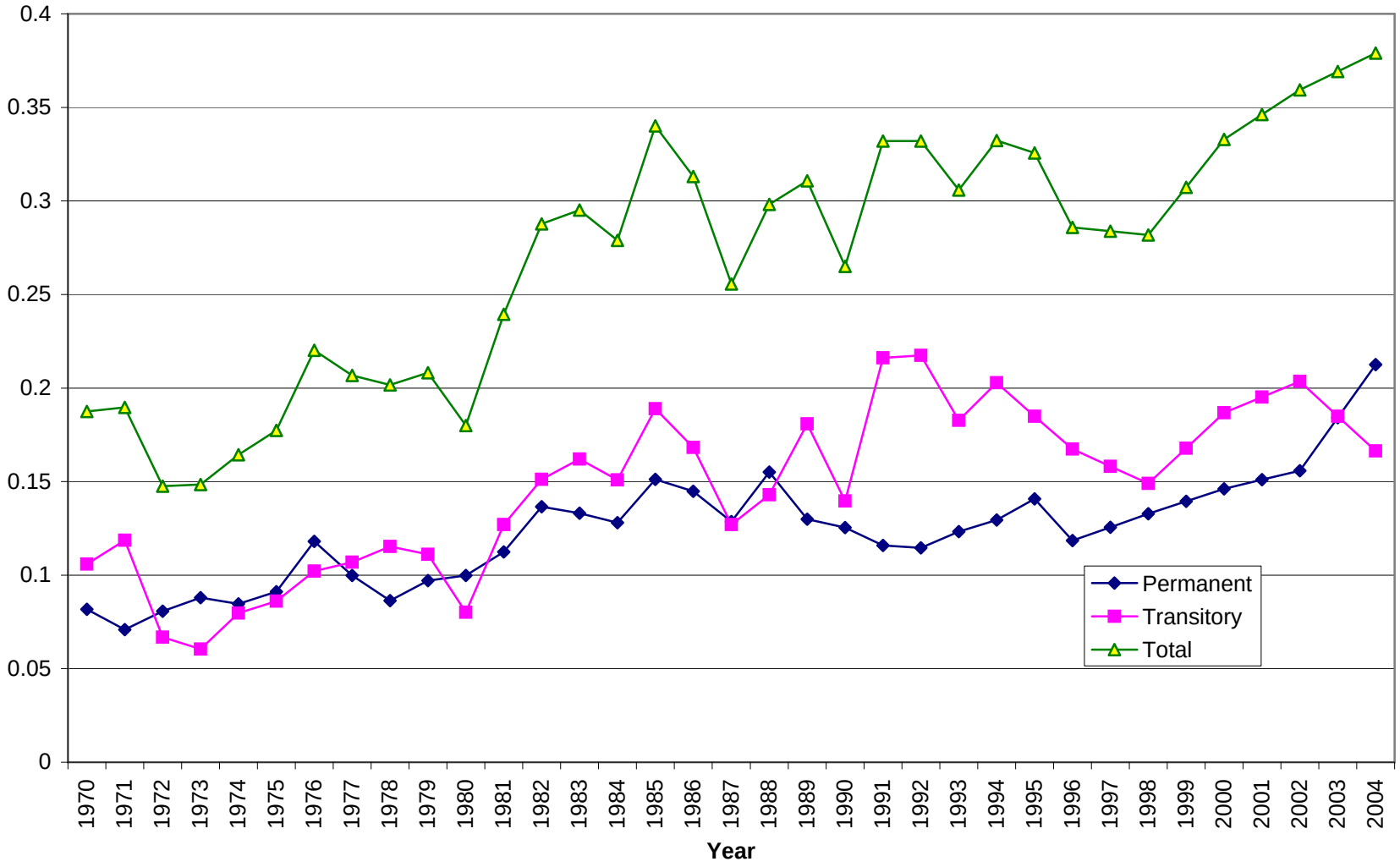
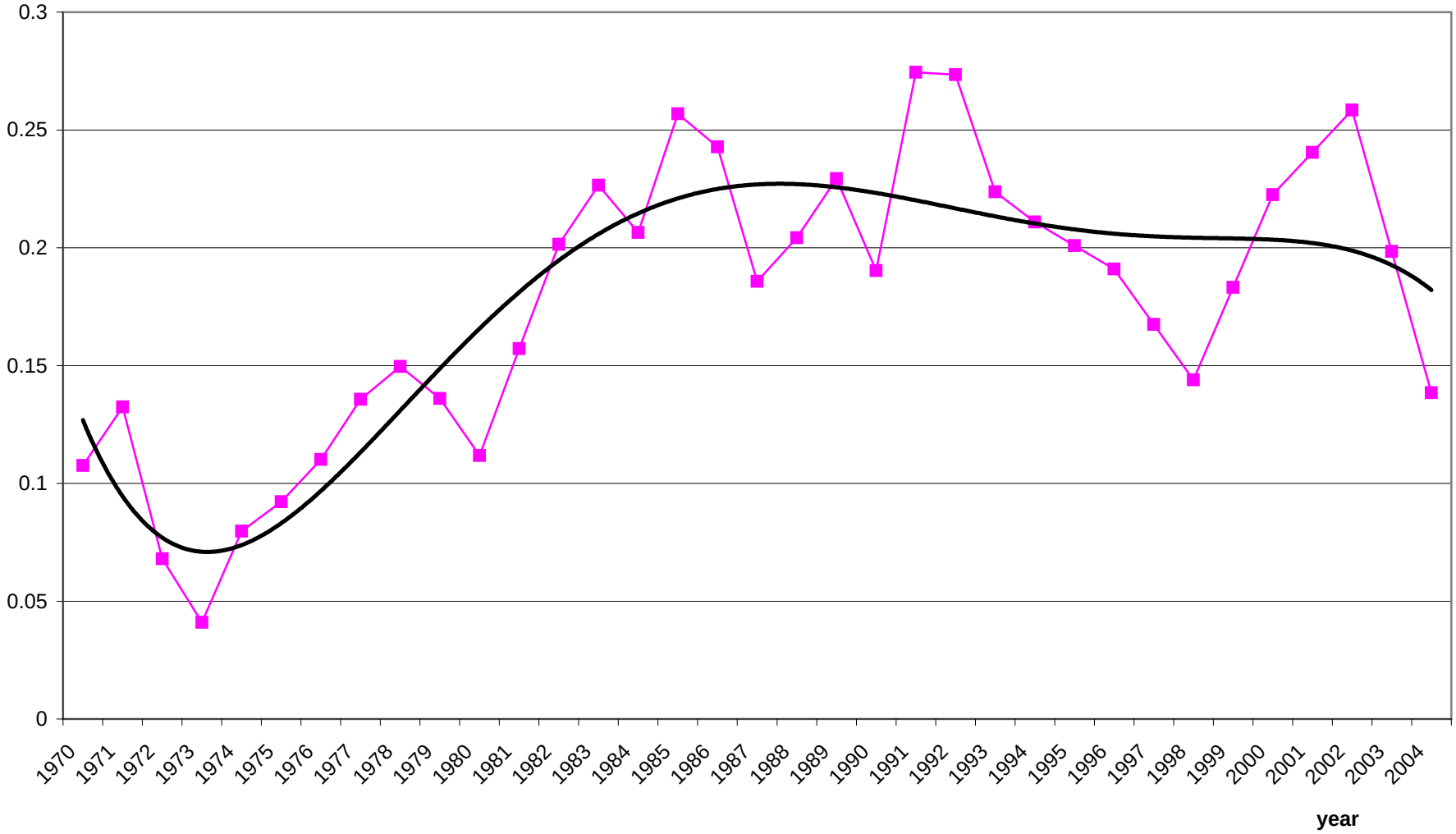


Figure 8: Approximate Nonparametric Estimate of Transitory Variance: PSID



Averaged over all ages.

Figure 9: Error Components Model--

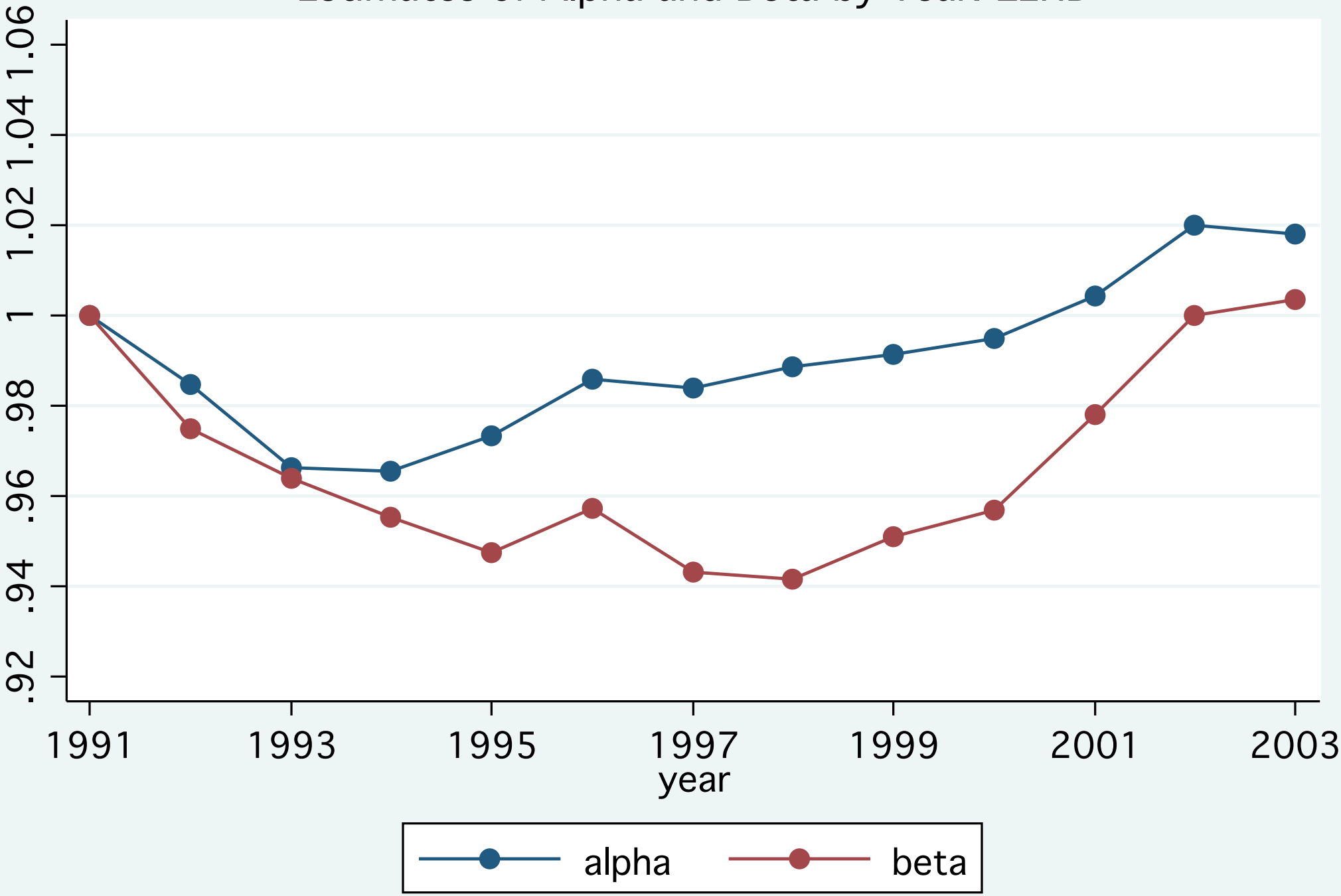


Figure 10: Fitted Permanent and Transitory Varainces

from Error Componets Model: LEHD

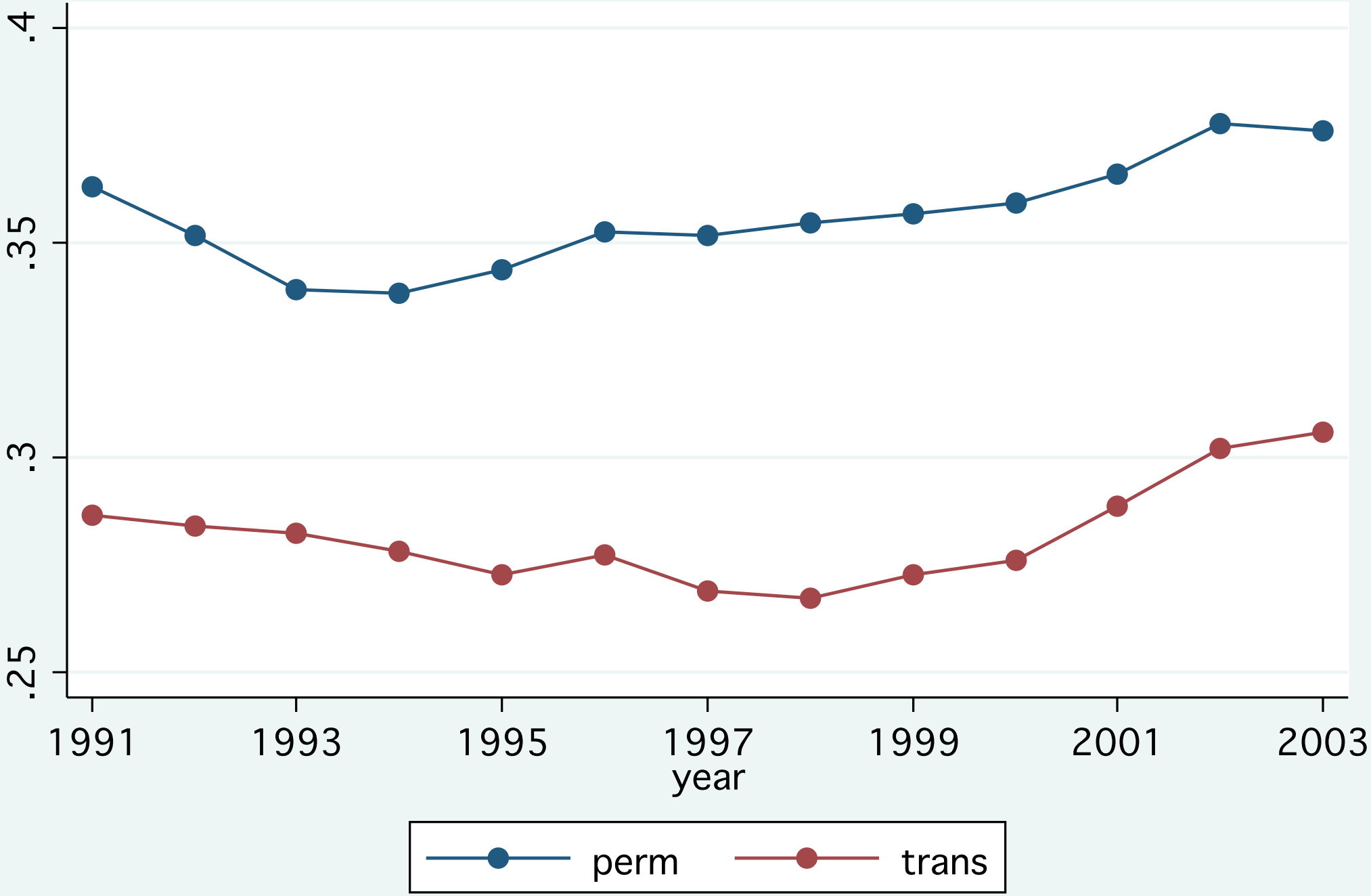


Figure 11: Permanent and Transitotry Variances

from Approximate Nonparametric Method: LEHD