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Abstract
We document facts about earnings and disposable income risk in Denmark during the period 1987-2016. During this period, log earnings growth exhibit skewness, which varies with the business cycle, and has strong excess kurtosis. Denmark has a progressive income tax system with high level of taxes and a relatively generous and heavily subsidized UI system. Consequently, the dispersion of log disposable income growth is much smaller than for earnings, and it exhibits very limited skew and much reduced excess kurtosis. These results emphasize the importance of distinguishing between earned and disposable income when modelling income risk. In addition to the descriptive work, we estimate an income process with permanent and transitory shocks for both earned and disposable income. Over the period considered, the variance of transitory shocks has remained constant, but the variance of permanent shocks has increased, in particular since the onset of the financial crisis in 2008. The magnitude of the variance of shocks to disposable income ranges from one third to one half compared to the earned income counterpart. These findings suggest that the Danish welfare state generally provides a high level of insurance but point towards its decreasing ability to insure workers against persistent shocks to earned income.

Keywords: income risk, earnings, disposable income

JEL Codes: D31, J31, H24

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1 Introduction

This paper documents trends in earnings and income inequality in Denmark during the period 1987-2016 with a particular focus on understanding the stochastic properties of earnings and disposable income growth rates and, hence, the nature of income risk that individuals and households face.

Denmark is an interesting case for at least three reasons. First, Denmark has a well-developed research data infrastructure making it possible to measure dynamics of income inequality for the entire population, and not only for earned income but also for disposable income and at both the individual and at the household level. Second, Denmark is characterized by a high level of redistribution in the economy implying that there are likely to be important differences in the stochastic properties of pre-tax earned income and overall (disposable) income including transfers. Third, since the beginning of the 1990s a sequences of policies has reduced the marginal tax rate on earnings from 74 to about 50 percent today while at the same time reduced the generosity of transfers in several dimension, for example by shortening the period of potential unemployment insurance benefits and by lowering the average replacement rate. These changes has the potential to change both the level of inequality and the nature of income risk.

The paper contains two parts. In part one, a set of facts about the level of earnings inequality and the dynamics of earnings risk are presented. We find that the level of inequality has increased over the period considered, in particular since the financial crisis in 2008. The most dramatic development happened at the very top and at the bottom 10 percent of the earnings distribution. Earnings inequality is most predominant in the bottom half of the distribution where the spread is almost the double of what it is in the top half. Also, while inequality in the bottom half of the distribution is quite business cycle dependent, it is stable in the top half. The picture for earnings dynamics, i.e. log earnings growth, looks different. Here, dispersion is similar for the top and the bottom half of the distribution. The distribu-
tion of earnings growth rates is moderately right skewed (this varies over the business cycle) and exhibits significant excess kurtosis. We do not find large differences in the patterns of income dynamics for men and women. This likely owes to the facts that education levels are similar and female labor force participation rate has been relatively high in Denmark throughout the observation period.

Part two is devoted to describing the development of the distribution of log disposable income growth. The properties of disposable income dynamics are quite different from those of earnings. As a consequence of significant and progressive income taxation and relatively generous UI benefits in Denmark, the volatility of disposable income growth is about half of what it is for earned income. Moreover, the distribution of disposable income growth is practically not skewed and exhibits much less kurtosis than earned income growth. Finally, volatility, skew and kurtosis of disposable income growth are remarkably stable over the three decades considered. These results suggest that redistribution through the tax and transfer system is quite effective in ironing out much of the earnings risk faced by individuals. We illustrate this by estimating a permanent-transitory income process for both earned income and disposable income. The results show that the variance of both permanent and transitory shocks estimated from disposable income are about one third in magnitude of the corresponding measures estimated for earned income. This suggest that the effective income risk faced by individuals may be vastly overstated when modelling income risk based on earned income.

During the period 1987-2016, the variance of permanent shocks has increased, in particular since the onset of the financial crisis in 2008, while the variance of the transitory shocks remain roughly constant. These findings point towards the decreasing ability of the Danish welfare state to insure workers against persistent shocks to earned income.

Our paper contributes to the collection of results presented in this volume by documenting trends in earnings dynamics in Denmark. One set of results worth highlighting show that the distribution of log earnings growth exhibit procyclical skewness, i.e. it tends to be positive during booms and approach zero during recessions. Procyclical skewness of the log earnings
growth distribution has also been documented in data from several other countries, including the US \cite{Pruitt2020}, \cite{Guvenen2014}, Norway \cite{Halvorsen2019}, Sweden, Germany and France \cite{Busch2020}. This suggests that the nature of earnings risk for Danish workers is similar to the nature of earnings risk faced by workers in similar developed economies. One interesting finding is that the patterns documented are very similar for men and women in Denmark. This is likely related to the fact that the female labor market participation rate has been high in Denmark throughout the period considered in this paper, 1987-2016, and that men and women work in the same labor markets. Related, the results for household earnings are very similar to that of individual earnings indicating that there is little insurance provided within the household by way of an added-worker effect.

A second contribution is to show how different the stochastic properties of earned income and disposable income are for Denmark. We show that skewness and kurtosis are much less pronounced for disposable income growth than for earned income growth and, of course, that the variance of disposable income is much smaller due to the substantial redistribution through the tax and welfare system. These findings add to the evidence by \cite{DeNardi2021} who study the Netherlands, \cite{Blundell2015} and \cite{Halvorsen2019}, both studying Norway, and \cite{Busch2020} studying Sweden. They show that the tax and transfer income system is important in reducing the quantifiable income risk facing workers in these countries and jointly point towards the importance of taking into account the institutional structure when quantifying income risk. We go one step further and estimate income processes with permanent and transitory shocks, and we estimate these processes for both earned income and disposable income. Income processes of this type has a long history, see for example \cite{Meghir2004}, \cite{Blundell2008}, \cite{Moffitt2012}, and \cite{Moffitt2018} to mention just a few. They have played an important role, because many papers have shown evidence, both theoretically and empirically, that households adjust consumption differently as a response to permanent and transitory income changes \cite{Attanasio2010}. Well-known examples are \cite{Blundell2008} and
Kaplan and Violante (2010).

The next section of the paper describes the data and institutional features that are relevant to keep in mind. Section 3 presents the part that is common with the other papers in this volume. Section 4 compares the stochastic properties of earned and disposable income. The final section sums up and concludes.

2 Data and institutions

The results presented in this paper are based on merged administrative data covering the entire Danish population for the period 1987 to 2016. The various administrative registries are collected by Statistics Denmark from relevant public authorities and made available to researchers. The core data set used in this paper is compiled by the Danish Tax Agency who collect information about earned income for all employees directly from all employers in Denmark. Earned income includes the value of fringe-benefits, severance payments, and value of stock options, but it does not include contributions to employer pension accounts, since these are tax deductible and are subtracted at the the payroll. As taxes are calculated based on gross income, including transfer income, we measure earned income before taxes. The tax authorities also collect information about total income, including transfer income, and annual tax payments through the annual tax return, where most entries are also third-party reported. None of the income measures are top-coded. Tax evasion is known to be very limited and the data to be of high quality (Kleven et al. (2011)). Moreover, there is no attrition other than due to migration and death.

Data on various types of income are linked to other administrative data sets through a personal ID number which is applied universally by the public sector. We exploit this to link the income-tax data to, among other things, the population registry, which allows us to connect individuals to partners and children.

All economic variables are deflated using the consumer price index with 2018 being the base
year. We impose a few restrictions on the gross data set. First, we include only individuals aged 25-55 and who have positive earned income. Next, we include only individuals who have both earned income and disposable income amounting to at least 28,500DKK annually (2018 prices). In terms of earned income this roughly compares to the level of earnings collected in a part-time job held for one quarter. For many of the statistics that we consider we shall be working with log-residualized measures, i.e. the residual from a pooled OLS regression of the log of (earned) income on a full set of year, age, and gender dummies.

Denmark is, together with the other Scandinavian countries, known for its well-developed welfare state providing free health and old-age care, free child care, free education and generous UI benefits. As a consequence the female labor force participation is about 80 percent. About 80 percent of Danish workers are members of a UI fund. UI fund membership costs between 450-500 DKK per month (1USD ≈ 6.5DKK, 2018 level). UI benefits replace up to 90 percent of the income in the previous job. UI benefits are capped such that you can at most receive 18,633 DKK per month (2018 level). This roughly compares to the level of income earned in a full time job for an unskilled worker paid the minimum wage rate. Through the period considered in the paper, the potential duration of UI benefits have been reduced in several steps: In 1993 the potential duration was limited to seven years, in 1996 to five years, in 1999 to four years, and, finally, in 2010 it was reduced to 2 years. Moreover, UI benefits are indexed by the consumer price index and not by a wage index. Figure shows that the replacement rate of UI benefits compared to mean wages has shrunk from about 60 percent to close to 45 percent over the period, since real wages have grown more than real prices.

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1 In robustness checks we have tried lower limits and imposing limits on only earned income or only disposable income. We have also tried winsorizing values below the limits, and these exercises did not change the results reported in the paper in any important way.

2 For people who are not members of a UI fund it is possible to qualify for cash benefits. Cash benefits are paid by the municipality and at 11,554 DKK per month provide a significantly lower level of payments. Rates are lower for people aged less than 30, but are higher for parents. Cash benefits are wealth tested at a very low threshold, 10,000 DKK, which practically only allows people to hold a moderate transaction balance.
**Figure 1: UI Benefits Relative to Mean Earnings**

Notes: The figure shows the maximum UI benefits relative to the average earnings level among people with a job. The shaded areas indicate periods with GDP growth below 2 percent.

The flip-side of the welfare state is, of course, a relatively high level of taxation. However, over the observation period a number of tax reforms have been implemented lowering the marginal tax rate from 68 percent for top tax payers in 1987 to 56 percent in 2010, see Kleven and Schultz (2014) and Kreiner et al. (2016).

In sum, across the data period a sequence of UI-benefit and tax reforms have reduced the value and duration of UI benefits and lowered the marginal tax rate on earned income. These changes would, all else equal, be expected to have contributed to increasing the cross-sectional dispersion of disposable income over the period 1987-2016.

Table I presents selected summary statistics for earnings for the sample in year 1995 and 2015. All monetary values are measured in US dollars (2018 prices). The sample that we analyze includes 1.8 to 1.9 million observations per year. The average level of income for women is about 25-30 percent lower than for men, and the gap is shrinking over time. Hence, men’s average earnings has grown about 10 percent over the two decades from 1995-2015 while it has grown about 20 percent for women over the same period. The perhaps most radical change over the observation period concerns education: Going from 1995 to 2015 there has been a significant lift in the overall education.
In the bottom panel selected percentiles of the earnings distribution are tabulated for 1995 and 2015. This shows an interesting pattern where the growth has largely taken place in the upper part of the earnings distribution. For example, earned income at the 10th percentile is practically unchanged while median earned income has grown 8 percent, and earned income at the 90th percentile has grown 15 percent. In the next section we will present numbers describing the distribution of earned income for the entire period 1987-2016.

Table 1: Descriptive Statistics for Different Samples

<table>
<thead>
<tr>
<th>Year</th>
<th>Obs. Mean Income</th>
<th>Women Age Shares %</th>
<th>Education Shares %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Mill)</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>1995</td>
<td>1.86</td>
<td>68,593</td>
<td>49,124</td>
</tr>
<tr>
<td>2015</td>
<td>1.83</td>
<td>75,424</td>
<td>58,504</td>
</tr>
</tbody>
</table>

Notes: Table 1 shows selected summary statistics for the sample for 1995 and 2015. All monetary values are summarized in US dollars (USD) by converting Danish Kroner (DKK) values to USD using yearly exchange rates. HS: High School, VOC: Vocational Education, CD: College Degree.

3 Trends in the inequality and dynamics of earnings

This section presents a set of key facts about the distribution of the level and growth of log earned income. We start out presenting the percentiles of the level log earnings by year. After that, we turn to consider income inequality, both cross-sectionally and over the life cycle. We then turn to the dynamics of earnings and consider the dispersion, skewness and kurtosis of 1-year changes in residualized log earnings. Finally, we consider income mobility. For all of these statistics we report them separately for men and women.

Figure 2 presents selected percentiles of the log real earnings distribution for men and women. In all cases are the percentiles indexed by its level in 1987. For both men and women practically all non-extreme percentiles develop such that they are below the level in 1987. Im-
portantly, this is mainly due to relatively dramatic decline in income from 1987-1993 where Denmark went through a very long and severe recession, and for all percentiles above the 10th percentile the level of earned income was significantly higher in 2016 than it was in 1996. One exception is the 10th percentile where the level of earned income is lower in 2016 than in bother 1987 and 1996 for men and almost unchanged for women since 1996. Also, at the 10th percentile fluctuations are more strongly synchronized with the business cycle than at the other percentiles, suggesting that this group is more loosely attached to the labor market. Moreover, the 10th percentile exhibit the most pronounced negative growth of all the percentiles shown when considering the whole span from 1987 to 2016. In panel (c) and (d) we show selected percentiles at the top of the distribution. Contrary to the lower percentiles, at the upper end of the distribution, the level of income is increasing relative to its 1987 level. Overall, Figure 2 shows that inequality in the level of income has increased and where the very top and the bottom are drifting further apart. It is remarkable how similar the figures are for men and women.
Figure 2: Change of Percentiles of the Log Real Earnings Distribution

Notes: The figure plots raw log earnings for selected percentiles where all percentiles are normalized to 0 in the first available year. The figure plot against time the following variables: (a) Men: P10, P25, P50, P75, P90 (b) Women: P10, P25, P50, P75, P90, (c) Men: P90, P95, P99, P99.9, P99.99, (c) Women: P90, P95, P99, P99.9, P99.99. Shaded areas are recessions.

Figure 3 measures the spread directly. Panel (a) and (b) presents the standard deviation and a dispersion measure: The distance between the 90th and the 10th percentile in the distribution. In the rest of the paper we will restrict ourselves to using the robust dispersion measure, as it is less sensitive to outliers. Both measures suggest a tendency towards an increase in spread of the overall income distribution, in particular since the financial crisis, but the spread generally tends to increase during recession periods. Again, the pattern is
relatively similar between men and women. Panel (c) and (d) plots the time series of the difference between the 90th percentile and the median, $P_{90} - P_{50}$, and the difference between the median and the 10th percentile, $P_{50} - P_{10}$, and this illustration can show whether the variance is driven disproportionately by the bottom or the top of the earnings distribution. For both men and women, the evidence suggest that the spread is highest at the bottom part of the distribution of earned income and also more business cycle dependent. In fact, for the top part of the distribution the spread is quite stable, albeit with a weak tendency for increased spread over the period.
Figure 3: **Income Inequality**

Notes: The figure plots dispersion of raw log earnings. The following variables are plotted against time: (a) Men: P90-10 and 2.56*SD of log income (b) Women: P90-10 and 2.56*SD of log income (c) Men: P90-50 and P50-10, (d) Women: P90-50 and P50-10. Shaded areas are recessions. 2.56*SD corresponds to P90-10 differential for a Gaussian distribution.

Figure 4 considers the spread of initial earnings, which in this context is defined as earnings at age 25. Again the panels show the time series of the difference between the 90th percentile and the median, $P90 - P50$, and the difference between the median and the 10th percentile, $P50 - P10$, of the initial earnings level. For this statistic the spread is also biggest at the bottom of the distribution, but there is a tendency that the spread at the top and at the bottom of the earnings distribution are converging. Compared to the spread of the
overall distribution shown in Figure 3, the spread of initial earnings distribution seems to be less business cycle dependent. This could suggest that business cycle variation in the spread is not caused by business cycle variation in entry wages. Again, the pattern is quite similar for men and women.

**Figure 4: Income Inequality**

![Graph](image)

(a) Men
(b) Women

Notes: the figure plots dispersion of raw log earnings. The following variables are plotted against time: (a) Men: P90-50 and P50-10 at age 25, (b) Women: P90-50 and P50-10 at age 25. Shaded areas are recessions.

So far we have only considered cross sectional measures of the earnings distribution. Figure 5 plots the life cycle paths for four selected birth cohorts. The solid and colored lines track the within-cohort earnings spread, measured by the $P90 - P10$ distance, across time and the dashed lines track the spread for people at different ages, 25, 30, 35, and 40. The pattern is striking. The spread declines drastically with age, as indicated by the downwards sloping cohort lines, while the spread for given age categories is actually relatively constant. As with most of the other figures presented in this part of the paper, the pattern is quite similar for men and women.
We now turn to consider the dispersion and higher moments of (residual) log earnings growth. Figure 6 show the time series of the difference between the 90th percentile and the median, $P_{90} - P_{50}$, and the difference between the median and the 10th percentile, $P_{50} - P_{10}$, for residual log earnings growth. By considering the spread of earnings growth, we are now narrowing in on the individual level dynamics rather than cross-sectional differences. Figure 6 show that the spread is quite similar for the top and the bottom part of the distribution and this is the case for both men and women. There is a weak tendency that female (residual) log earnings growth is slightly higher than male residual log earnings growth, but overall, the gender differences are small. There are indications that earnings growth for the bottom-half of the distribution moves pro-cyclically while the top-half of the distribution moves counter-cyclically, but this pattern is not strong. Perhaps most importantly, the level of income risk appears to be approximately constant when considered over the entire observation period.
Figure 6: Dispersion of 1-Year Log Earnings Changes

(a) Men
(b) Women

Notes: Using residual one-year earnings changes, the following variables are plotted against time: (a) Men: P90-10 differential, (b) Women: P90-10 differential. Shaded areas are recessions.

Figure 7 plots skewness, panel (a), and kurtosis, panel (b), for the distribution of earnings growth. As for the 2nd moment, we will throughout the paper use robust percentile measures for the 3rd and 4th moments, as they are as less sensitive to outliers. For skewness we use the Kelly skewness defined as:

\[
\frac{P_{90}-P_{50} - P_{50}-P_{10}}{P_{90}-P_{10}}
\]

and the Crow-Siddiqui excess kurtosis defined as:

\[
\frac{P_{97.5}-P_{2.5}}{P_{75}-P_{25}} - 2.91
\]

Skewness summarize the extent to which the distribution of earnings growth is asymmetric. A positive skewness-value indicates that the right tail of the distribution is longer, such that the mean and median tend to be greater than the modal point and vice versa for negative skewness. According the panel (a) the overall level of skewness of earnings growth is relatively small, but there is a tendency for it to be business cycle dependent such that right
skew is more pronounced in booms. Interestingly, left-skewness does not appear to play an important role in the overall distribution, perhaps except for 2008 where the financial crisis hit. Finally, in Appendix B we show results for household level earnings. Also here there is evidence of procyclical skewness indicating that households are not able to mitigate the higher risk of earnings losses during recessions.

Panel (b) shows the time series of kurtosis for the distribution of earnings growth. Generally, kurtosis is quite high indicating that the distribution of earnings growth is leptocurtic. The level of excess kurtosis tend to increase during recessions and to decline when the economy is booming. The level and time series pattern of kurtosis and skewness is very similar for men and women.

To summarize the variations in the 3rd and 4th moments: Larger symmetric shocks during recessions and smaller, but more positive, shocks during booms.

Figure 7: Skewness and Kurtosis of 1-Year Log Earnings Changes

(a) Kelly Skewness
Notes: Using residual one-year earnings changes, Figure 7 plot against time the following variables: (a) Men and Women: Kelly skewness calculated as \( \frac{P_{90}-P_{50}-P_{50}-P_{10}}{P_{90}-P_{10}} \), (b) Men and Women: Excess Crow-Siddiqui kurtosis calculated as \( \frac{P_{97.5}-P_{2.5}}{P_{75}-P_{25}} - 2.91 \) where the first term is the Crow-Siddiqui measure of Kurtosis and 2.91 corresponds to the value of this measure for Normal distribution. Shaded areas are recessions.

Figure 5 illustrates how the cross sectional and life cycle pattern of earnings dispersion are quite different with more variation across the life cycle than within age groups across time.
Figure 8 explores whether higher order moments, i.e. dispersion, skewness and kurtosis, of the distribution of earnings growth vary across levels of permanent income and age groups where permanent income is defined as the three-year average earnings. Panel (a) and (b) shows that dispersion is highest among individuals positioned at the lower end of the permanent income distribution, but also at the very top end. Young people tend to have more variable earnings growth than older people and this is more pronounced for women than for men.

Panel (c) and (d) of Figure 8 plot skewness along across quantiles of permanent income and does so separately for broad age groups. Skewness tend to be positive for low levels of permanent income and negative for high levels of permanent income, consistent with a tendency for reversion to the mean. For men there is hardly any differences across age groups, but for women negative skew is more pronounced for the youngest age group, 25-34, than for the other groups.

Panel (e) and (f) plot excess-kurtosis along the same dimensions. Excess kurtosis tend to be more pronounced at the bottom of the permanent income distribution and higher for the middle-aged and older subgroups. For women, excess kurtosis is not as concentrated at low levels of permanent income as for men.
Figure 8: Dispersion, Skewness and Kurtosis of 1-Year Log Earnings Changes

Notes: Using residual one-year earnings changes, Figure 8 plot against permanent income quantile groups the following variables for the 3 age groups: (a) Men: P90-10, (b) Women: P90-10, (c) Men: Kelly Skewness, (d) Women: Kelly Skewness, (e) Men: Excess Crow-Siddiqui kurtosis, (f) Women: Excess Crow-Siddiqui kurtosis. Excess Crow-Siddiqui kurtosis calculated as $\frac{P_{97.5} - P_{2.5}}{2.91} - 2.91$ where the first term is the Crow-Siddiqui measure of Kurtosis and 2.91 corresponds to the value of this measure for Normal distribution.
An important aspect of inequality is mobility, i.e., how people move across the distribution of income. The final set of statistics presented in this section summarize this. Figure 9 presents 10-year mobility statistics based on permanent income, which is defined by three-year average income. On the horizontal axis is the rank-position in the permanent income distribution and on the vertical axis the corresponding rank-position ten years later. The red line shows mobility for 25-34 year olds (in the base year) and the blue line shows mobility for 35-44 year olds. The closer the mobility measure is positioned to the diagonal the less mobility there is. The graphs generally show that there is some degree of mobility, particularly at the bottom end of the initial distribution. Mobility is most pronounced at young ages reflecting a life cycle pattern with increasing earnings levels at the beginning of the working life. The pattern is similar for men and women, and it is very stable across time, see figure 10 showing that the mobility measures are practically identical whether calculated using 1995 and 2005 as the base year.

**Figure 9: Evolution of 10-Year Mobility Over the Life Cycle**

![Graphs showing 10-year mobility statistics for men and women.](attachment:graphs.png)

Figure 9 shows average rank-rank for men and women and for different age groups. Income ranks are based on three-year average income. The black diagonal dashed line is the 45 degree line inserted to indicate what would be expected if there is no mobility.
Figure 10: Evolution of 10-Year Mobility Over Time

(a) Men
(b) Women

Notes: Figure 10 shows average 10-year rank-rank mobility for men and women and for different baseline years. Income ranks are based on three-year average income. The red line uses 1995 as base year and the blue line uses 2005 as base year. The black diagonal dashed line is the 45 degree line inserted to indicate what would be expected if there is no mobility.

3.1 Summary of part 1

Overall earnings inequality in Denmark has increased over the period 1987-2016 when considering the level of earned income. The most dramatic development shows up at the very top and at the bottom 10 percent of the earnings distribution. Earnings inequality is most predominant in the bottom half of the distribution where the spread is almost the double of what it is in the top half. Also, while inequality in the bottom half of the distribution is quite business cycle dependent, the top half is very stable.

The picture for earnings dynamics looks different. The dispersion of residual log earnings growth is similar for the top and the bottom half of the distribution. The distribution of earnings growth rates is moderately right skewed and exhibits significant excess kurtosis. Generally, higher spread, positive skewness and excess kurtosis are most pronounced at the lower end of the income distribution.

Related to this, income mobility is significant and mostly so among the young and among those positioned in the lower end of the distribution of earned income. A person positioned
at the 10th percentile will on average be positioned at the 35th percentile 10 years later, and a person positioned at the 90th percentile will on average be positioned below the 80th percentile ten years later. Earned income mobility has been stable across the observation period. Finally, one remarkable feature of the Danish case is that the patterns are very similar across men and women, and this is the case for almost all of the metrics considered in this analysis.

4 Disposable Income, Earnings and Income Risk

The previous section focused on selected aspects of the level of inequality as well as on the distributional properties of earnings dynamics, i.e. earnings growth rates. In this section we will consider how the distributional properties of earnings dynamics compare with those of the dynamics of disposable income. Studying how the properties of income dynamics change when considering disposable income rather than earned income is of interest because it will shed light on how redistribution can moderate earnings risk. This is of interest because it documents the degree to which the welfare state is able to insulate its citizens from income fluctuations. More narrowly, it is directly relevant for calibrating income processes in macroeconomic models of consumption and savings and understanding life cycle behavior in the context of these models. Denmark is an ideal case for studying exactly this dimension for two reasons. First, both types of income are documented in the Danish administrative data. Second, Denmark has a high level of redistribution and is as such an example of a country where the properties of earned and disposable income dynamics are likely to be different.

We will start out by presenting key moments of disposable income growth rates, directly comparable to the earnings results in the previous section, and how they have developed over the observation period. After this, we will estimate standard permanent-transitory income processes for earned income and for disposable income as a way illustrating some
first order differences between *earned income* risk and *disposable income* risk.

### 4.1 Trends in The Dynamics of Disposable Income Growth

In Figure 11 we show measures of dispersion of residual log disposable income growth by the top and bottom half and separately for men and women. Figure 11 shows at least two interesting patterns compared to the evidence presented for earned income in Figure 6. First, the level of dispersion is considerably lower at around a little less than 0.2. This is consistent with the fact that disposable income is a result of considerable redistribution through the tax and transfer system. Another interesting difference is that the spread of disposable income growth is very stable over the three decades in question compared to what it is for residual earned income growth. This suggests that the effective income risk has not changed and that is is relatively stable across the business cycle. Apart from this, some patterns are similar when comparing the spread of residual disposable income growth and residual earned income growth: the spread in the top and bottom half is similar and the spreads for men and women are also similar.

**Figure 11: Dispersion of 1-Year Log Disposable Income Changes**

Notes: Using residual one-year earnings changes, Figure 11 plots against time the following variables: (a) Men: P90-10 differential, (b) Women: P90-10 differential. Shaded areas are recessions.
Figure 12 shows how skewness and excess kurtosis develops for residual log disposable income growth. The figure corresponds to 7 for residual earned income growth. It shows that skewness is quite moderate and relatively stable across time, i.e. with very limited business cycle variation, for both men and women. Similarly, excess kurtosis is very stable, i.e. it exhibits no business cycle variation, at a level of about 4, i.e. about one third of the level of excess kurtosis for residual earned income growth.

**Figure 12: Skewness and Kurtosis of 1-Year Log Disposable Income Changes**

(a) Kelly Skewness

(b) Excess Crow-Siddiqui Kurtosis

Notes: Using residual one-year disposable income changes, Figure 12 plot against time the following variables: (a) Men and Women: Kelly skewness calculated as \( P_{90} - P_{50} - P_{50} - P_{10} \), (b) Men and Women: Excess Crow-Siddiqui kurtosis calculated as \( \frac{P_{97.5} - P_{2.5}}{P_{75} - P_{25}} - 2.91 \) where the first term is the Crow-Siddiqui measure of Kurtosis and 2.91 corresponds to the value of this measure for Normal distribution. Shaded areas are recessions.
Figure 13: Dispersion, Skewness and Kurtosis of 1-Year Log Disposable Income Changes

Notes: Using residual one-year earnings changes, Figure 13 plots against permanent income quantile groups the following variables for the 3 age groups: (a) Men: P90-10, (b) Women: P90-10, (c) Men: Kelly Skewness, (d) Women: Kelly Skewness, (e) Men: Excess Crow-Siddiqui kurtosis, (f) Women: Excess Crow-Siddiqui kurtosis. Excess Crow-Siddiqui kurtosis calculated as $\frac{P_{97.5} - P_{2.5}}{P_{75} - P_{25}}^2 - 2.91$ where the first term is the Crow-Siddiqui measure of Kurtosis and 2.91 corresponds to the value of this measure for Normal distribution.
Figure 8 showed evidence that dispersion, skew and excess kurtosis for residual log earned income growth were heterogeneous across permanent income levels and to some extent also across age groups. Figure 13 draws the corresponding pictures for residual disposable income growth. The overall impression is quite different. A first thing to notice is that the patterns for all three statistics is similar across age groups and across gender. There is some heterogeneity across levels of permanent income, but the heterogeneity is much less pronounced than for residual earned income growth. There spread is larger at the extreme ends of the income distribution, but otherwise quite homogeneous. Skewness is somewhat different. Here there is evidence that those with the lowest levels of income face a right skewed distribution and that individuals at the upper end face a negatively skewed distribution of residual disposable income growth. The level of skewness is, however, moderate at all levels of income. Finally, the two bottom panels of Figure 13 show that excess kurtosis is practically constant and at a much lower level than for residual earned income.

The findings presented in this section suggests that the stochastic properties of residual disposable income are quite different from those of residual earned income.

4.2 Income Risk: Earned Income vs. Disposable Income

In this section we estimate standard permanent-transitory income processes. Parametric income processes of this type has a long history, see for example Meghir and Pistaferri (2004), Blundell et al. (2008), Moffitt and Gottschalk (2012), Moffitt and Zhang (2018) to mention just a few, and they have played an important role, because many papers have shown evidence, both theoretically and empirically, that households adjust consumption differently as a response to permanent and transitory income changes (Attanasio and Weber (2010)). Well-known examples are Blundell et al. (2008) and Kaplan and Violante (2010).

We estimate a version of the permanent-transitory income process characterized by equation...
\[ \varepsilon_{it} = \alpha_i + p_t u_{it} + \lambda_t \nu_{it} \quad (1) \]

\[ u_{it} = u_{i,(t-1)} + \omega_{it} \quad (2) \]

\[ \nu_{it} = \rho \nu_{i,(t-1)} + \gamma_{it} \quad (3) \]

\( \varepsilon_{it} \) is residualized log income, \( \alpha_i \) is an individual effect, \( u_{it} \) is the permanent component, \( \omega_{it} \) is a shock to the permanent component, \( \nu_{it} \) is the transitory component, \( \rho \) is an AR parameter, and \( \gamma_{it} \) is a shock to the transitory component. \( p_t \) and \( \lambda_t \) are time factor loadings of the permanent and transitory components that allow these components to vary across time in a way common across individuals.\(^3\)

The results are presented in Table 2. Columns (1) and (2) show estimates for men where residualized income growth is based on earned income and disposable income, and columns (3) and (4) present corresponding results for women. There are several things to notice. The first order result is that the estimated variances of permanent and transitory effects are much smaller for disposable income than for earned income. The estimated variance of permanent component, \( \sigma^2_w \), for disposable income is about one third of the size of the corresponding variance estimated from earnings. Similarly, the variance of the transitory component, \( \sigma^2_\gamma \), estimated from disposable income is estimated to be about one fifth of the corresponding measure for earned income. While the estimated income process ignores the influence of higher order moments\(^4\), which are likely important for earnings growth, the results from section 4.1 shows that the distribution of disposable income growth is not skewed and exhibits limited excess kurtosis. To the extent that the objective is to assess how income risk affects spending and savings behavior then the relevant income concept is disposable income. The estimation results also has other interesting features. First, the persistence

\(^3\)The process is estimated using the estimation procedure provided by Doris et al. (2011)

\(^4\)We refer to Druedahl and Munk-Nielsen (2020) for a fully developed structural approach to estimating income processes taking higher order moments into account
### Table 2: Predicted Variances for the Earned and Disposable Income Processes

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th></th>
<th>Women</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) Earned income</td>
<td>(2) Disposable income</td>
<td>(3) Earned income</td>
<td>(4) Disposable income</td>
</tr>
<tr>
<td>( \sigma^2_{\alpha} )</td>
<td>0.0182</td>
<td>0.0038</td>
<td>0.0199</td>
<td>-0.0031</td>
</tr>
<tr>
<td></td>
<td>(0.0004)</td>
<td>(0.0002)</td>
<td>(0.0005)</td>
<td>(0.0002)</td>
</tr>
<tr>
<td>( \rho )</td>
<td>0.3629</td>
<td>0.3382</td>
<td>0.3802</td>
<td>0.4699</td>
</tr>
<tr>
<td></td>
<td>(0.0006)</td>
<td>(0.0009)</td>
<td>(0.0005)</td>
<td>(0.0009)</td>
</tr>
<tr>
<td>( \sigma^2_{\nu_1} )</td>
<td>0.1878</td>
<td>0.0608</td>
<td>0.1752</td>
<td>0.0421</td>
</tr>
<tr>
<td></td>
<td>(0.0010)</td>
<td>(0.0004)</td>
<td>(0.0009)</td>
<td>(0.0003)</td>
</tr>
<tr>
<td>( \sigma^2_{\gamma} )</td>
<td>0.1999</td>
<td>0.0377</td>
<td>0.2551</td>
<td>0.0337</td>
</tr>
<tr>
<td></td>
<td>(0.0038)</td>
<td>(0.0008)</td>
<td>(0.0052)</td>
<td>(0.0007)</td>
</tr>
<tr>
<td>( \sigma^2_{w} )</td>
<td>0.0105</td>
<td>0.0040</td>
<td>0.0115</td>
<td>0.0043</td>
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<tr>
<td></td>
<td>(0.0001)</td>
<td>(0.0000)</td>
<td>(0.0001)</td>
<td>(0.0000)</td>
</tr>
</tbody>
</table>

Notes: Estimation results from equations (1)-(3). Estimated separately for men vs. women and earned vs. disposable income. \( \sigma^2_{\alpha} \) is the variance of the individual effect, \( \rho \) is the AR parameter, \( \sigma^2_{\nu_1} \) is the variance of the initial transitory component, \( \sigma^2_{\gamma} \) is the variance of shocks to the transitory component, and \( \sigma^2_{w} \) is the variance of shocks to the permanent component. Figures in parentheses are corrected standard errors. Time factor loadings from the estimation are reported in figure 14.

Parameter, \( \rho \), is quite similar across the two income concepts, and at a level of 0.35-0.45 it is moderate in size. A high value of \( \rho \) could cause problems identifying persistence from heterogeneity and hence to separately identifying \( \sigma^2_{\alpha} \) and \( \sigma^2_{\nu_1} \) (Doris et al. (2011)). \( \sigma^2_{\alpha} \) is the variance of the individual-specific permanent component. This is naturally smaller for disposable income because of redistribution. \( \sigma^2_{\nu_1} \) is the variance at the start of the sample period. This measures heterogeneity rather than income risk. Also here, the tax and transfer system is effective in muting differences as estimates of \( \sigma^2_{\nu_1} \) based in disposable income are about one fourth to one third of the estimates based on earned income. Finally, it is worth mentioning how compellingly similar the estimates of variance components are between men and women. This is consistent with the descriptive evidence shown throughout this paper.

In Figure 14 we present the time factor loadings, \( p_t \) and \( \lambda_t \), to illustrate how the variance of the permanent and transitory components have developed over the sample period when estimated using both earned income and disposable income. Common for both men and women is that the level of the variances of permanent and transitory innovations estimated
from earned income are always two to four times bigger than the corresponding components estimated on disposable income. Interestingly, when considering disposable income for men, the variance of the permanent component has almost doubled over the period, and the increase has been particularly strong after the financial crisis, while the variance of the transitory component has remained roughly constant. The pattern is less strong for women, but it shares some of the same features, in particular there appears to have been an increase in the variance of the permanent component after 2008. This increase in the variance of the permanent component after 2008 is similar for earned income and for disposable income suggesting that it is driven by productivity shocks.

**Figure 14:** Estimated permanent and transitory variances

![Graph showing estimated permanent and transitory variances for men and women.](image)

**(a) Men**

**(b) Women**

Notes: Time factor loadings from estimation results from equations (1)-(3). Time factor loadings show how shocks has evolved over time. They are estimated separately for men (Panel a) vs. women (Panel b), and earned (blue) vs. disposable (red) income. Shocks to the permanent component are shown in solid lines, shocks to the transitory component are shown in dashed lines. Parameter estimation results are reported in table 2.

The results presented so far suggest that disposable income risk is quite different from earned income risk. This could have been caused by tax collection and/or by transfer income
such as unemployment insurance benefits. In Appendix A, we present figures corresponding to figures 11-13 as well as estimates of the permanent-transitory income process based on gross income, i.e. the sum of earnings and public income before deducting taxes. The properties of gross income growth are quite similar to the properties of disposable income with dispersion, and skewness measures being almost identical. Kurtosis is also very stable for gross income across the observation period but at a higher level. This is to be expected as the tax system reduces the effective size of shocks. Results from estimation of (1)-(3) based on gross income suggests that the variance of transitory component is at the same level as for that based on disposable income, consistent with the transfer income system insulating well against transitory income fluctuations. Estimates of the variance of the permanent component based on gross income are closer to the estimated variance of the permanent component of earned income. This is consistent with the notion that the welfare system does not insulate persistent shocks as well as it does for transitory shocks.

Finally, we also consider insurance within the household by repeating the analysis for household rather than individual level income. The results from this are presented in Appendix B. Household income is split evenly among household members, and the population is considered on the individual level. People living in single adult households are unchanged compared to the main analysis. The results for household disposable income growth are strikingly similar to the results for individual level disposable income growth. This is indicative that very little insurance takes places within the household. These findings are consistent with Andersen et al. (2020) showing that the added-worker effect is not important in Denmark in relation to unemployment events. This likely owes to the fact that both male and female labor market participation rates are very high and the potential for increasing labor supply limited.

4.3 Summary of part 2

The properties of disposable income dynamics are quite different from those of earnings. As a consequence of significant and progressive income taxation in Denmark and relatively
generous UI benefits, the volatility of earnings growth is about half of what it is for earned income. The distribution of disposable income growth is practically not skewed and exhibits much less kurtosis than earned income growth. Moreover, volatility, skew and excess kurtosis of disposable income growth are remarkable stable over the three decades considered. The patterns for household level disposable income growth are for all practical purposes identical to the patterns for individual level disposable income growth suggesting that insurance within the household is not important. These results suggests that insurance through the tax and transfer income system is more important in ironing out the income risk faced by individuals than insurance within the household.

These features have important implications for the magnitude of shocks that households effectively have to deal with when planning their consumption and savings decisions. We illustrate this by estimating a permanent-transitory income process for both earned income and disposable income. The results show that the variance of both permanent and transitory shocks estimated from disposable income growth are about one third in magnitude of the corresponding measures for earned income. This suggest that the risk faced by households may be vastly overstated when modelling income risk based on earned income.

5 Conclusion

This paper documents facts about the nature of income risk in Denmark over the period 1987-2016. This is done by analysing administrative registry data covering the entire Danish population. The administrative data include information about earned income as well as gross income and disposable income, and we are able to construct household units by linking to the population registry. We use this information to document a number of facts.

First, we document that log earned income growth exhibits significant pro-cyclical skewness and excess kurtosis. Second, the properties of log earned income growth appears to be practically similar for men and women. This likely owes to the fact that education levels
are similar and female labor force participation rate has been high in Denmark throughout the observation period. Related, we find that the properties of household level log earned income growth are similar to those of individual level log earned income growth, indicating that the added-worker effect is not an important insurance mechanism in the Danish context. Third, we find that the properties of log disposable income growth are quite different from the properties of log earned income growth. The volatility of disposable income growth is about half of what it is for earned income, and the distribution of log disposable income growth is practically not skewed and exhibits much less kurtosis than for log earned income growth. Finally, volatility, skew and kurtosis of log disposable income growth are remarkably stable over the three decades considered. These results suggest that the tax and transfer income system is quite effective in ironing out much of the earnings risk faced by individuals in Denmark. Given the well-developed welfare-state these findings are not surprising, but nevertheless important to keep in mind for researchers modelling income risk.

Finally, we estimate simple permanent-transitory income processes for both earned income and disposable income. Consistent with a high level of insurance provided through the tax and transfer system, the results show that the variance of both permanent and transitory shocks estimated from disposable income are about one third to one half in magnitude of the corresponding measures estimated for earned income. During the period 1987-2016, the estimated variance of the transitory component for disposable income growth is more or less constant, but the estimated variance of permanent the permanent component has increased, in particular since the onset of the financial crisis in 2008. These findings suggest that the welfare state cushions transitory fluctuations well, but point towards its decreasing ability to insure workers against persistent shocks to earned income.
References


Appendix A. Results Based on Gross Income

A.1. Gross Income

**Figure 15: Dispersion of 1-Year Log Gross Income Changes**

- **(a) Men**
- **(b) Women**

Using residual one-year gross income changes and the LS+TMax sample, Figure 22 plot against time the following variables: (a) Men: P90-10 differential, (b) Women: P90-10 differential. Shaded areas are recessions.

**Figure 16: Skewness and Kurtosis of 1-Year Log Gross Income Changes**

- **(a) Kelly Skewness**
- **(b) Excess Crow-Siddiqui Kurtosis**

Using residual one-year gross income changes and the LS+TMax sample, Figure 23 plot against time the following variables: (a) Men and Women: Kelly skewness calculated as $P_{90} - P_{50} - P_{50} - P_{10}$, (b) Men and Women: Excess Crow-Siddiqui kurtosis calculated as $P_{97.5} - P_{2.5} - 2.91$ where the first term is the Crow-Siddiqui measure of Kurtosis and 2.91 corresponds to the value of this measure for Normal distribution. Shaded areas are recessions.
Figure 17: Dispersion, Skewness and Kurtosis of 1-Year Log Gross Income Changes

Using residual one-year earnings changes and the H+TMax sample, Figure 17 plots against permanent income quantile groups the following variables for the 3 age groups: (a) Men: P90-10, (b) Women: P90-10, (c) Men: Kelly Skewness, (d) Women: Kelly Skewness, (e) Men: Excess Crow-Siddiqui kurtosis, (f) Women: Excess Crow-Siddiqui kurtosis. Excess Crow-Siddiqui kurtosis calculated as $P_{97.5} - P_{2.5} - 2.91$ where the first term is the Crow-Siddiqui measure of Kurtosis and 2.91 corresponds to the value of this measure for Normal distribution.
Table 3: Predicted Variances, Gross Income

<table>
<thead>
<tr>
<th></th>
<th>Men (1)</th>
<th>Women (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gross income</td>
<td>Gross income</td>
</tr>
<tr>
<td>$\sigma^2_\alpha$</td>
<td>0.0310 (0.0004)</td>
<td>0.0107 (0.0003)</td>
</tr>
<tr>
<td>$\rho$</td>
<td>0.4600 (0.0009)</td>
<td>0.5858 (0.0008)</td>
</tr>
<tr>
<td>$\sigma^2_{\nu_1}$</td>
<td>0.1168 (0.0007)</td>
<td>0.0884 (0.0006)</td>
</tr>
<tr>
<td>$\sigma^2_\gamma$</td>
<td>0.0696 (0.0012)</td>
<td>0.0903 (0.0018)</td>
</tr>
<tr>
<td>$\sigma^2_w$</td>
<td>0.0106 (0.0001)</td>
<td>0.0083 (0.0001)</td>
</tr>
</tbody>
</table>

Notes: Estimation results from equations (1)-(3). Estimated separately for men vs. women. $\sigma^2_\alpha$ is the variance of the individual effect, $\rho$ is the AR parameter, $\sigma^2_{\nu_1}$ is the variance of the initial transitory component, $\sigma^2_\gamma$ is the variance of shocks to the transitory component, and $\sigma^2_w$ is the variance of shocks to the permanent component. Figures in parentheses are corrected standard errors. Time factor loadings from the estimation are reported in figure 18.

Figure 18: Estimated permanent and transitory variances, gross income

Notes: Time factor loadings from estimation results from equations (1)-(3). Time factor loadings show how shocks has evolved over time. They are estimated separately for men (Panel a) vs. women (Panel b). Shocks to the permanent component are shown in solid lines, shocks to the transitory component are shown in dashed lines. Parameter estimation results are reported in table 3.
Appendix B. Results Based on Household Level Income

B.1. Household Earned Income

Figure 19: Dispersion of 1-Year Log Earned Income Changes, Households

Using residual one-year earned income changes and the LS+TMax sample, Figure 22 plot against time the following variables: (a) Men: P90-10 differential, (b) Women: P90-10 differential. Shaded areas are recessions.

Figure 20: Skewness and Kurtosis of 1-Year Log Earned Income Changes, Households

(a) Kelly Skewness
(b) Excess Crow-Siddiqui Kurtosis

Using residual one-year earned income changes and the LS+TMax sample, Figure 23 plot against time the following variables: (a) Men and Women: Kelly skewness calculated as $\frac{P_{90} - P_{50} - P_{50} - P_{10}}{P_{90} - P_{10}}$, (b) Men and Women: Excess Crow-Siddiqui kurtosis calculated as $\frac{P_{97.5} - P_{2.5}}{P_{90} - P_{10}} - 2.91$ where the first term is the Crow-Siddiqui measure of Kurtosis and 2.91 corresponds to the value of this measure for Normal distribution. Shaded areas are recessions.
Figure 21: Dispersion, Skewness and Kurtosis of 1-Year Log Earned Income Changes, Households

Using residual one-year earnings changes and the H+TMax sample, Figure 21 plot against permanent income quantile groups the following variables for the 3 age groups: (a) Men: P90-10, (b) Women: P90-10, (c) Men: Kelly Skewness, (d) Women: Kelly Skewness, (e) Men: Excess Crow-Siddiqui kurtosis, (f) Women: Excess Crow-Siddiqui kurtosis. Excess Crow-Siddiqui kurtosis calculated as \( \frac{P_{97.5} - P_{2.5}}{2.91} \) where the first term is the Crow-Siddiqui measure of Kurtosis and 2.91 corresponds to the value of this measure for Normal distribution.
B.2. Household Disposable Income

Figure 22: Dispersion of 1-Year Log Disposable Income Changes, Households

Using residual one-year disposable income changes and the LS+TMax sample, Figure 22 plot against time the following variables:
(a) Men: P90-10 differential, (b) Women: P90-10 differential. Shaded areas are recessions.

Figure 23: Skewness and Kurtosis of 1-Year Log Disposable Income Changes, Households

Using residual one-year disposable income changes and the LS+TMax sample, Figure 23 plot against time the following variables:
(a) Kelly skewness calculated as \( \frac{P_{90} - P_{50}}{P_{50} - P_{10}} \), (b) Excess Crow-Siddiqui kurtosis calculated as \( \frac{P_{75.5} - P_{2.5}}{P_{25} - P_{10}} - 2.91 \) where the first term is the Crow-Siddiqui measure of Kurtosis and 2.91 corresponds to the value of this measure for Normal distribution. Shaded areas are recessions.
Using residual one-year earnings changes and the H+TMax sample, Figure 24 plot against permanent income quantile groups the following variables for the 3 age groups: (a) Men: P90-10, (b) Women: P90-10, (c) Men: Kelly Skewness, (d) Women: Kelly Skewness, (e) Men: Excess Crow-Siddiqui kurtosis, (f) Women: Excess Crow-Siddiqui kurtosis. Excess Crow-Siddiqui kurtosis calculated as \( \frac{P_{97.5} - P_{2.5}}{2^{1.91}} - 2.91 \) where the first term is the Crow-Siddiqui measure of Kurtosis and 2.91 corresponds to the value of this measure for Normal distribution.
## Households, Predicted Variances

### Table 4: Predicted Variances for the Earned and Disposable Income Process

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th></th>
<th>Women</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Earned income</td>
<td>Disposable income</td>
<td>Earned income</td>
<td>Disposable income</td>
</tr>
<tr>
<td>( \sigma^2_\alpha )</td>
<td>0.0168</td>
<td>0.0001</td>
<td>0.0208</td>
<td>-0.0014</td>
</tr>
<tr>
<td></td>
<td>(0.0004)</td>
<td>(0.0001)</td>
<td>(0.0004)</td>
<td>(0.0001)</td>
</tr>
<tr>
<td>( \rho )</td>
<td>0.4598</td>
<td>0.3753</td>
<td>0.4674</td>
<td>0.3929</td>
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<td>(0.0006)</td>
<td>(0.0008)</td>
<td>(0.0007)</td>
<td>(0.0010)</td>
</tr>
<tr>
<td>( \sigma^2_{v1} )</td>
<td>0.1407</td>
<td>0.0466</td>
<td>0.1247</td>
<td>0.0362</td>
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<td>(0.0007)</td>
<td>(0.0003)</td>
<td>(0.0007)</td>
<td>(0.0003)</td>
</tr>
<tr>
<td>( \sigma^2_\gamma )</td>
<td>0.1618</td>
<td>0.0310</td>
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<td>0.0300</td>
</tr>
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<td>(0.0028)</td>
<td>(0.0006)</td>
<td>(0.0024)</td>
<td>(0.0007)</td>
</tr>
<tr>
<td>( \sigma^2_w )</td>
<td>0.0103</td>
<td>0.0034</td>
<td>0.0101</td>
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<tr>
<td></td>
<td>(0.0001)</td>
<td>(0.0000)</td>
<td>(0.0001)</td>
<td>(0.0000)</td>
</tr>
</tbody>
</table>

Notes: Estimation results from equations (1)-(3). Estimated separately for men vs. women and earned vs. disposable income. \( \sigma^2_\alpha \) is the variance of the individual effect, \( \rho \) is the AR parameter, \( \sigma^2_{v1} \) is the variance of the initial transitory component, \( \sigma^2_\gamma \) is the variance of shocks to the transitory component, and \( \sigma^2_w \) is the variance of shocks to the permanent component. Figures in parentheses are corrected standard errors. Time factor loadings from the estimation are reported in figure 25.
Figure 25: EStimated permanent and transitory variances, Households

(a) Men
(b) Women

Notes: Time factor loadings from estimation results from equations (1)-(3). Time factor loadings show how shocks has evolved over time. They are estimated separately for men (Panel a) vs. women (Panel b), and earned (blue) vs. disposable (red) income. Shocks to the permanent component are shown in solid lines, shocks to the transitory component are shown in dashed lines. Parameter estimation results are reported in table 4.