Earnings and labour market volatility in Britain

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Abstract

We provide new evidence about earnings and labour market volatility in Britain over the period 1992–2008, and for women as well as men. (Most research about volatility refers to earnings volatility for US men.) We show that earnings volatility declined slightly for both men and women over the period as a whole but the changes are not statistically significant. When we widen the scope to look at labour market volatility, i.e. including in the calculations individuals with zero earnings as well as employees with positive earnings, we find that there is a marked and statistically significant decline over the period for both women and men, with the fall greater for men. Using variance decompositions, we show that the fall in labour market volatility is largely accounted for by changes in employment transition rates rather than changes in earnings volatility. Earnings and labour market volatility trends in Britain, and what contributes to them, differ from their US counterparts in several respects.

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1. Introduction

This is a paper about earnings changes over time for workers and non-workers. It describes how this longitudinal instability – 'volatility' for short – has been changing over the last two decades for British men and women, and contrasts the British situation with the US one.

Volatility is of interest for several reasons. First, in the canonical parametric model of earnings dynamics, log earnings are the sum of a permanent component and a transitory component (the source of the longitudinal instability), and there has been much research about the extent to which increases in earnings inequality reflect permanent increases in earnings differentials across workers or increases in the variability of transitory earnings changes (see the review below). So, information about trends in longitudinal instability contributes to understanding about the recent rise in inequality. Second, income instability is also relevant to other aspects of household behaviour. For example, consumption smoothing is greater in the face of transitory income shocks compared to permanent shocks (Friedman 1957, Attanasio and Weber 2010). Third, there is also much interest in earnings and income stability from a normative perspective. An increase in the transitory variance increases longitudinal mobility – unlike increases in the permanent variance – and also equalizes lifetime incomes, aspects that are often viewed as welfare-improving (Shorrocks 1978, Gottschalk and Spolaore 2002). Finally, much of the interest in earnings instability is undoubtedly because of its link with income risk. This aspect is emphasized in popular accounts such as the books by Hacker (2008) and Gosselin (2008) though, as many economists have emphasised, assessments of the welfare consequences of greater instability also need to take into account the extent to which earnings changes reflect voluntary decisions by workers and their families and the extent to which they are insurable in principle and anticipated and insured against in practice.[1]

In this paper, we document volatility in the British labour market using descriptive measures of short-run longitudinal instability rather than using estimates derived from

[1] See the caveats expressed by, for example, Celik et al. (2012), Dahl, DeLeire, and Schwabisch (2012), Dynan, Elmendorf, and Sichel (2008), Gottschalk and Moffitt (2009), Moffitt and Gottschalk (2012), and Shin and Solon (2012). For structural models aiming to identify income risk, see Blundell, Pistaferri, and Preston (2008) and Cunha, Heckman, and Navarro (2005).

parametric models (for reasons discussed later).[2] Our research combines several distinctive features.

First, we examine instability among both earners and non-earners, i.e. not focusing only on workers with positive earnings as in most previous studies. We exploit the properties of our main volatility measure (the arc percentage change in earnings; see below) to examine not only earnings volatility among workers with positive earnings in two consecutive years but also the volatility among all workers, including those gaining or losing a job or remaining without a job. In this respect, our research follows Ziliak, Hardy, and Bollinger (2011) who in turn used a measure proposed by Dynan, Elmendorf, and Sichel (2012) that allows one to 'include the zeros'.[3] For brevity, we use the term 'earnings volatility' to refer to volatility among workers with positive earnings at the two time points, and we use the term 'labour market volatility' to refer to volatility among all potential workers, i.e. including individuals with zero earnings as well as those with positive earnings.

Second, and related, we provide estimates about volatility trends for women as well as men. This is appropriate given the secular increase in women's employment rates in Britain over the last few decades (as in the USA), and the growing importance of women's earnings to total household income. Most US studies of volatility to date have either focused on men only (Cameron and Tracy 1998; Celik et al. 2012; Shin and Solon 2011, Shin 2012) or examined household heads (mostly men) and their spouses (Dahl, DeLeire, and Schwabish 2012; Dynan, Elmendorf, and Sichel 2012).[4] Indeed, Dynan, Elmendorf, and Sichel (2012) restrict their attention to household heads belonging to households that do experience a change in head or residential mobility. Only Ziliak, Hardy, and Bollinger (2012) study volatility for men and women regardless of headship status.

Third, our research focuses on Britain. Virtually all previous earnings volatility research has been about the USA: see Cameron and Tracy (1998), Celik et al. (2012), Congressional Budget Office (2008), Dahl, DeLeire, and Schwabisch (2012), Debacker et al. (2013), Dynan, Elmendorf, and Sichel (2008), Shin and Solon (2011), Shin (2012), and Ziliak, Hardy, and Bollinger (2011). Cross-national comparisons help benchmark estimates of levels and trends in volatility for each country, and draw attention to similarities and differences in labour markets and other institutions. Some brief comparisons of volatility in

[2] We employ parametric models in a companion paper (Cappellari and Jenkins 2013).
[3] Celik et al. (2012: Figure 2) and Shin and Solon (2011: Figure 6) include some estimates that include non-workers, but this aspect is not the focus of their analysis.
[4] The literature fitting parametric models of permanent and transitory variances (discussed in the next section) has also only been fitted to data for men.

the USA and EU countries are presented in an OECD report (2011) but only a single volatility measure is used (discussed later) and estimates for men and women are not provided separately. In previous work for Britain, Jenkins's (2011*a*, *b*) analysis of the instability of total household income gave little attention to earnings instability: this paper is a substantial extension of that research. Much of the US research on earnings volatility has been based on the Panel Study of Income Dynamics and linked data from the Current Population Survey. We argue below that the survey data we use, from the British Household Panel Survey (BHPS), are of high quality and compare well with US survey data.

Fourth, we use multiple summary measures of volatility in order to check the robustness of our estimates of trends (details below). All but one of the measures has been used before in various studies, but ours is the only one to employ all of them.

In the next section, we briefly review methods used to describe earnings instability and its trends in order to motivate our focus on descriptive summary measures of short-term changes. In Section 3, we discuss the BHPS data that we use, including sample selections and earnings variables, and define the measures of volatility. The principal findings about British earnings and labour market volatility trends between 1992 and 2008 are presented in Section 4, for men and women separately. In Section 5, we decompose the trends in labour market volatility into contributions related to trends in earnings volatility and the patterns of employment attachment using variance decomposition methods. Section 6 contains our transatlantic comparisons.

We show that earnings volatility in Britain declined slightly for both men and women between 1992 and 2008 but the changes are not statistically significant. When we widen the scope to look at labour market volatility, we find that there is a marked and statistically significant decline over the period for both women and men, with the fall greater for men. The main factor accounting for the downward trend in labour market volatility is a secular decline in the proportions of workers moving into and out of employment. Also, the flat trend in earnings volatility is not attributable to factors related to job-changing that offset each other. These findings differ from those for the USA in several respects. In particular there has been no fall in labour market volatility as there has been in Britain, and trends in labour market attachment rates are quite different.

2. Methods for measurement of earnings instability

Earnings instability has been estimated using both model-based and non-model-based methods. There is a long tradition of fitting parametric models of earnings dynamics using GMM methods and deriving transitory variances from the estimates. Applications include Abowd and Card (1989), Baker (1997), Baker and Solon (2003), Haider (2001), Guvenen (2009), Hause (1980), Lillard and Willis (1978), Lillard and Weiss (1979), MaCurdy (1982), Meghir and Pistaferri (2004), and Moffitt and Gottschalk (2008, 2011 [originally 1995], 2012). All this research uses US or Canadian data. Applications to British men's earnings data are Daly and Valletta (2008), Dickens (2000), Kalwij and Alessie (2007), and Ramos (2003). An excellent review of variance components modelling and recent extensions is provided by Meghir and Pistaferri (2010).

At the same time, the parametric model approach has potential weaknesses. Guvenen (2009) and Dorís, O'Neill, and Sweetman (2012) draw attention to the difficulties of differentiating between model specifications when using the panel data sets on earnings that are typically available. Similarly, Shin and Solon make the case that model-based 'estimates of trends can be sensitive to arbitrary variations in model specification' (2011: 975). Illustrating this point, we note that the estimated time paths of the transitory variance are quite different in the Ramos (2003) and Daly and Valetta (2008) studies for Britain despite only minor differences in parametric model specification. All of the studies cited in this section consider men's earnings and so women's earnings are not analysed. Also, all refer to workers with positive earnings and any additional labour market instability associated with movements into or out of employment is not captured.

Model-based estimates of the transitory variance have been supplemented by non-parametric estimation approaches, notably by what Moffitt and Gottschalk (2012) refer to as a 'window averaging' method (otherwise known as the Gottschalk and Moffitt (1994) 'BPEA' method). See also their more recently proposed 'approximate non-parametric' method (Moffitt and Gottschalk 2012). US applications include Gottschalk and Moffitt (1994, 2009), Moffitt and Gottschalk (2008, 2012), and Keys (2008). Beach, Finnie, and Gray's (2010) Canadian study is one of the few that presents separate estimates for men and women.

Shin and Solon (2011) argue that the window averaging method provides potentially biased estimates of the transitory variance on the grounds that it reflects (unobserved) changes over time in the contribution of the permanent component of the total earnings

variance. In short, any descriptive measure is likely to capture permanent as well as transitory shocks. But Shin and Solon do not see this as a problem: '[b]ecause permanent shocks … are even more consequential than transitory ones, it makes sense to include them in a measure of earnings volatility' (2011: 976), and they argue for 'transparent methods that focus on simple measures of dispersion in year-to-year earnings changes' (2011: 973).

There is now a growing number of papers about the USA using these measures in addition to Shin and Solon's own research: see Cameron and Tracy (1998), Celik et al. (2012), Congressional Budget Office (2008), Dahl, DeLeire, and Schwabisch (2012), Debacker et al. (2013), Dynan, Elmendorf, and Sichel (2008), Shin and Solon (2011), Shin (2012), and Ziliak, Hardy, and Bollinger (2011). In the spirit of this literature, our research also employs 'simple measures' but studies Britain, men and women, and both labour market and earnings volatility.

3. Data and measures of volatility

Data

We use data from waves 1–18 (survey years 1991–2008) of the British Household Panel Survey (BHPS). The BHPS is a household panel with design features similar to those of the US Panel Study of Income Dynamics (PSID) but with some differences discussed below.[5] The original respondents were a nationally-representative sample of the private household population of Great Britain (England, Wales, and Scotland) in 1991.[6] The survey re-interviewed respondents annually thereafter in the autumn of each year, through to 2008 after which the survey no longer exists in the same form.[7] The BHPS follows individuals from originally-sampled and split-off households. This is like the PSID, and unlike the rotating panel component of the US Current Population Survey (CPS) used to derive 'matched CPS' estimates of volatility.[8]

[5] For BHPS documentation and Quality Profile, see https://www.iser.essex.ac.uk/bhps.
[6] Additional samples drawn from Scotland and Wales were added in 1999 and from Northern Ireland in 2001. In line with most BHPS-based analyses of the full period 1991–2008, we do not use these samples in this paper in order to avoid introducing problems associated with sample combination and complex probability weighting systems.
[7] In 2009–10, the BHPS sample was absorbed into the new UK household panel survey, Understanding Society, which has a different questionnaire.
[8] The CPS returns to addresses rather than individuals, which has two consequences. First, residential movers are not followed – a factor that may lead to potential bias in earnings changes if changes are associated with

Our analysis of earnings instability is based on individual-level earnings changes between two consecutive years t–1 and t, for t = 1992, …, 2008. We focus on working-age individuals in employment or non-employment. More specifically, we work with samples that exclude individuals who were (i) aged either less than 16 years or aged 60 years or more at t or t–1; (ii) non-respondents (did not provide a full, telephone or proxy interviews at t or t–1); (iii) self-employed at either t or t–1; or (iv) a full-time student at either t or t–1.

The age selection is similar to that of Ziliak, Hardy, and Bollinger (2011). Although the age range is wider than those used by, for example, Shin and Solon (2011) and others who use a bottom age limit of 25 years, our choice is effectively the same because we also drop individuals in education.[9] Regarding the top age limit, note that the State Retirement Pension age in the UK was 60 years for women and 65 years for men over this period, and that a significant proportion of men leave the labour market before age 65. We drop self-employed individuals, as do Celik et al. (2012) and Shin and Solon (2011), because of concerns that self-employment earnings data are less accurate than employment earnings data due to a combination of higher rates of response error and higher rates of item non-response.

The total base sample size for the period as a whole was an unbalanced panel of around 6357 men (43,880 person-years) and 6697 women (54,130 person-years). This corresponds to subsamples for each (t–1, t) year-pair of between 2000 and 2600 men, and between 2600 and 3300 women. The BHPS sample sizes for men are larger than those used in Shin and Solon's (2011) study of US men's earnings volatility using PSID data (ranging between about 1000 and 2000 individuals per year-pair). The sample sizes are substantially smaller than those derived from matched-CPS data (Ziliak, Hardy, and Bollinger 2011 report sample sizes of men and women combined of between 10,000 and 30,000 for each year pair) or from longitudinally-linked administrative record data (Congressional Budget Office 2008 and Dahl, DeLeire, and Schwabish 2011 use Continuous Work History Sample data comprising more than 700,000 individuals for each year pair). Given BHPS sample sizes, we report standard errors for our headline estimates (as did Shin and Solon 2011), and use only relatively coarse subgroup breakdowns in our volatility decomposition analysis (Section 5).

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residential mobility (Perrachi and Welch 1995, Celik et al. 2012). Second, individuals are not allocated unique identifiers, and so panels can only be created by matching procedures. Matching may introduce mismatch and measurement error in any given year and also fluctuations in estimates of cross-year volatility trends associated with year-to-year differences in match rates. See the discussions of matching and match algorithms in Cameron and Tracy (1998), Celik et al. (2012), and Ziliak, Hardy, and Bollinger (2012). We also note the different match rates reported by the different studies.

[9] We repeated analyses dropping all individuals aged less than 25 years and the findings were the same.

Sample weights that adjust for non-response and post-stratification grossing-up to match population totals are supplied with the BHPS release files, but their use makes little difference to earnings volatility estimates (see below) and so for brevity we report only results based on unweighted data (sensitivity analyses are reported in the Appendix).

The quality of our earnings measures benefits from the BHPS design: interviews are sought with all individuals aged 16 or more years within a household. Hence information about earnings is gathered from the earner himself or herself, by contrast with the practice of the US PSID or CPS, each of which uses a single household informant to report on each household member's earnings. The BHPS practice is likely to improve reporting accuracy especially for women's earnings since household headship in couple households is typically attributed to men. In addition, earnings data are not top-coded in the BHPS, also by contrast with the PSID and CPS.

Our measure of earnings is earnings from employment in the pay period most recent to the annual BHPS interview, converted to a monthly amount pro rata (BHPS variable payg). The measure refers to a main job, whether part-time or full-time, and does not include earnings from any second or other jobs (which are less well measured). Nominal amounts are converted to 2011 prices using the consumer price index (UK Office for National Statistics series D7BT). Earnings values are positive for workers, zero for non-workers.

Our earnings measure differs from the 'annual earnings' measures used in US studies of earnings volatility. Although a measure of 'annual labour income' is released in the BHPS files, arguably this measure is inherently less accurate than the current earnings measure because it is estimated by the survey producers from responses to a series of questions about last earnings received (as above) and retrospective recall questions about circumstances during the reference period: numbers of weeks worked, dates of job changes (if any) and the earnings received when beginning a new job or jobs.[10] The BHPS emphasis on current earnings is in line with virtually all UK household surveys.[11]

Although the British current earnings variable is of better quality than the annual labour income variable, its use is potentially problematic if used for comparisons with the

[10] The reference period for the annual measures is the calendar year starting on September 1 of the calendar year preceding the current interview. For example, for someone interviewed in October 1993, the reference year would be 1 September 1992 to 30 August 1993.

[11] See Böheim and Jenkins (2006) and Francesconi, Sutherland, and Zantomio (2011) for further discussion of earnings measures in the UK context. Böheim and Jenkins (2006) show, inter alia, that estimates of inequality and of its trends over time derived from BHPS annual and current measures of income are remarkably similar. OECD (2011) used the BHPS's derived annual earnings variable in their cross-national comparisons of earnings volatility.

USA. Because some people do not work all year round, there is a greater chance of finding zero earnings values with a current earnings measure than an annual measure. Put another way, some of what may be counted as labour market volatility when a current measure is used would contribute to earnings volatility were an annual measure to be used. To minimise the chances of the problem contaminating our transatlantic comparisons, we use annual earnings measures for these, having first demonstrated that our principal findings about British volatility trends are the same regardless of whether a current or annual measure is used.

Respondents with missing values on the BHPS monthly (and annual) earnings variables have values imputed by the survey producers using a regression-based cross-wave predictive mean matching procedure (see Jenkins 2011 chapter 4 for details), rather than using hot-deck procedures as in the PSID and CPS. In line with the concern expressed by US researchers about measurement error and hence spurious earnings instability being introduced by item-response imputation ('allocated earnings' in US jargon), the results that we report in the main text are based on samples from which imputed observations are dropped. We show in the Appendix that including observations with imputed earnings in the calculations changes results very little.

There was a change in BHPS data collection methods from wave 16 (2006) onwards. Under new dependent interviewing procedures, an earnings response from a current employee was compared with a fed-forward earnings response from the previous wave if the employee was also employed at the previous annual interview and, if there was an unusually large change in earnings, a follow-up question was prompted in order to check that the current response was correct.[12] We would expect this design change to reduce earnings volatility from 2006 onwards, other things being equal, but no discontinuity in time series of volatility estimates is apparent (see below). Another dependent interviewing procedure introduced at the same time introduces a discontinuity in the time series for the prevalence of job changing between annual interviews. This is relevant to one of the decomposition analyses undertaken and we discuss this issue in greater detail in Section 5.

To ensure that longitudinal earnings changes reflect genuine instability rather than systematic lifecycle variation, many US studies age-adjust earnings or earnings changes: observed earnings (or earnings changes) are regressed on a polynomial in age, and subsequent analysis is of earnings residuals. We show in the Appendix that volatility

[12] For details of the new dependent interviewing procedures introduced in wave 16, see Jäckle, Laurie, and Uhrig (2007).

estimates based on age-adjusted and raw earnings changes are very similar in our data set and so we focus on unadjusted estimates in the main text. Observe in addition that the BHPS following rule ensures that the average age within each of our two-year sub-samples changes little over the 18-year period, reducing the likelihood that estimates of volatility trends are driven by sample ageing.[13]

Many of the US studies of earnings instability cited earlier use samples from which the top and bottom one per cent of positive earnings observations are dropped (e.g. Shin and Solon 2011; Celik et al. 2012; Moffitt and Gottschalk 2012). The motivation is to reduce the influence of top-coding (not relevant in the BHPS case) and of outlier observations. Like Dahl, DeLeire, and Schwabish (2012: 753), our preliminary analysis suggested that trimming made little difference to estimated trends in earnings volatility and so for brevity the results reported below refer to estimates based on untrimmed distributions. An additional reason for not trimming the data is that we are interested in labour market volatility as well as earnings volatility and, for the commonly-used arc-standard deviation measure of volatility (see below), observations moving from employment to non-employment or vice versa are attributed with earnings change values that would be at risk of being dropped were trimming to be employed although they are genuine. Hence, rather than trimming the data to reduce the influence of outliers, we employ a number of earnings instability measures that are more robust to the influence of outliers than the standard deviation in order to check the sensitivity of our results.

Measures of volatility

The principal measure of volatility used in this paper is the standard deviation of the arc percentage change in individual earnings between two years t–1 and t, I, a measure also used by Dahl, Deleire, and Schwabish (2011), Dynan, Elmendorf, and Sichel (2012), and Ziliak, Hardy, and Bollinger (2011):

$$I = \sqrt{\text{Variance}\left[100(E_{it} - E_{it-1})/E_{i\tau}\right]}, \quad (1)$$

where $E_{i\tau} = (E_{it-1} + E_{it})/2$ for each individual i with earnings E_{it} in year t. $E_{i\tau}$ is the two-year longitudinal average of person i's earnings. If an individual is not working at both t–1 and t,

[13] For men, the average age increases from 36 in the 1992 subsample to 40 in the 2008 subsample; for women, the corresponding averages are 37 and 40. The standard deviation of age is between 10 and 11 for all subsamples.

his or her arc percentage change value is set equal to zero. Measure *I* is bounded above by 200 per cent and below by –200 per cent. (The arc percentage change in earnings for an individual moving from non-employment at *t*–1 to employment at *t* is 200 per cent and –200 per cent for an individual moving from employment at *t*–1 to non-employment at *t*.) The standard deviation is used to summarize dispersion rather than the variance because the former leads to a volatility measure that is in the same metric as earnings levels and earnings changes (Dynan, Elmendorf, and Sichel 2012). We use the variance, however, when decomposing total volatility into within- and between-group components because the standard deviation is not additively decomposable thus (see below).

Measure *I* has the great advantage that it can be used to summarize both earnings volatility and labour market volatility – because zero earnings values can be included in the measure. Shin and Solon (2011) and subsequent research (e.g. Celik et al. 2012; Shin 2012, Ziliak, Hardy, and Bollinger 2011) also summarise earnings volatility using the standard deviation of the distribution of changes in log(earnings), *S*:

$$S = \sqrt{\text{Variance}[\log(E_{it}) - \log(E_{it-1})]}. \quad (2)$$

S is defined only for workers with positive earnings at both *t*–1 and *t.* If the distribution of earnings changes primarily consists of relatively small values, then $S \approx I$. We confirm below that *S* and *I* provide very similar estimates of earnings volatility trends in Britain.

As summary measures of dispersion in a distribution, the standard deviation and variance are known to be potentially sensitive to outliers. We check the robustness of our estimates of trends by presenting more information about the complete distribution of earnings changes at each *t* – we track quantiles of the earnings change distribution over time (as did Shin and Solon 2011 and Dahl, DeLeire, and Schwabish 2011) – and we also present estimates for two other summary indices. The absolute Gini coefficient (one-half of Gini's mean difference) of the earnings change distribution, *A*, is a monotonic transformation of the so-called 'L2 moment', a measure of dispersion based on order statistics with desirable properties such as robustness to outliers relative to the variance: see Hosking (1990) for details.[14] We also provide estimates of the proportion of persons experiencing a year-on-year earnings change of greater than 20 per cent in magnitude, *P*. A volatility measure of this form was used by Dahl, DeLeire, and Schwabish (2011), and OECD (2011). *P* is analogous to a headcount measure of poverty (because it only depends on the prevalence of earnings

[14] For a distribution consisting of all positive values, the conventional Gini coefficient is equal to Gini's mean difference divided by twice the mean. The absolute Gini coefficient equals the conventional Gini coefficient multiplied by the mean. We calculate the absolute Gini using the Stata module by Van Kerm (2010).

changes larger than some threshold value) rather than a measure of inequality of earnings changes per se. Because *P* does not summarise dispersion across the entire distribution of changes, we do not use it as our 'headline' measure.

4. Volatility trends: Britain, 1992–2008

Our headline estimates of trends in earnings and labour market volatility trends are shown in Figure 1 for men and Figure 2 for women. (These are based on the BHPS current earnings measure; estimates based on annual earnings are presented later.) Volatility is summarized using the standard deviation of the arc percentage changes in earnings (*I*). In each chart, the lower line summarizes earnings volatility (calculated for annual subsamples with positive earnings in both years) and the upper line summarizes labour market volatility (calculated for samples also including individuals with zero earnings). The vertical bars show 95% confidence intervals around each year's volatility estimate.

<Figures 1 and 2 near here>

For both men and women, there is no significant change in earnings volatility over the period 1992–2008. For men, the estimate of *I* for 1992 is 27.9 per cent (s.e. 1.83) and for 2008, 25.1 per cent (s.e. 1.33), representing a decline of 2.8 percentage points or around 3 per cent but which does not differ significantly from zero (t-statistic for test of non-zero difference assuming independence = 1.3). Earnings volatility is slightly greater for women than for men, but the trend is also flat. *I* is estimated to be 31.3 per cent (s.e. 1.11) for 1992 and 29.9 per cent (s.e. 1.00) for 2008, a decline of 1.4 percentage points or about 4.6 per cent which does not differ significantly from zero (t-statistic = 0.96).

By contrast with earnings volatility, labour market volatility declined significantly over the period as a whole for both men and women. For men, we estimate that *I* fell from 63.8 per cent (s.e. 1.08) in 1992 to 43.6 per cent (s.e. 1.73) in 2008, which is a decline of 20 percentage points, or some 32 per cent. The change in *I* is significantly different from zero (t-statistic = 9.9). For women, there is also a statistically significant decline (t-statistic = 5.7) but the size of the change is smaller: from 66.3 per cent (s.e. 1.40) in 1992 to 54.0 per cent (s.e. 1.62) in 2008, which is a fall of 12.3 percentage points or 18 per cent. For men, the rate of decline is fastest in the early-1990s, and slowed thereafter but, for women, there is no similar pattern in the trend. For both sexes, there are year-to-year fluctuations in *I*, and most of these are within the bounds of sampling variability.

The estimates of volatility levels and trends shown in Figures 1 and 2 are robust to whether individuals with imputed earnings are included in the estimation samples, whether there is age-adjustment of raw earnings changes, or whether sample weights are used: see Appendix Figures A1 and A2. For example, inclusion of imputed earnings observations increases volatility estimates (as expected), but the impact is very small.[15]

We now show that estimates of trends are unaffected by the choice of index used to summarize volatility. Figures 3 and 4 display estimates of labour market volatility for men and women respectively calculated using the standard deviation of the arc percentage earnings changes (*I*), the absolute Gini coefficient (*A*), and the percentage of individuals with an earnings change greater than 20 per cent in magnitude (*P*). Earnings volatility is summarized using the same three indices plus the standard deviation of changes in log earnings (*S*).

<Figures 3 and 4 near here>

The overwhelming impression provided by Figures 3 and 4 is that, over the 1992–2008 period and for both men and women, earnings volatility is broadly constant, and labour market volatility declined. Changing the summary index simply leads to different estimates of the magnitude of the latter decline. For men, the decline in labour market volatility between 1992 and 2008 was 32 per cent according to *I*, 22 per cent according to *P*, and 38 per cent according to *A*. For women, the corresponding declines are 23 per cent, 6 per cent, and 26 per cent. Since the trend decline is smallest for *P*, and *P* summarizes changes in the prevalence of large earnings changes and is otherwise insensitive to the magnitude of those changes, it is likely that the larger declines in volatility that are registered by *I* and *A* are attributable to a decline in dispersion among earnings changes sufficiently large to be included in the calculation of *P*.

This is confirmed by inspection of Figures 5 (for men) and 6 (for women), which show trends in the quantiles of earnings change distributions. Six quantiles are plotted; three below the median (the 5th, 10th, and 25th percentiles) and three above the median (the 75th, 90th, and 95th percentiles). The median change is not plotted in order not to obscure the plot lines (it is slightly above zero in each case). It is clear from Figures 5 and 6 that the flat trend in earnings volatility for men and women in aggregate reflects flat trends in all sections of the earnings change distribution; it is not a matter, say, of there being a decline in large earnings

[15] The results about earnings volatility trends for men are also robust to the use of a 'usual earnings' measure rather than pay last received: see Jenkins (2011*a*, *b*).

changes being offset by a rise in small earnings changes.[16] Turning to labour market volatility for men, we see that the faster rate of decline observed in the 1990s in aggregate volatility is due to a marked decline during this period in the magnitude of earnings increases and decreases for the individuals near the extremes of the distribution. For women, for whom labour market volatility declined more continuously over the period as a whole, we see that this reflects a decline in the magnitude of earnings increases and earnings decreases for the individuals near the extremes of the distribution (as for men but to a greater extent), but this decline occurred over the whole period (unlike for men).

<Figures 5 and 6 near here>

Do these time-series patterns for men and women reflect what is happening to earnings changes among individuals with a job at both $t-1$ and t, to the earnings changes associated with transitions into and out of employment, or to the proportions of individuals retaining, losing, or gaining employment? The contrasting trends for earnings and labour market volatility suggest that trends in employment transitions and the earnings changes associated with them are the relevant factors. The volatility decomposition analysis presented in the next section provides a framework for answering these questions.

5. Accounting for volatility trends: decomposition analysis

In this section, we employ two sets of variance decompositions to examine the volatility trends. The first is a decomposition of labour market volatility in which groups are defined according to attachment to employment in two consecutive years. The second is a decomposition of earnings volatility among individuals with positive earnings in two consecutive years in which an individual's group membership depends on whether he or she experiences a job change over the two years. In both applications, analysis is conducted separately for men and women.

We exploit the fact that, for a population of individuals that is exhaustively classified into a set of mutually-exclusive groups, the variance of a quantity for the population at a particular date, V, is equal to the sum of the 'within-group' variance plus the 'between-group' variance. (See Celik et al. 2012 and Ziliak, Hardy, and Bollinger 2011.) The within-group

[16] Figure 6(a) suggests that the upward blip in 2002 in earnings volatility for women apparent in Figure 4(a) arises from a blip increase in the size of earnings decreases for those near the bottom end of the earnings change distribution.

variance is the weighted sum of the variances within each group, where a group's weight is equal to the group's size expressed as a proportion of the total population size (the subgroup 'population share'). The between-group variance is the variance in the population that would arise were each individual to be attributed with the mean value of the quantity for his or her group.[17]

Labour market volatility decomposed

We decompose labour market volatility measured by the variance of individuals' arc percentage change in earnings ($V = I^2$), and four groups of individuals are defined depending on employment attachment at t–1 and at t:

- Group '11': with positive earnings at both t–1 and at t, and with variance V_{11}, mean M_{11}, and subgroup population share P_{11}.
- Group '00': with zero earnings at both t–1 and at t, and with variance V_{00}, mean M_{00}, and subgroup population share P_{00}.
- Group '01': movers from non-employment to employment, and with variance V_{01}, mean M_{01}, and subgroup population share P_{01}.
- Group '10': movers from employment to non-employment, and with variance V_{10}, mean M_{10}, and subgroup population share P_{10}.

The arc percentage earnings change is zero for every group member of group 00, and hence $M_{00} = 0$ as well. For every member of group 01, the arc percentage change is +200 and hence M_{01} equals +200. Similarly, $M_{10} = -200$. The population mean arc percentage earnings change, M, equals $P_{11}M_{11} + P_{00}M_{00} + P_{01}M_{01} + P_{10}M_{10} = P_{11}M_{11} + 200(P_{01} - P_{10})$, where $P_{11} + P_{00} + P_{01} + P_{10} = 1$. Since $V_{00} = V_{01} = V_{10} = 0$, the within-group variance is equal to V_{11} weighted by its population share P_{11}. The remainder of the total variance is accounted for by the four group-specific terms that comprise the between-group variance: for each group, the term is the square of the difference between the group's mean and the population mean, weighted by the group's population share.

It follows that labour market volatility in any given year can be written as the sum of five terms:

$$V = P_{11}V_{11} + P_{00}M^2 + P_{01}(200 - M)^2 + P_{10}(200 + M)^2 + P_{11}(M_{11} - M)^2. \qquad (3)$$

[17] In the jargon of income inequality analysis, the variance is additively decomposable by population subgroup (Cowell 2000). The standard deviation is not decomposable thus; nor is the absolute Gini coefficient (A).

We can therefore account for trends in labour market volatility by examining the changes over time in each of the five terms and in their constituent components.

The trends in V and the five variance contributions are shown in Figure 7 (for men) and Figure 8 (for women). Observe that the magnitude of the fall in labour market volatility is greater when calculated using V rather than I. For example, for men, the decline in V between 1992 and 2008 is around 54 per cent (compared with 32 per cent) and, for women, the fall is 18 per cent (compared with around 8.3 per cent). For both sexes, earnings volatility accounts for virtually none of the fall in labour volatility in the 1992–2008 period since $P_{11}V_{11}$ does not change over time. The between-group contributions to labour market volatility from groups 11 and 00, $P_{00}M^2$ and $P_{11}(M_{11} - M)^2$, also do not change over time, and both are negligible in size in any case. Instead, the fall in V is attributable to declines in the between-group contributions associated with transitions into and out of the labour market. For men, the rate of decline in $P_{01}(200 - M)^2$ and in $P_{10}(200 + M)^2$ is fastest in the early 1990s when V also fell fastest, whereas for women, the trend downwards in these two terms occurs more continuously over the period as a whole.[18]

<Figures 7 and 8 near here>

The trends in the variance contributions are themselves attributable to changes in the proportions of persons in each of the four labour market attachment groups and changes in M_{11} and V_{11}. The trends in P_{11}, P_{00}, P_{01}, P_{10}, and M_{11} are shown in Figures 9 (for men) and 10 (for women). The pattern of mean earnings changes among group 11 is a flat inverse U-shape for both men and women: M_{11} rises from less than five per cent per year during the early 1990s to around five per cent for the decade between the mid-1990s and mid-2000s, and then declines to less than five per cent per year again subsequently.

The most perceptible changes over time are in the group population shares. Specifically, the proportion of men in group 11 rises from just below 81 per cent at the start of the 1990s to around 86 per cent at the start of the 2000s, after which the rate of increase is somewhat smaller (the group's share is 88 per cent in 2008). The rise primarily reflects a shift from the proportion of men in group 00: the share decreases from just over 13 per cent in 1994 to around 9 per cent in the late-2000s accompanied by decreases in the shares in the other two groups. The population share of group 01 falls from just over 3 per cent in 1994 to just over 1 per cent in 2008; for group 10, the corresponding change is from just over 3 per

[18] Although the variance contribution associated with earnings volatility fell in absolute terms, its share of total labour market volatility increased over the period from around 14 per cent to 28 per cent for men and 13 per cent to 19 per cent for women. And, although $P_{01}(200 - M)^2$ and $P_{10}(200 + M)^2$ fell in absolute terms, their shares of the total variance, were roughly constant. See Appendix Table A1.

cent to just over 2 per cent. For women, the rise in the population share of group 11 is more continuous over the period, increasing from around 66 per cent in 1994 to 73 per cent in 2008, matched by a decline in the proportion in group 00 from around 25 per cent at the start of the 1990s to around 20 per cent in 2008, together with small declines in the other two groups' shares (from just under 5 per cent in 1994 to just under 3 per cent in 2008 for group 01 and from just under 5 per cent in 1994 to just under 4 per cent for group 10). For brevity, annual estimates of V_{11} are not reported; we report the changes between 1992 and 2008 in Table 1. The direction of changes over the years in earnings volatility calculated using V_{11} is of course identical to the direction of changes for I summarized in Figures 1 and 2, but the magnitude of the estimated decline over the period is greater for V_{11} than I. The fall in V_{11} between 1992 and 2008 is –15 per cent for men (compared with –3 per cent for I), and –18 per cent for women (compared with –8 per cent).

<Figures 9 and 10 near here>

We illustrate the importance of the trends in population shares for explaining trends in labour market volatility with a counterfactual exercise. Using equation (3), we can ask what labour market volatility would have been in 2008 were group population shares to have remained as they were in 1992 while M_{11} and V_{11} take their observed values for the two years (counterfactual A) or, instead, we can ask what labour market volatility would have been in 2008 if M_{11} and V_{11} were to have remained as they were in 1992 but group population shares take their observed values in the two years (counterfactual B). The results are summarized in Table 1. If population shares are fixed as in A, then the observed changes in group 11's mean and variance of earnings changes would have reduced labour market volatility between 1992 and 2008, but only slightly: just over 2 per cent of the observed change in V for men, and just over 1 per cent of the observed change for women. In contrast, counterfactual B shows that changes in the group population shares with M_{11} and V_{11} fixed generate estimates for V for 2008 that are virtually identical to those that are observed.

<Table 1 near here>

Assembling the evidence, the story that emerges for both men and women is that earnings volatility trends make a negligible contribution to labour market volatility trends between 1992 and 2008. The within-group variance contribution is constant over time, because a small fall in earnings volatility was offset by an increase in the proportion of individuals who are employed for two consecutive years. Instead, the decline in labour market volatility is primarily accounted for by the declines in the proportions of individuals making transitions into or out of employment between two consecutive years. Although these

two groups' population shares are small in every year, they are used in the variance decomposition formula to weight a group average earnings change (200 per cent or –200 per cent) that is very large by comparison with the average earnings change in the population as a whole. The finding that labour market volatility trends in Britain are not attributable to earnings volatility trends is of course consistent with what was shown by the trends in quantiles of earnings change distributions presented in Figures 5 and 6 earlier. The advantage of the approach used in this section based on the variance as a summary index is that it provides an exact decomposition of the various contributions; the potential disadvantage is that there may be disagreement with the particular way in which the variance aggregates earnings changes of different magnitudes.[19]

Earnings volatility decomposed

Although earnings volatility hardly changed over the 1992–2008 period, the flat trend in aggregate may reflect offsetting contributions from different groups of workers. Celik et al. (2012) analysed whether this was the case in the USA, distinguishing between workers who stayed with the same employer and workers who changed job from one year to the next. They found higher volatility among job-changers (as expected), but there was no clear cut association between earnings volatility trends and job-change rates. We examine whether this is also the case in Britain.

Following Celik et al. (2012), we consider the contributions to overall earnings volatility of earnings volatility among employees who change jobs (group '*C*'), earnings volatility among employees who do not change jobs (group '*N*'), and the prevalence of job-changing between interviews. By the same principles used to define eq. (3), we can write earnings volatility in any given year as the sum of four terms:

$$V = P_C V_C + P_N V_N + P_C(M_C - M)^2 + P_N(M_N - M)^2 \qquad (4)$$

where P_C and $P_N = 1–P_C$ are the proportions of individuals changing jobs and not changing jobs, respectively, in the period between the BHPS annual interviews for years t–1 and t. Analogously, V_N and V_C are the group variances, and M_N and M_C are the group means of arc percentage earnings changes. (M is now used denote the aggregate mean among all

[19] Checking whether the absolute Lorenz curves (Moyes 1987) for a pair of distributions intersect is a way of checking whether conclusions about volatility trends are robust to the choice of summary index. We find that labour market volatility rose between 1992 and 2008 according to the absolute Lorenz criterion, but there is no unanimous ordering of 1992 and 2000. (Details are available from the authors on request.)

individuals with positive earnings at t–1 and t; M in this subsection corresponds to M_{11} in the previous subsection.)

The BHPS variable summarizing job change is derived from responses from employees to the following questions about their employment history in period back to the start of the reference year (1 September of the calendar year before the current interview year): 'What was the date you started working in your present position? If you have been promoted or changed grades, please give me the date of that change. Otherwise please give me the date when you started doing the job you are doing now for your present employer'. The definition of job change is broader than Celik et al.'s (2012) because it includes promotions and grade changes with the same employer as well changes in employer.

Trends in the prevalence of between-interview job change (P_C) are shown in Figure 11. For both men and women, the general picture is of a steady rise over the 1990s of more than five percentage points in prevalence rates from a baseline of around 13 per cent in the early 1990s to around 18 per cent. The rates fell back slightly thereafter until at least the mid-2000s, after which a change in BHPS data collection methods introduces a discontinuity in the series. Dependent interviewing procedures were introduced to the BHPS in 2006, one component of which was the use of fed-forward information to identify respondents in the same job as the previous wave and then route them past the detailed employment history questions altogether. (See Jäckle, Laurie, and Uhrig 2007 for details.) Other things equal, this design change is likely to lead to a reduction in reported between-interview job changes – which is what we see in Figure 11.

<Figure 11 near here>

Trends in the within-group variances of earnings change, V_C and V_N, are shown for men and women in Figure 12. The chart shows that earnings volatility among employees that did not change jobs between interviews was broadly constant throughout the whole period. Earnings volatility among job changers is not only greater than earnings volatility among job stayers (as expected), but also trends distinctively downwards from the early 1990s through until at least the mid-2000s, after which the series discontinuity makes inferences about trends more difficult.[20] The discontinuity aside, the gap between volatility among job-changers and volatility among job-stayers decreases throughout the period as a whole.

<Figure 12 near here>

[20] The greater year-on-year fluctuation in volatility among job-changers than in volatility among job-stayers most likely reflects the smaller sample sizes involved.

For both sexes, and for each year, within-group earnings volatility accounts for almost all of total earnings volatility, whereas between-group volatility accounts for almost none. The between-group volatility components are so small because the differences between mean earnings changes for both groups and the overall mean change are so small. See Figure 13 (for men) and Figure 14 (for women) for time series for each of the four variance contribution terms shown in eq. (4).

<Figure 13 and Figure 14 near here>

For men, volatility among job-stayers accounts for around 70 per cent of total volatility throughout the period, with some fluctuation from one year to the next; volatility among job-changers accounts for the remaining 30 per cent. It appears that the flat trend for men's earnings volatility cannot be attributed to trends in factors related to job-changing (which is what Celik et al. 2012 found for the USA). For women, the conclusion differs slightly. Total earnings volatility declined slightly over the period as a whole (more obviously than for men), with the decline most apparent from around 2000 onwards. Inspection of the trends in the series shown in Figures 11 and 12 suggests that the trajectory from 2000 primarily reflects the combination of a decline in earnings volatility among job-changers and a fall in the proportion of workers changing jobs.

Using similar decompositions, we also conclude that the flat trend in earnings volatility for men and women cannot be related to changes associated with persistence in part-time versus full-time work. We partitioned our samples of earners into groups according to whether an individual was in full-time work (30+ hours per week) at the time of the interviews in years t–1 and t, or not. As expected, earnings volatility for the persistent full-time workers was substantially lower than the remainder (for men and for women), but there was no trend over time for either group in the variance, nor in the percentages in each group. (Estimates available from the authors on request.)

6. Britain in comparison with the USA

We have shown that, for both men and women, earnings volatility in Britain changed little between the early-1990s and the late-2000s, whereas labour market volatility for both sexes fell over the same period. How do these results compare with those for the USA?

To answer this question, we switch to using volatility estimates for Britain that are based on annual earnings measures because they are used in US studies. This switch is

insubstantial because our headline findings for Britain are the same regardless of whether a current or annual earnings measure is used. See Appendix Figures A3–A6. As expected, earnings volatility is larger if calculated using the annual earnings measure rather than current earnings (but the increase is small) and there is also no trend upwards or downwards over time. Labour market volatility is also greater when the annual earnings measure is used (more obviously for women than for men), but both measures show a similar downward trend over the period. Trends in labour market attachment are also similar for the two earnings measures.

Transatlantic comparison

The US literature on volatility provides estimates for the period from the early 1970s through to 2008.[21] Virtually all studies show that earnings volatility for men increased during the 1970s, but then levelled off somewhat through to the early- to mid-1980s or fell slightly. Findings about what happened thereafter depend on the data set used. Estimates derived from the Panel Study of Income Dynamics suggest a rise in volatility (Celik et al. 2012, Shin and Solon 2011) whereas those derived using administrative record data or survey data linked to administrative record data suggesting that volatility remained flat (Celik et al. 2012, Dahl, DeLeire, and Schwabisch 2012, Debacker et al. 2013). One set of researchers using Current Population Survey (CPS) matched data reports a substantial spike increase in men's earnings volatility between 2007 and 2008 (Celik et al. 2012: Figure 1), whereas another reports virtually no change over the same interval (Ziliak, Hardy, and Bollinger 2012: Figure 3). In summary, the majority verdict (i.e. discounting the PSID estimates) is that there is no trend in men's earnings volatility in the USA between the beginning of the 1990s and 2008, a result which is the same as our finding for Britain. There is little US evidence about labour market volatility or about volatility among women.

To continue with our transatlantic comparisons, we therefore focus on the estimates from the US study by Ziliak, Hardy, and Bollinger (2011) for the period 1992–2008. Only their research provides volatility estimates for men and women separately, and for labour market volatility as well as earnings volatility. Our comparisons of earnings and labour market volatility are summarised in Figure 15 for men and Figure 16 for women.

<Figures 15 and 16 near here>

[21] A useful comparison of US studies of longitudinal earnings instability is provided by Dynan, Elmendorf and Sichel (2012, Table 3b).

Although earnings volatility is without trend in both Britain and the UK, the substantially greater magnitude of earnings volatility levels in the USA stands out. Ziliak, Hardy, and Bollinger (2011) estimate *I* to hover just above 50 per cent for US men whereas the British estimate is around 30 per cent. The corresponding estimates for women are between 55 per cent and 60 per cent in the USA but around 40 per cent in Britain.[22]

Labour market volatility levels are also substantially greater in the USA than in Britain, and there is downward trend in Britain that does not occur in the USA. According to Ziliak, Hardy, and Bollinger (2011), labour market volatility in the USA hardly changed over the 1992–2008 period, remaining at about 75 per cent for men and just under 85 per cent for women. In Britain, labour market volatility fell substantially for both sexes. The transatlantic differential is about 10 percentage points at the beginning of the 1990s for men (less for women) but around 30 percentage points by 2008.

US researchers have also argued that volatility for US men is higher during recessions: see e.g. Cameron and Tracy (1998), Celik et al. (2012), Shin and Solon (2011), Ziliak, Hardy and Bollinger (2011). Similarly, Moffitt and Gottschalk (2012) report that the transitory variance of men's earnings is larger in recessions. In contrast, Ziliak, Hardy and Bollinger (2011) using their full run of data from the early 1970s report that women's earnings volatility is lower during recessions.

Ascertaining whether such a relationship with the business cycle also holds for Britain is constrained by the fact that the period of observation (1992–2008) is shorter than the period spanned by most US data sets.[23] Indeed, the period covered by the BHPS spans only one cycle from trough to trough. The UK economy experienced a serious downturn at the start of the 1990s, with unemployment rates rising to around 10 per cent in 1992 and 1993 (with two consecutive quarters of negative GDP growth in 1991), followed by recovery at a steady rate until the turn of the 2000s when the unemployment rate was around 5 per cent and then steady until its sharp rise in 2008 with the onset of the Great Recession and the return of negative GDP growth (Greg and Wadsworth 2010: Figure 1).

The decline in labour market volatility is thus closely associated with the improvement in the macroeconomic health of the economy, which suggests that there may be some sort of 'business cycle' story at play in the UK. However, if this is the case, it must

[22] The transatlantic differential in volatility levels is confirmed if *P* is used as the volatility measure: see OECD (2011: Figure 3.1) for men and women combined.

[23] Time series regressions of volatility on measures of the cycle and a time trend using data for 1992–2008 do not yield statistically significant results for either men or women as found for the USA (estimates available from the authors on request).

arise via changes in labour market attachment, since earnings volatility is flat through the period. And it is in trends in labour market attachment rates that another interesting transatlantic contrast appears. See Figures 17 and 18 which compare Ziliak, Hardy, and Bollinger's (2011) estimates of labour force attachment rates with our British estimates.

For British men, the proportion of individuals with two consecutive years in employment (P_{11}) fell slightly during the early-1990s recession and then recovered to around 90 per cent by 2000 and then remained constant thereafter (Figure 17). The proportion of men with two consecutive years not in employment (P_{00}) rose in the recession to reach around 10 per cent and then fell back again, while the proportions moving into or out of employment declined slightly. This picture is in sharp contrast to that for US men, for whom P_{11} fell continuously throughout the period, P_{00} increased, and P_{01} and P_{10} remained constant. Put another way, labour market attachment rates for US and British appear to be similar at the start of the 1990s but marked differences open up by 2008. Figure 18 shows this is the case for women as well as men.

<Figures 17 and 18 near here>

What explains the transatlantic differences?

What might explain the transatlantic differences in levels and trends that we observe? With regard to the differential in levels, it is often said that the US labour market is more flexible than the British one, with employment arrangements less governed by collective bargaining arrangements, employment protection legislation, and so on (Nickell 1997). One might conjecture that this labour market flexibility is reflected in relatively greater instability in earnings and employment attachment for US workers compared to their British counterparts.

This leaves open the question why the transatlantic differences in trends arise. For example, why is there apparently an association between the business cycle and earnings volatility in the USA but apparently not in Britain? The subgroup decomposition approach used earlier provides a potentially useful framework for addressing this issue.[24]

Consider a stylized world in which, among all workers employed for two consecutive years, there are two types of worker, 'skilled' and 'unskilled'. Compared to unskilled

[24] As far as we are aware, the research to date that refers to the relationship between earnings volatility and the business cycle has focussed on the empirical finding itself. Although there are extensive discussions of the potential underlying sources of longitudinal earnings instability in any given year (from Gottschalk and Moffitt 1994 onwards), the reasons why there might be a relationship between earnings volatility and the business cycle are not discussed.

workers, skilled workers are more likely to be paid annual salaries rather than hourly or weekly, and to be paid on an incremental scale (increasing earnings each year). Longitudinal variability may arise because skilled workers may receive performance and incentive pay in addition to basic salary but the number affected is relatively small, whereas a large fraction of unskilled workers may have variable work hours because of changes in overtime hours, short-time working, and so on. In this stylized world, the distributions of year-on-year earnings changes for skilled and unskilled workers would be expected to differ. Having a skilled job is associated with a lower prevalence of negative earnings changes and higher prevalence of positive earnings changes, and also a lower dispersion of earnings changes. In short, $M_S > M_U$, and $V_S < V_U$, to adapt our previous notation in the obvious way. By analogy with eq. (4), overall earnings volatility in any given year is the sum of a population-share-weighted average of the earnings volatilities within the skilled and unskilled groups plus the between-group volatility contribution (which depends on the group mean changes).

The relationship between overall earnings volatility and the business cycle in this stylized world is unclear because there are several potentially offsetting influences. With the onset of a recession, one would expect both M_S and M_U to fall but for M_U to decrease by a greater amount (if only because of a relatively greater prevalence of negative earnings changes). This would increase overall volatility (the between-group variance contribution increases). Second, both group variances may change. If the recession leads to a truncation of the right-hand tail of the earnings change distribution because large positive earnings increases are less likely and the truncation is greater among unskilled workers, then one would expect both V_S and V_U to fall and V_U to decrease by the greater amount. The reduction in group variances would reduce overall earnings volatility, other things being equal.

A third potential effect of the recession is through compositional change. We would expect unskilled workers to be more likely than skilled workers to lose their jobs in a recession and, hence, to drop out of the calculations of overall earnings inequality (based on earnings changes for workers in employment for two consecutive years). That is, in a recession, P_S would rise and P_S would fall, so the calculation of overall earnings volatility would place greater weight on the variance for skilled workers. But, since $V_S < V_U$, this compositional shift may work to reduce overall earnings volatility – but it may also increase it. Since the within-group variance contribution for skilled workers is $P_S V_S$ and $P_U V_U$ for unskilled workers, the net effect depends on how large the compositional changes in the recession are relative to the groups' volatility changes, and their levels in the first place. In sum, the net effect of a recession on earnings volatility is unclear, even without invoking

additional institutional considerations such as national minimum wages (which may put a floor on the magnitude of negative earnings changes among unskilled workers), employment protection legislation, and the prevalence and nature of collective bargaining arrangements among skilled and unskilled workers (which may constrain earnings volatility and compositional change). And all the factors mentioned are likely to differ between men and women.

In sum, this discussion suggests potential reasons for the pro-cyclical relationship with earnings volatility found for the USA: a relatively large increase in between-group volatility, combined with relatively small effects from compositional change and within-group variability. Given greater labour market flexibility in the USA than in the UK (see above) leading to greater earnings volatility (but smaller differences in variances across groups, and in their changes over time), as well as more muted compositional effects, this might leave between-group changes to play the dominant role in recessionary times. Clearly, this stylised model is speculative and, in any case, it does not help explain the transatlantic differences in trends in labour market attachment rates and hence differences in labour market volatility trends.

7. Summary and conclusions

We have shown that, for both sexes, earnings volatility changed little between 1992 and 2008 in Britain, but there has been a marked fall in labour market volatility, largely due to changes in rates of employment attachment. Compared to the USA, earnings and labour market volatility levels are substantially lower in Britain. Although earnings volatility trends appear flat in both countries, the decline in labour market volatility in Britain is distinctive. In so far as there is a relationship between volatility and the business cycle in Britain, it appears to work via changes in persistence in labour market attachment rather than changes in earnings volatility.

Our research leaves a number of questions open. In particular, further analysis is required to explain the transatlantic differences that we have identified. As recovery in the US and UK economies and labour markets after the Great Recession is proving slow or non-existent, more knowledge about the impact of recessions on volatility is required. To address these issues requires both theoretical analysis going well beyond our stylized description and new empirical analysis of more up-to-date data.

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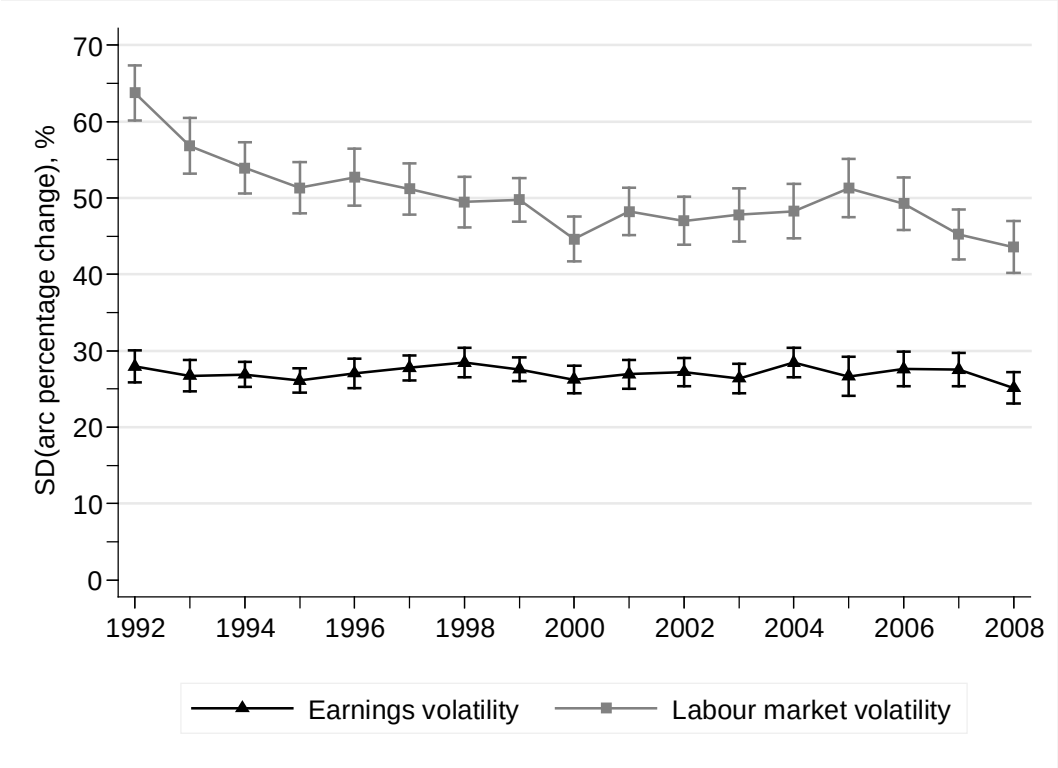
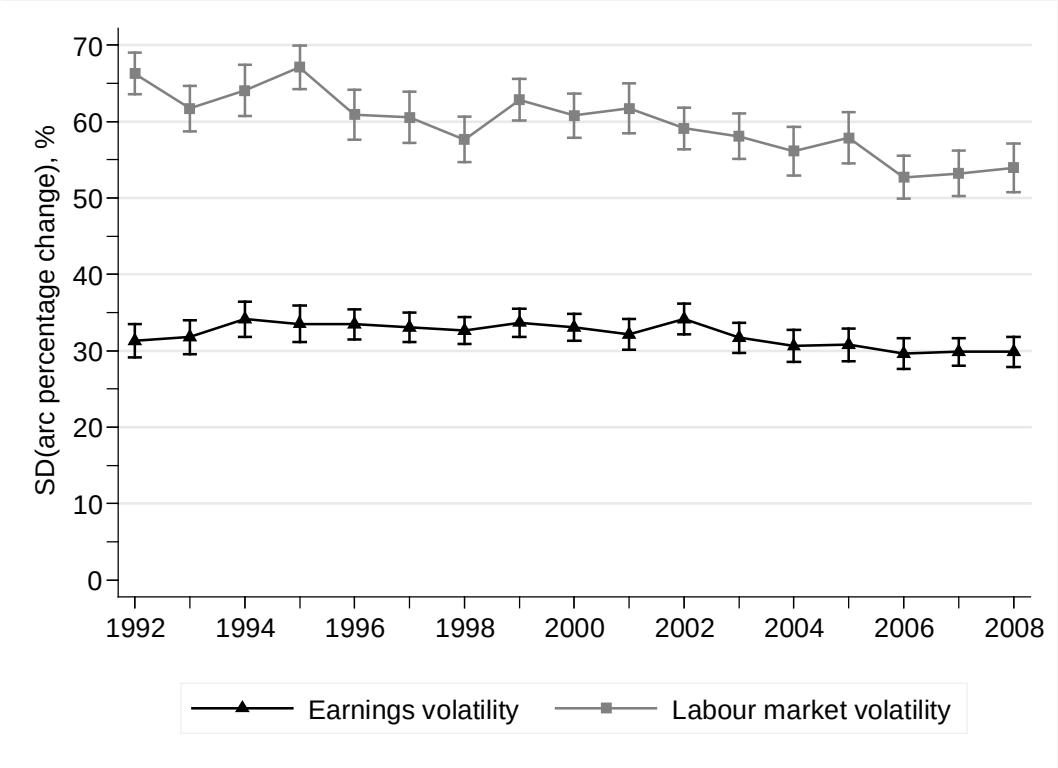
Figure 1. Earnings and labour market volatility for British men, 1992–2008



Notes: authors' estimates from BHPS data (unweighted, not age-adjusted, excluding imputed earnings values). The measure of volatility is *I* (see main text). Error bars show pointwise 95% confidence intervals, calculated using bootstrap standard errors (1000 replications) accounting for survey clustering and stratification. Year labels refer to year *t* for earnings changes between *t*–1 and *t*.

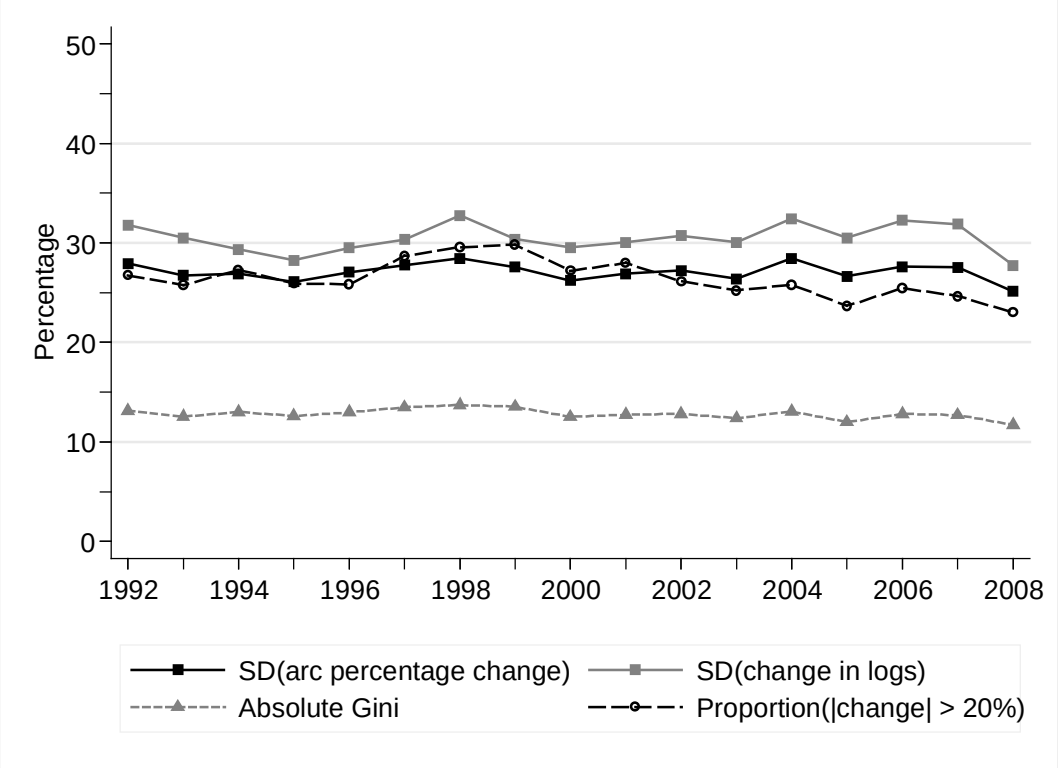
Figure 2. Earnings and labour market volatility for British women, 1992–2008



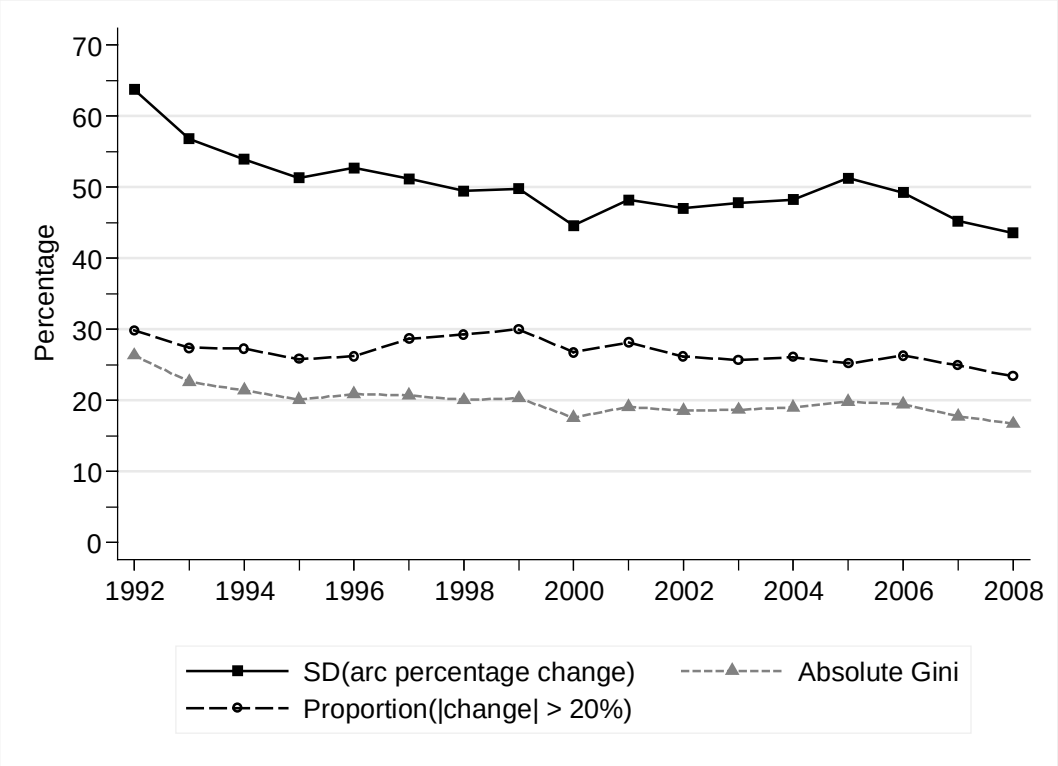
Notes: As for Figure 1.

Figure 3. Earnings and labour market volatility for British men, by summary index

(a) Earnings volatility



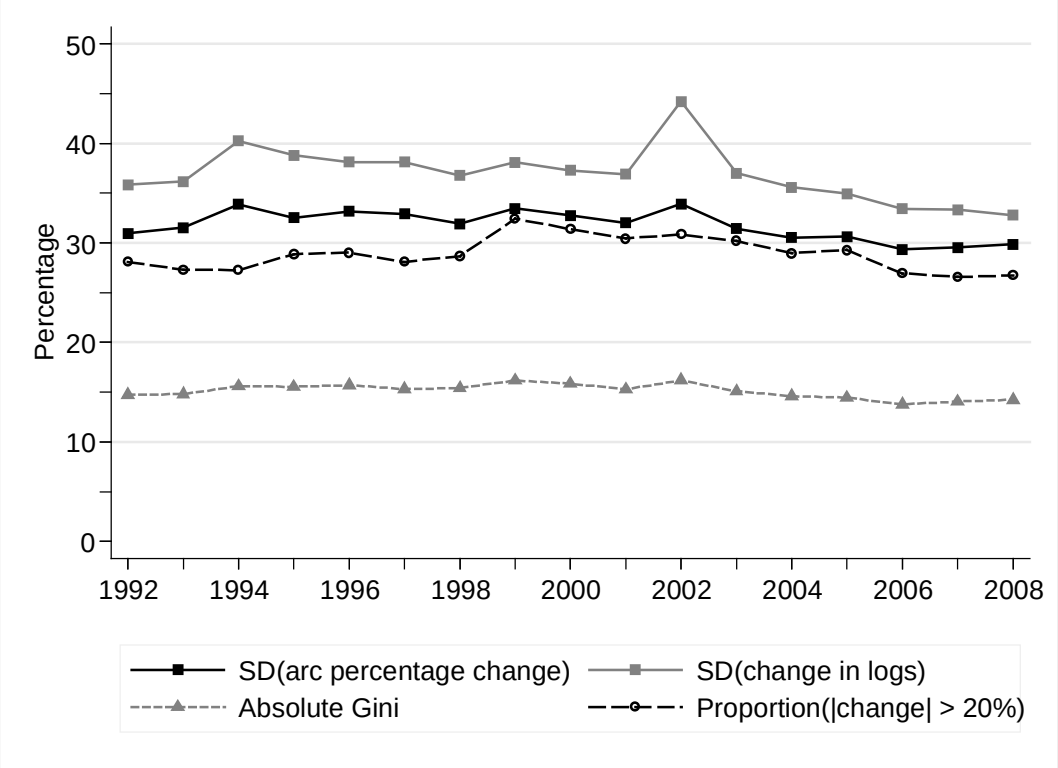
(b) Labour market volatility



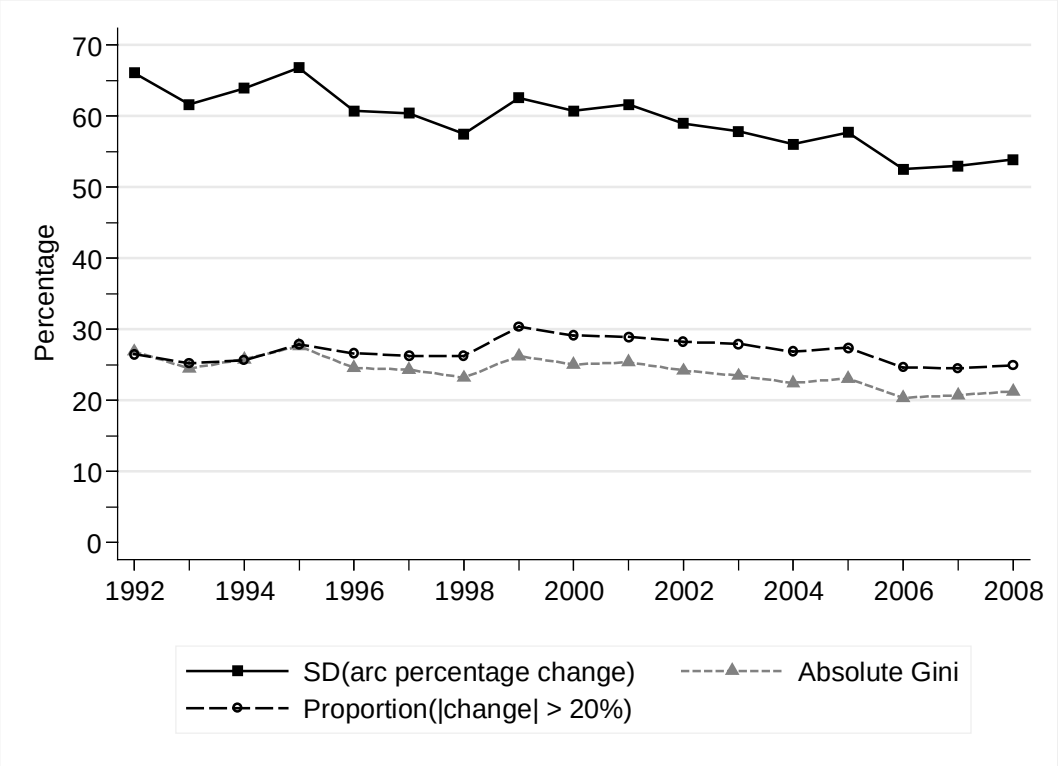
Notes: authors' estimates from BHPS data (as for Figure 1). Year labels refer to year *t* for earnings changes between *t*–1 and *t*. The indices of volatility are *I*, *S*, *A*, and *P*, as described in the main text. Each index is expressed as a percentage (multiplied by 100).

Figure 4. Earnings and labour market volatility for British women, by summary index

(a) Earnings volatility



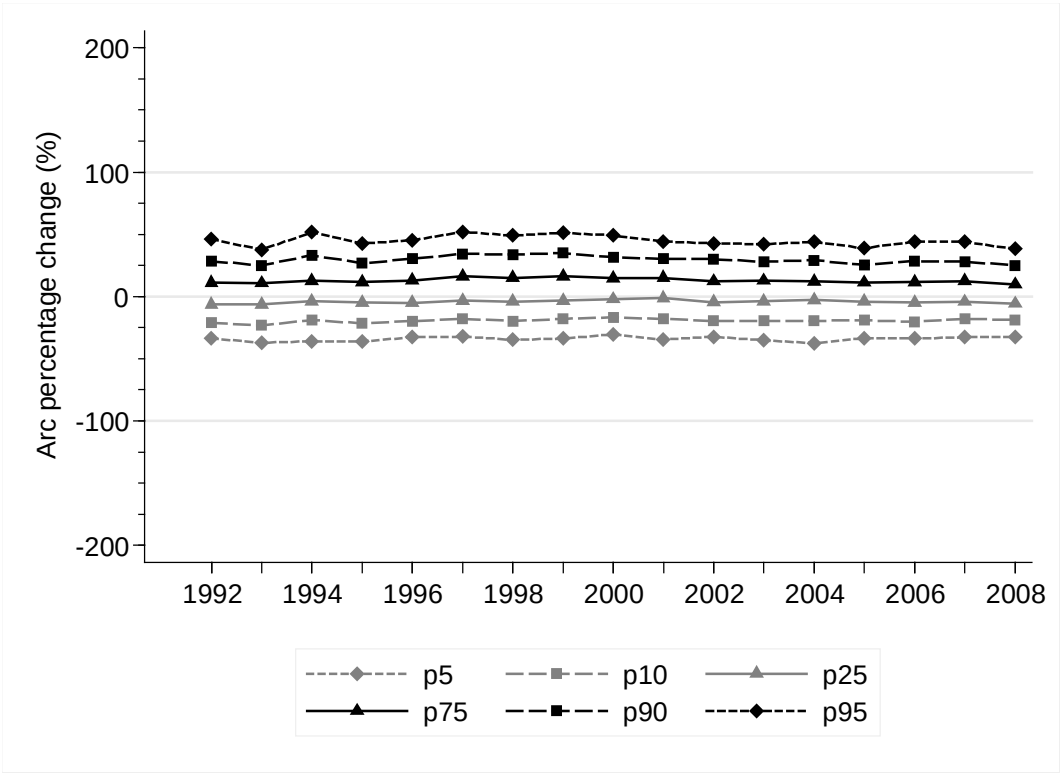
(b) Labour market volatility



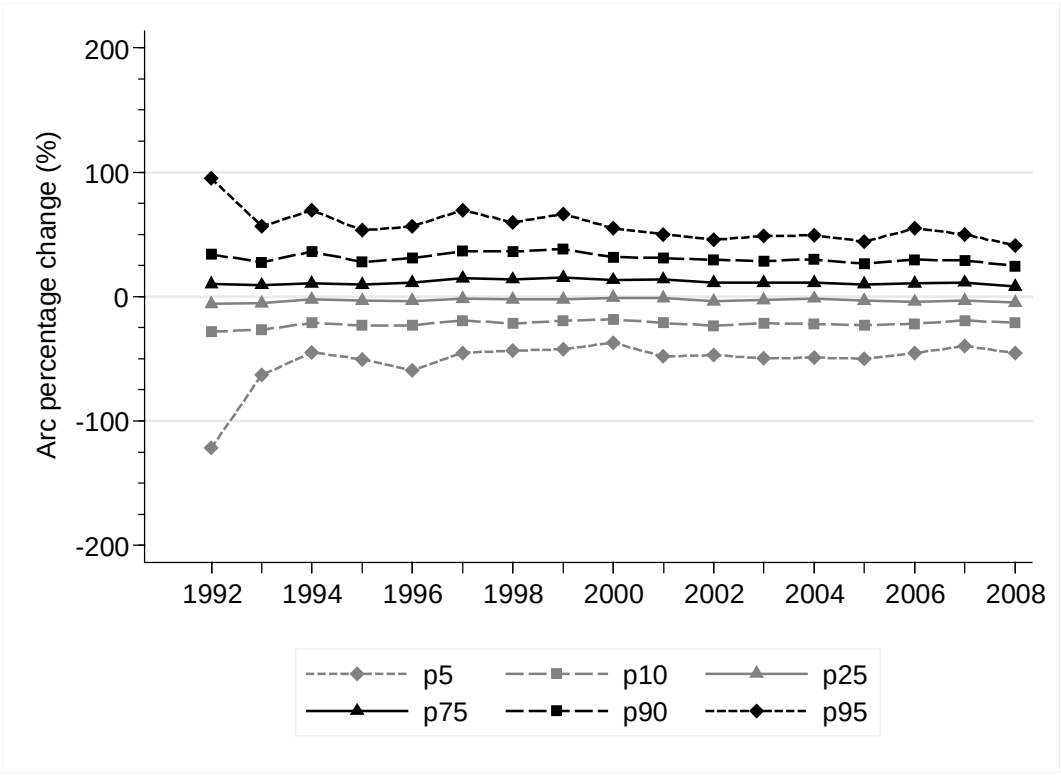
Notes: As for Figure 3.

Figure 5. Quantiles of the distributions of earnings changes for British men, including and excluding men with zero earnings

(a) Men with positive earnings at both year *t*–1 and year *t*



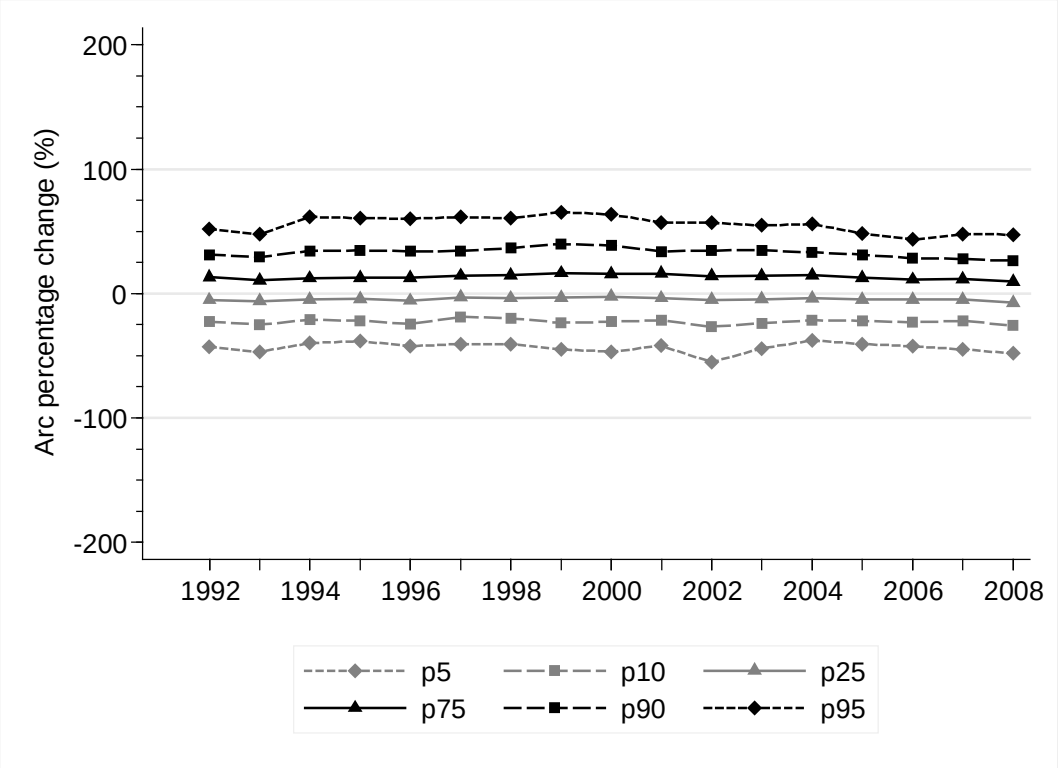
(a) All men – including those with zero earnings at either year *t*–1 or year *t*



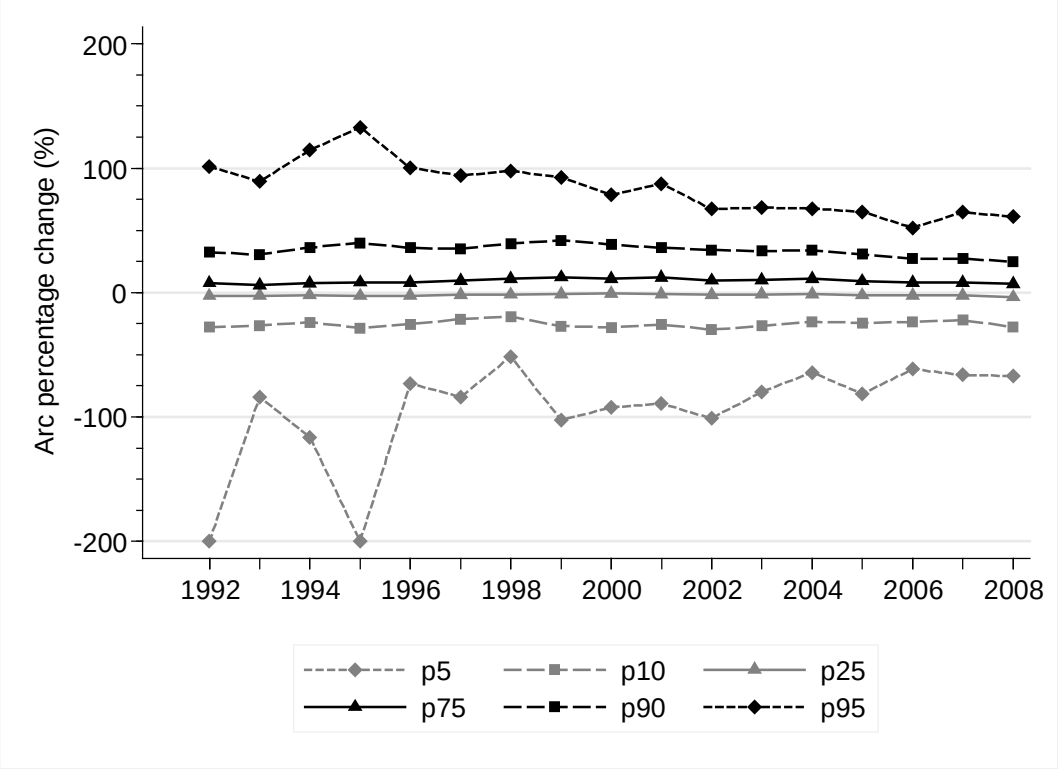
Notes: Authors' estimates from BHPS data. Year labels refer to year *t* for earnings changes between *t*–1 and *t*.

Figure 6. Quantiles of the distributions of earnings changes for British women, including and excluding women with zero earnings

(a) Women with positive earnings at both year *t*–1 and year *t*

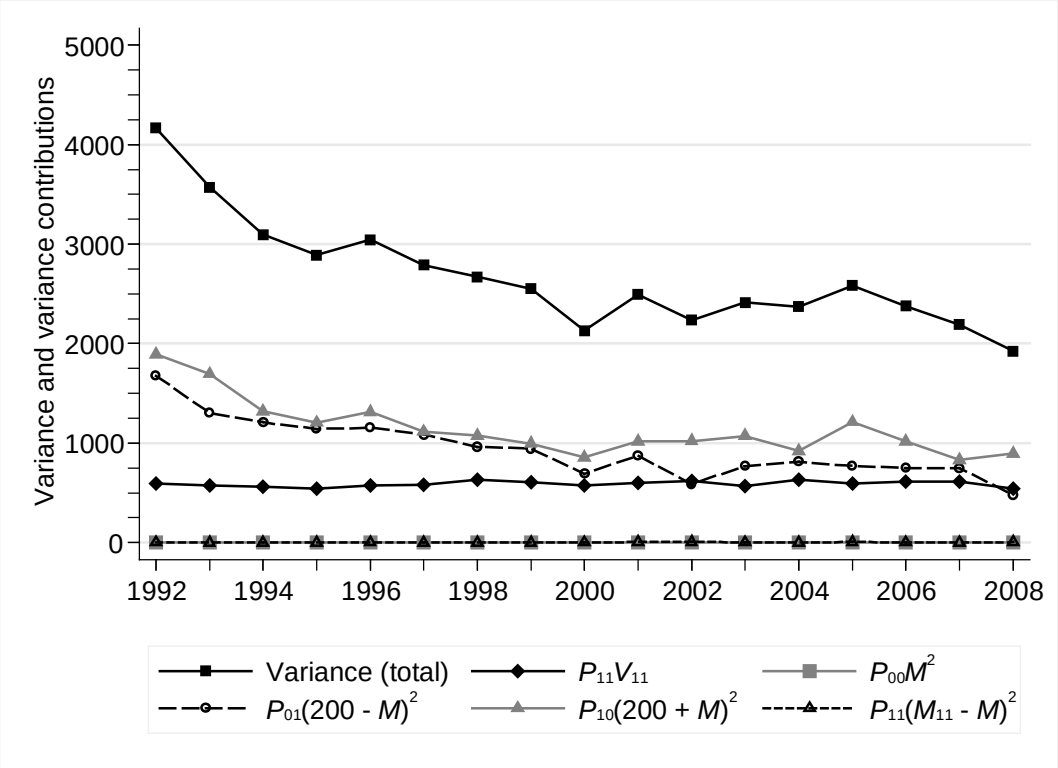


(a) All women – including those with zero earnings at either year *t*–1 or year *t*



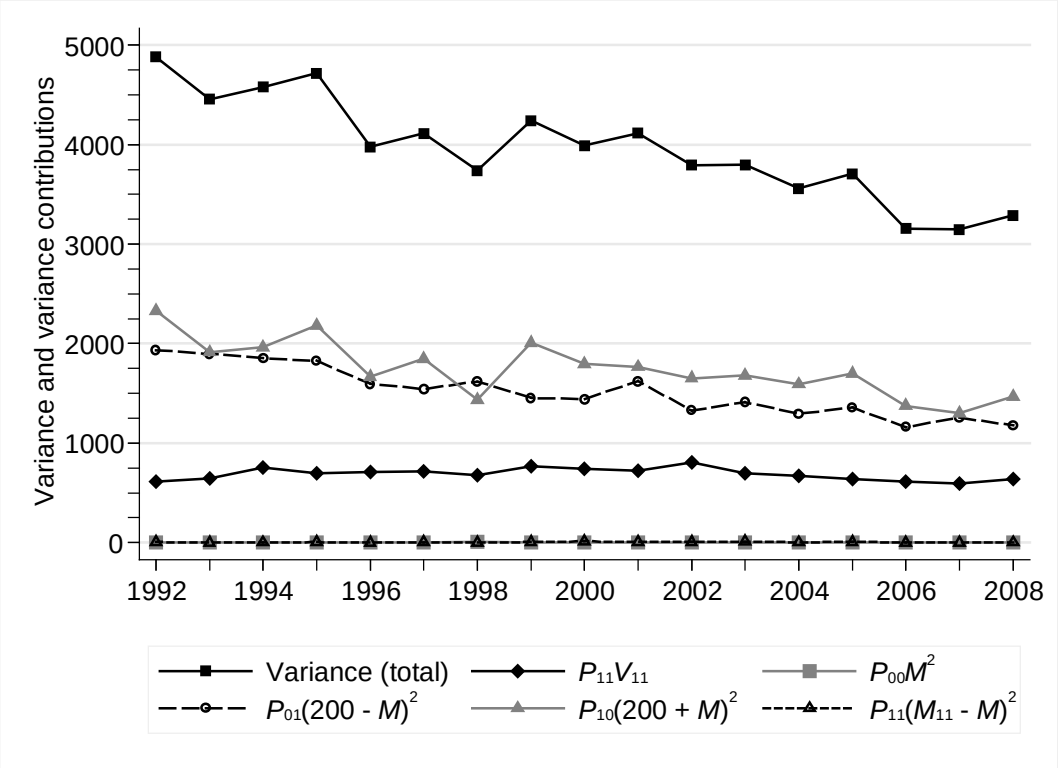
Notes: Authors' estimates from BHPS data. Year labels refer to year *t* for earnings changes between *t*–1 and *t*.

Figure 7. Decomposition of labour market volatility by labour market attachment, British men



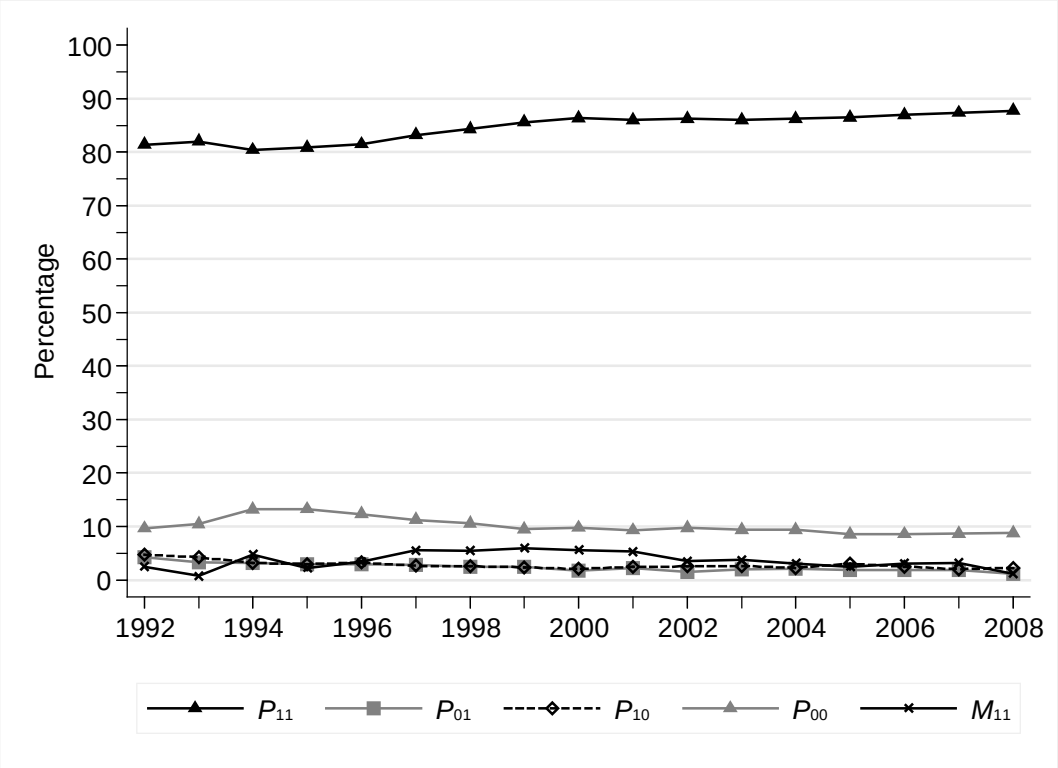
Notes: Authors' estimates from BHPS data. The measure of volatility is $V = I^2$ (see main text). The decomposition formula is shown in equation (3). The values of the variance and variance contributions, and the latter expressed as a share of the total variance, are tabulated by year and sex in Appendix Table A1.

Figure 8. Decomposition of labour market volatility by labour market attachment, British women



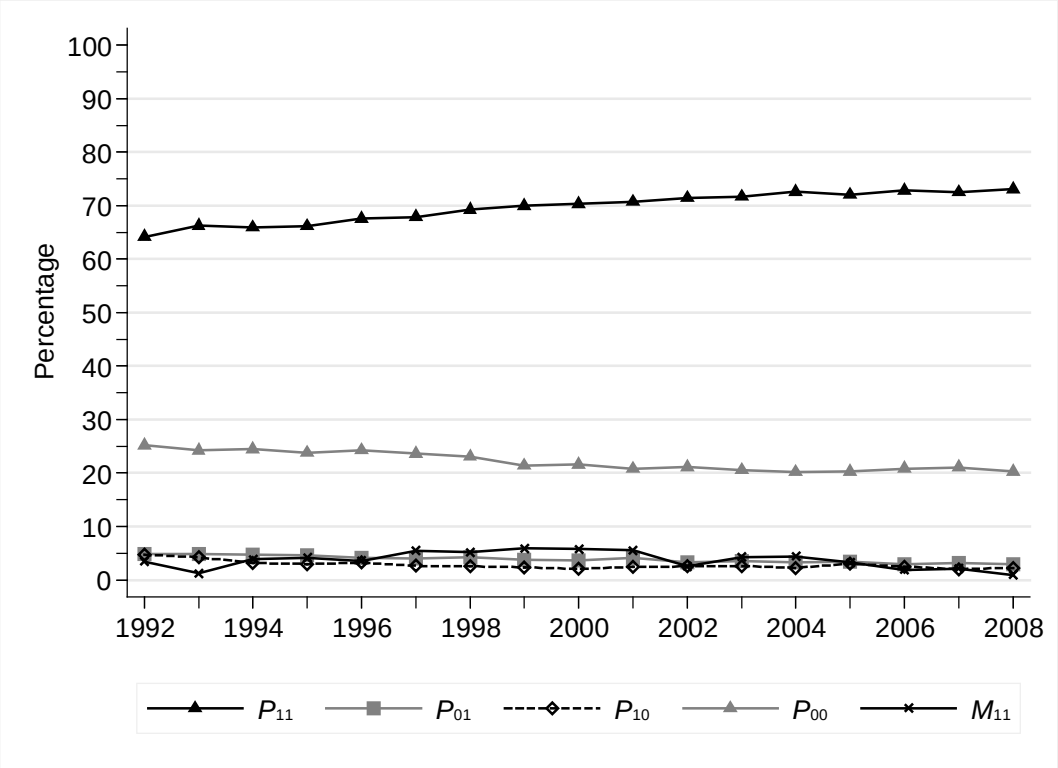
Notes: as for Figure 7.

Figure 9. Labour market attachment rates (%), and conditional mean earnings changes (M_{11}): British men



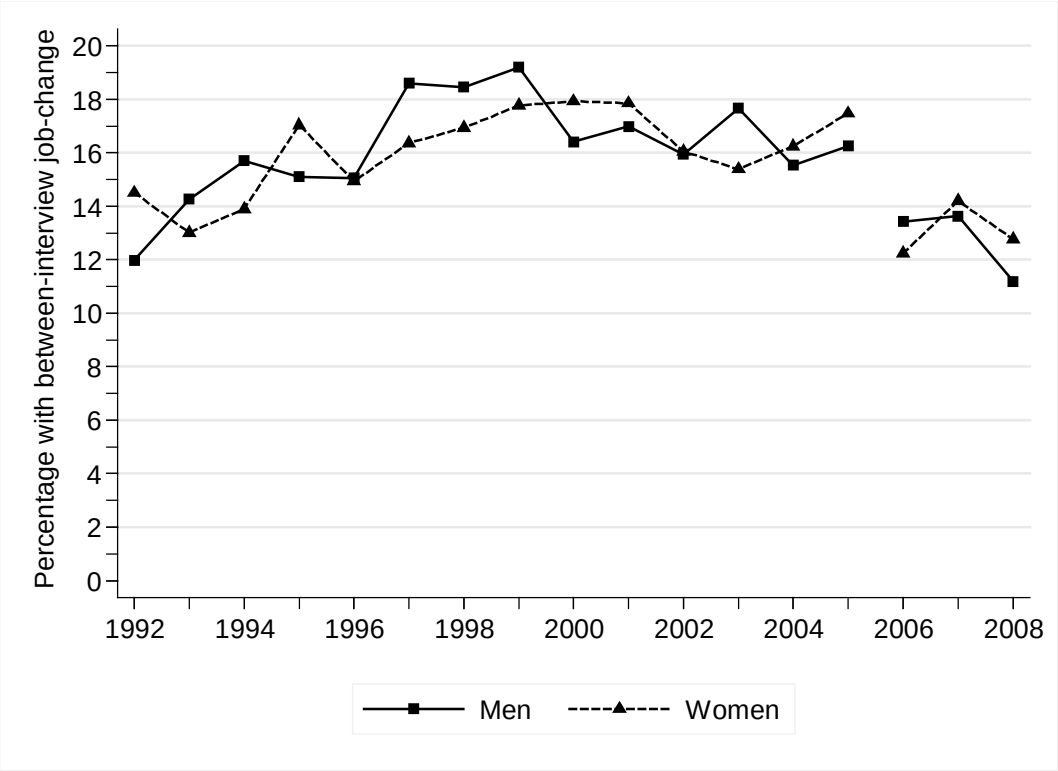
Notes: authors' estimates from BHPS data.

Figure 10. Labour market attachment rates (%), and conditional mean earnings changes (M_{11}): British women



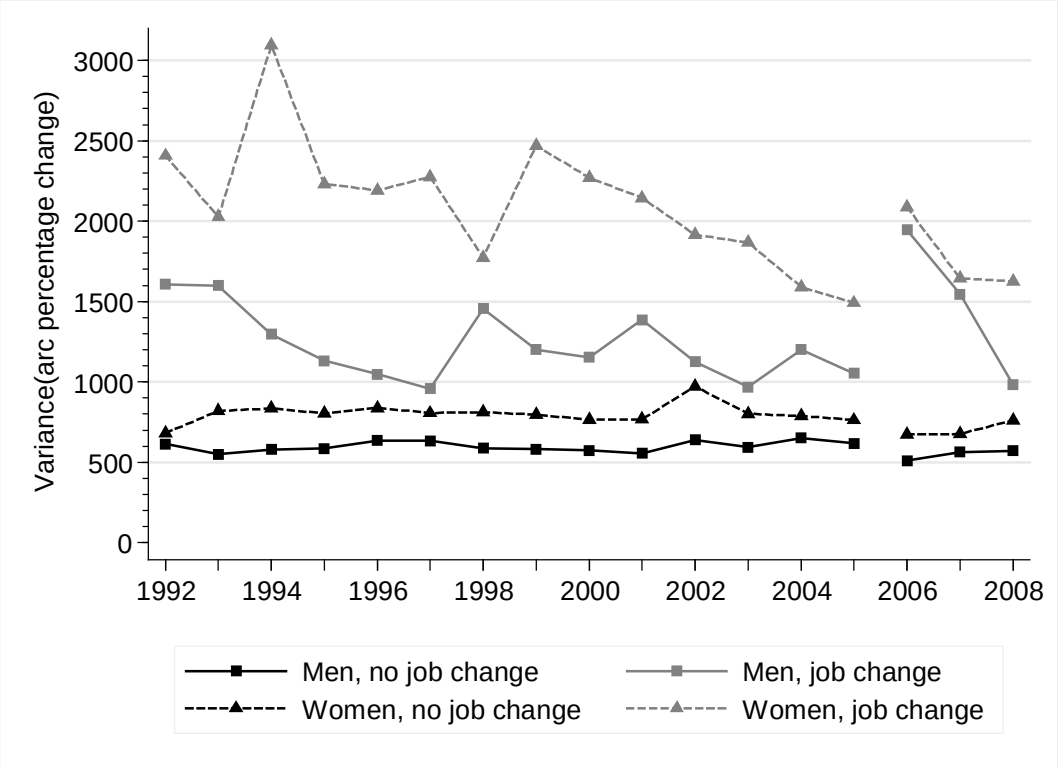
Notes: authors' estimates from BHPS data.

Figure 11. Prevalence of between-interview job change (%), British men and women



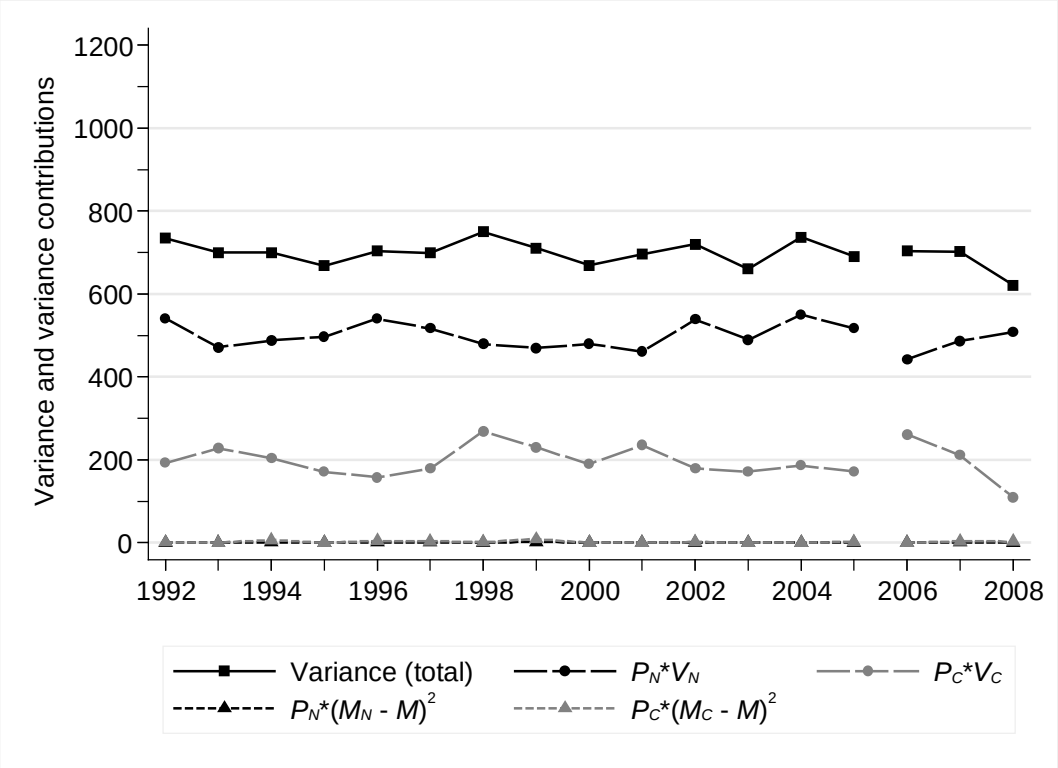
Notes: authors' estimates from BHPS data for individuals with two consecutive positive earnings observations (group '11'). Between-interview job change is defined in the main text. The prevalence of between-interview job change is P_C in eq. (4). The discontinuity in the series between 2005 and 2006 reflects the introduction of dependent interviewing in 2006: see main text.

Figure 12. Variance of earnings changes by whether changed job between annual interviews, British men and women



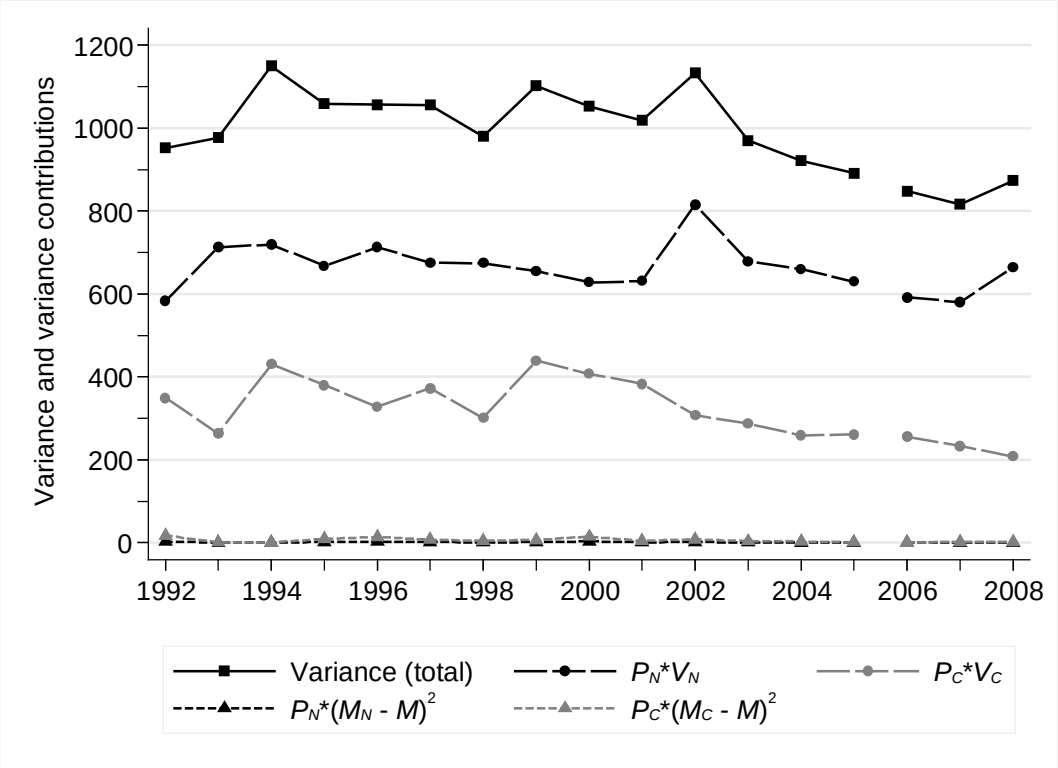
Notes: The chart shows V_C and V_N for men and women (see equation 4). See also the notes to Figure 11.

Figure 13. Decomposition of earnings volatility by whether changed job between annual interviews, British men



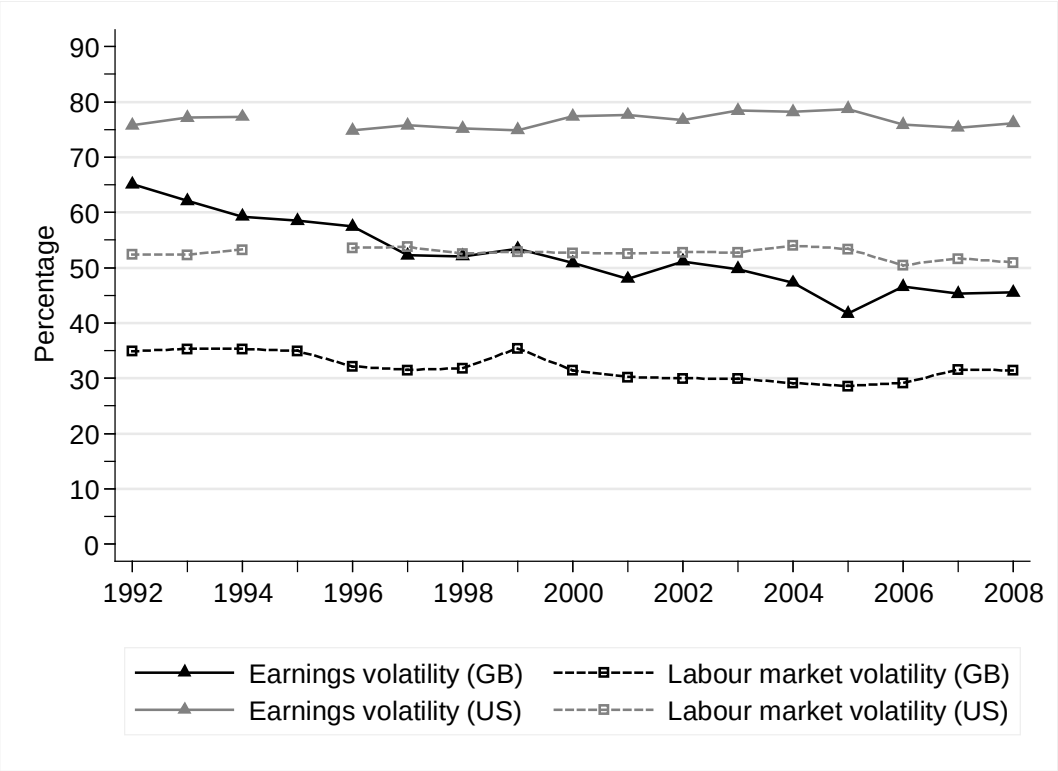
Notes: The decomposition formula is shown in equation (4). See also the notes to Figure 11.

Figure 14. Decomposition of earnings volatility by whether changed job between annual interviews, British women



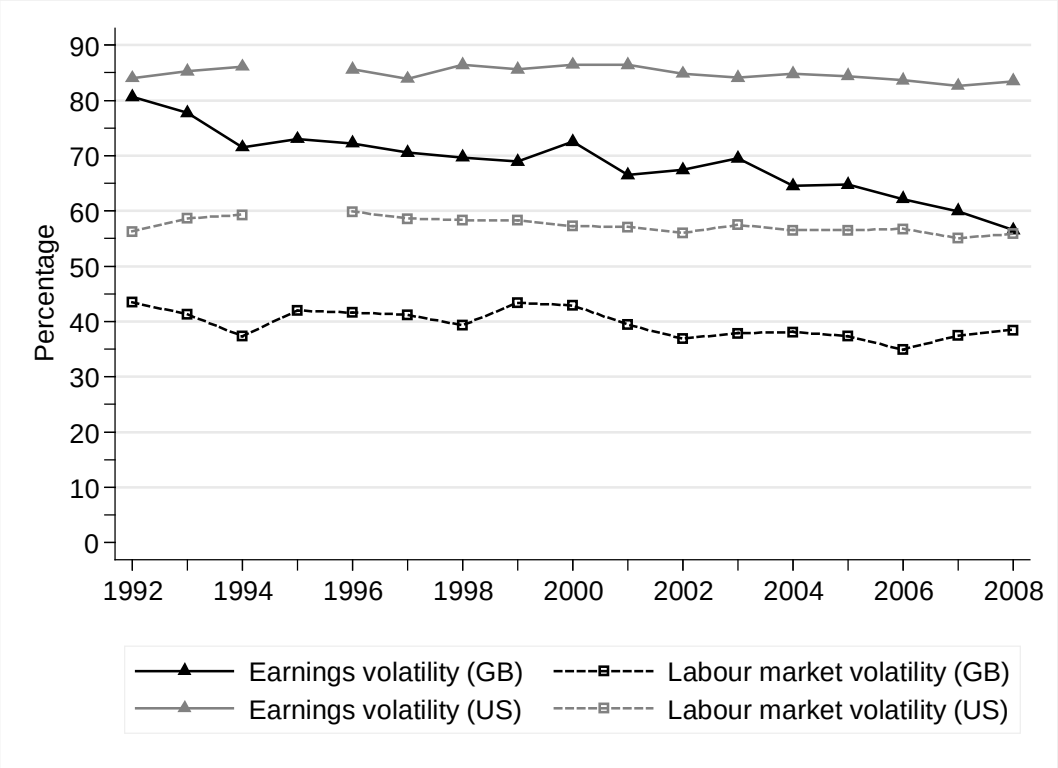
Notes: as for Figure 13.

Figure 15. Earnings and labour market volatility for men, Britain and the USA



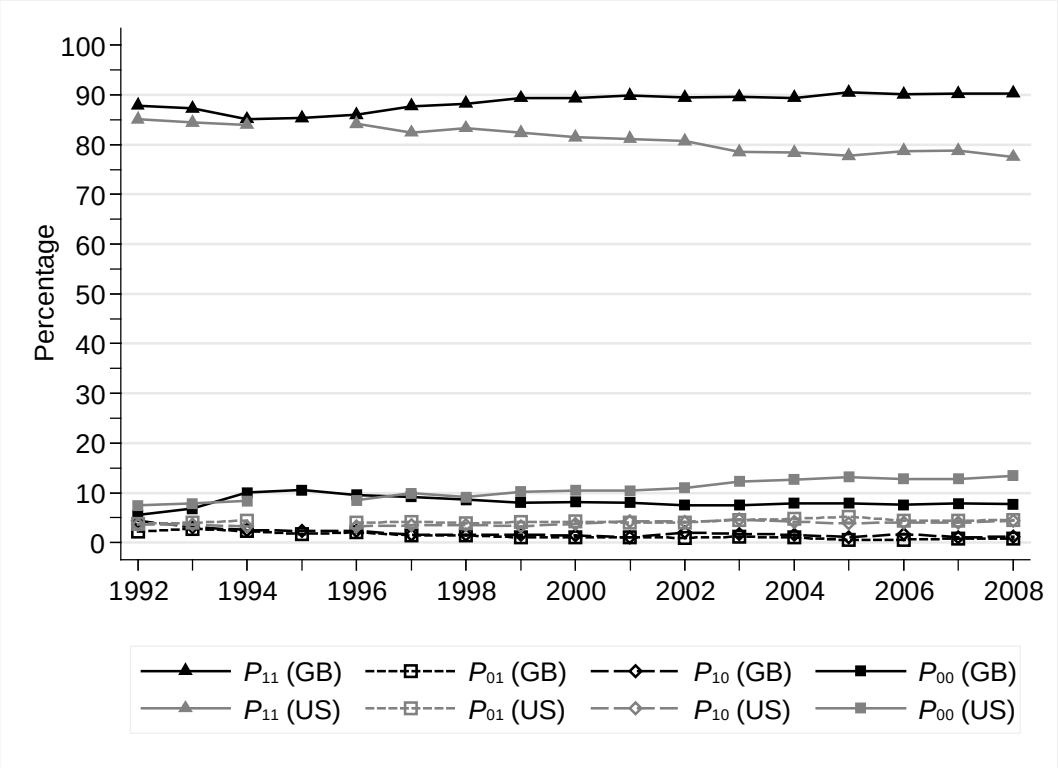
Notes: The measure of volatility is *I* (see main text). The earnings volatility estimates for Britain ('GB') are based on the BHPS measure of 'annual labour income'. (Comparisons of estimates based on current and annual earnings measures are shown in Appendix Figure A3–A6). The earnings volatility estimates for the USA ('US') are derived from matched CPS data, and are shown as the 'baseline series' in Ziliak, Hardy, and Bollinger (2011, Figures 1 and 3). The discontinuity in the US series at 1995 reflects a major redesign of the CPS.

Figure 16. Earnings and labour market volatility for women, Britain and the USA



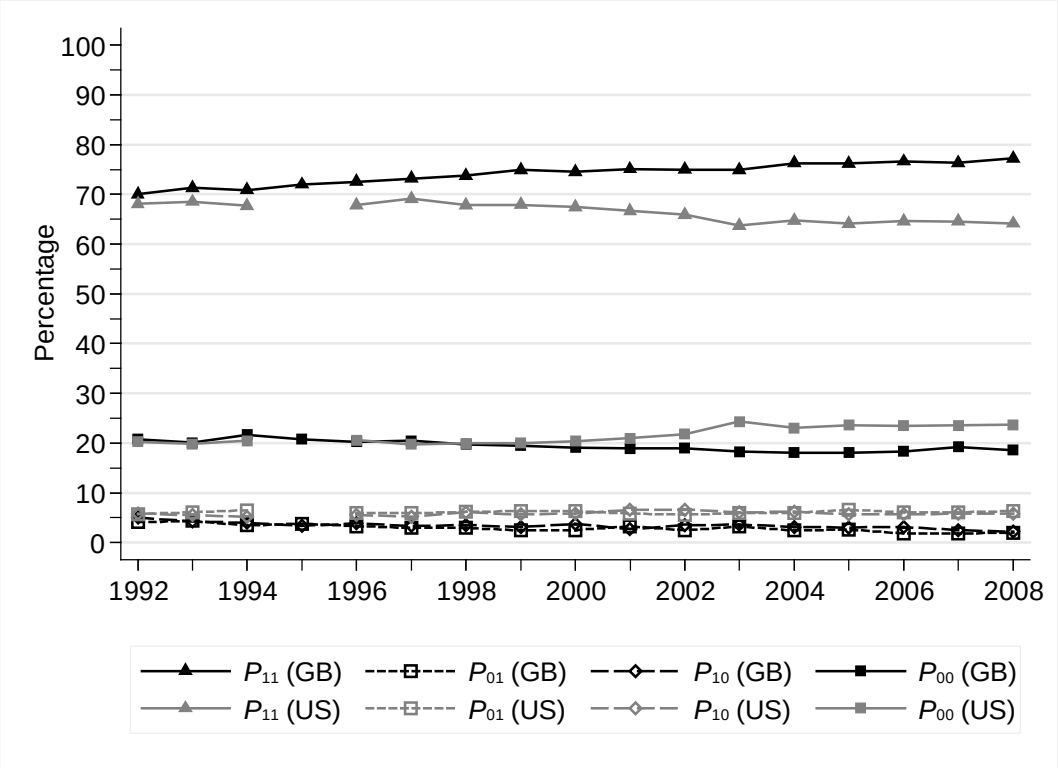
Notes: As for Figure 15.

Figure 17. Labour market attachment rates (%) for men, Britain and the USA



Notes: Attachment rates P_{11}, P_{01}, P_{10}, and P_{00}, are defined in the main text. The estimates for Britain ('GB') are based on the BHPS measure of 'annual labour income'. (Comparisons of estimates based on current and annual earnings measures are shown in Appendix Figure A3–A6). The estimates for the USA ('US') are derived from matched CPS data, and are shown as the 'baseline series' in Ziliak, Hardy, and Bollinger (2011, Figure 4). The discontinuity in the US series at 1995 reflects a major redesign of the CPS.

Figure 18. Labour market attachment rates (%) for women, Britain and the USA



Notes: As for Figure 17.

Table 1. Labour market volatility (*V*), 1992 and 2008, by sex: observed versus counterfactual estimates

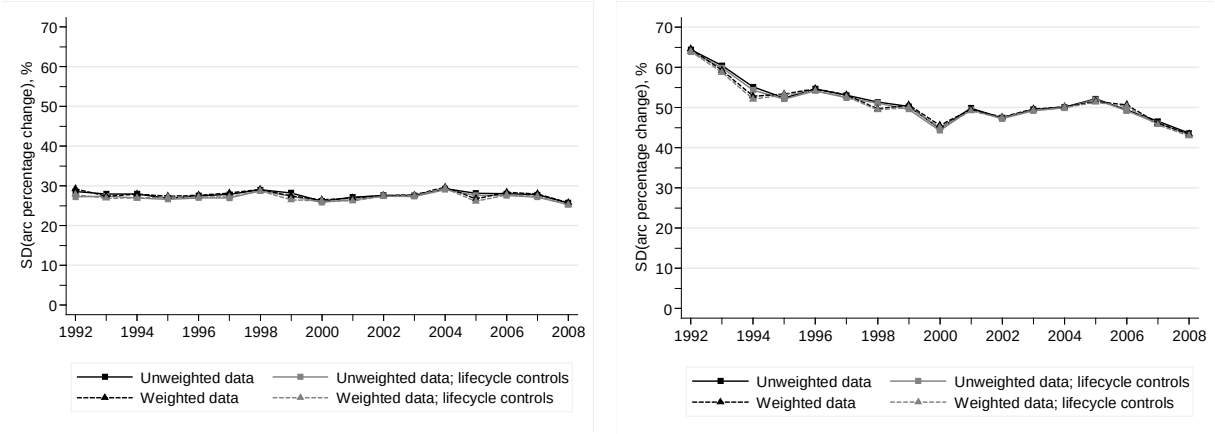
	Observed		Counterfactual	
			A	B
	1992	2008	2008	2008
Men	4169	1925	4073	1926
Women	4881	3288	4824	3288

Notes: authors' estimates using BHPS data. Calculations based on the decomposition formula *V* shown in eq. (3). Counterfactual A assumes that group population shares (P_{11}, P_{00}, P_{10}, P_{10}) are fixed at their 1992 values in 2008 and M_{11} and V_{11} are as observed in 2008. Counterfactual B assumes that M_{11} and V_{11} are fixed at their 1992 values in 2008 and the group population shares are as observed in 2008.

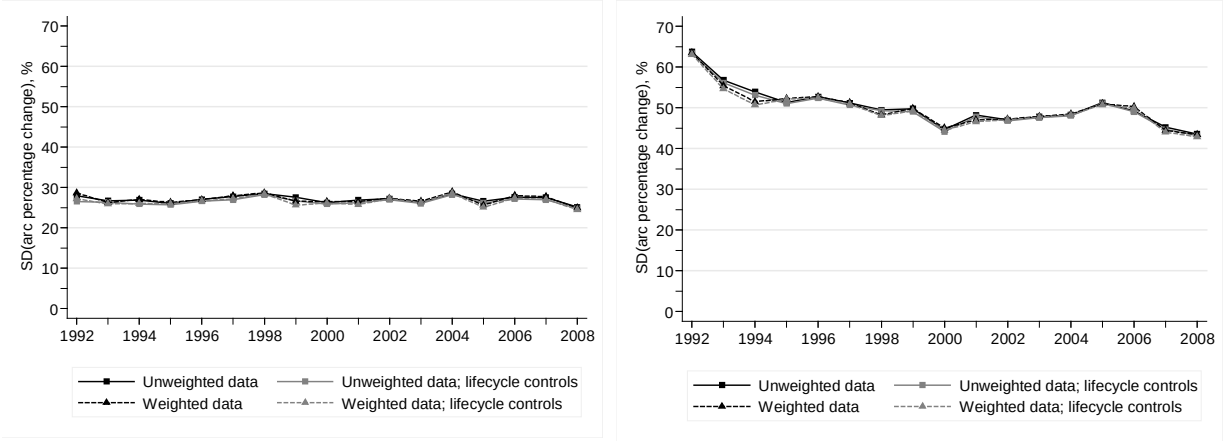
Appendix Figure A1. Volatility trends for British men and their sensitivity to the use of sample weights, lifecycle controls, and imputed observations

Earnings volatility *Labour market volatility*

(i) Including observations with imputed earnings



(ii) Excluding observations with imputed earnings

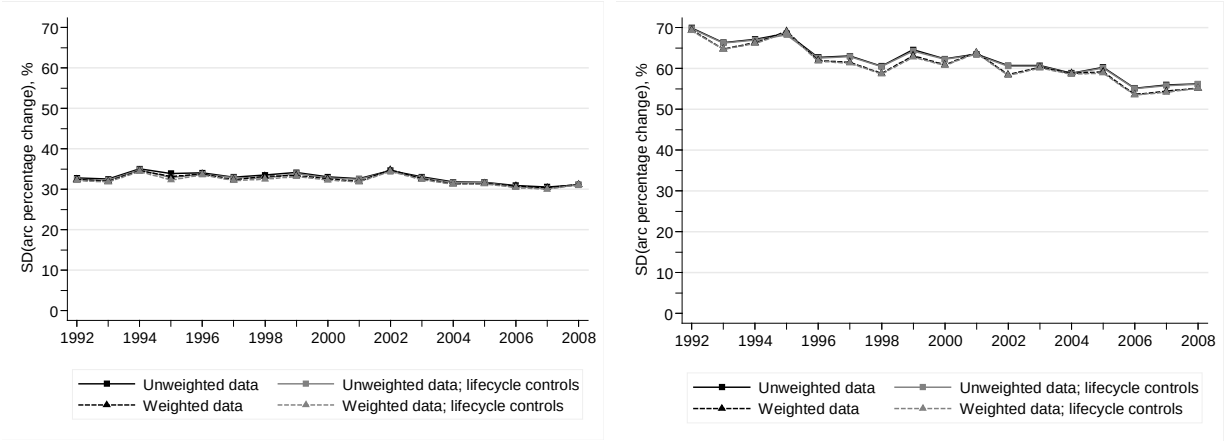


Notes: authors' estimates from BHPS data. Year labels refer to year *t* for earnings changes between *t*–1 and *t*. The index of volatility is *I* (described in the main text).

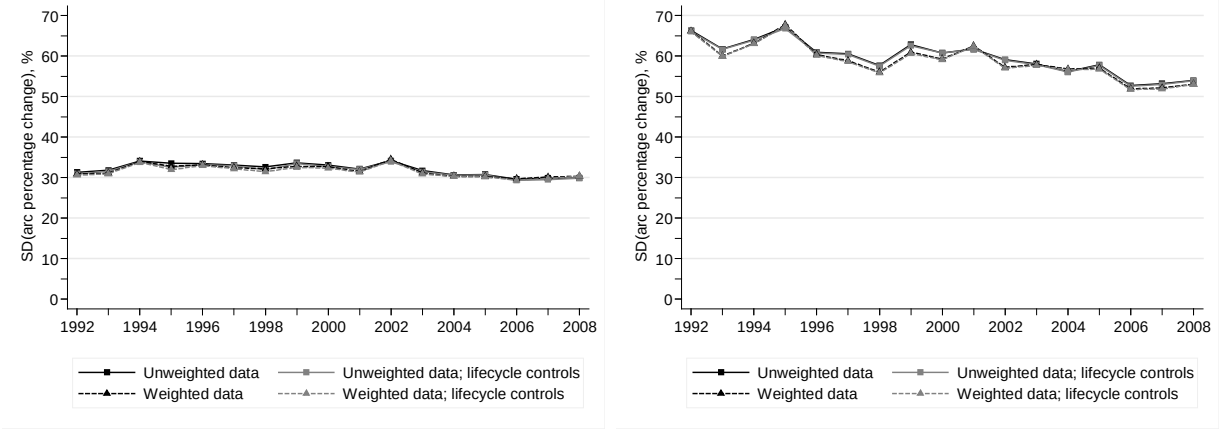
Appendix Figure A2. Volatility trends for British women: sensitivity to the use of sample weights, lifecycle controls, and imputed observations

Earnings volatility *Labour market volatility*

(i) Including observations with imputed earnings

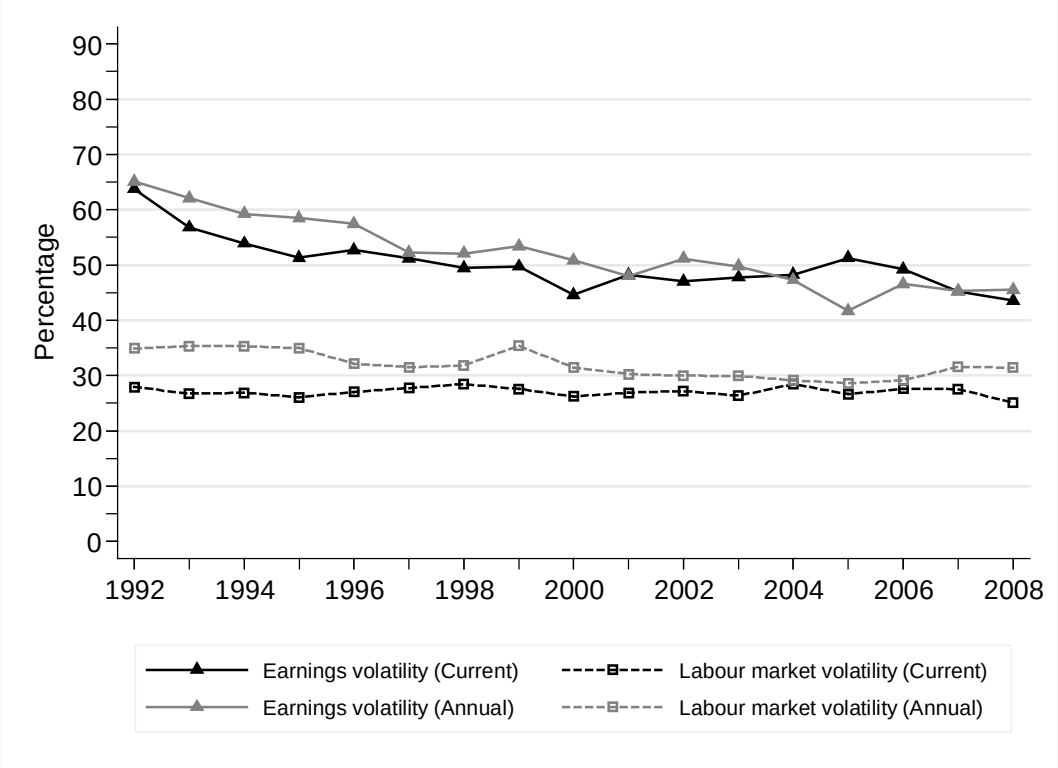


(ii) Excluding observations with imputed earnings



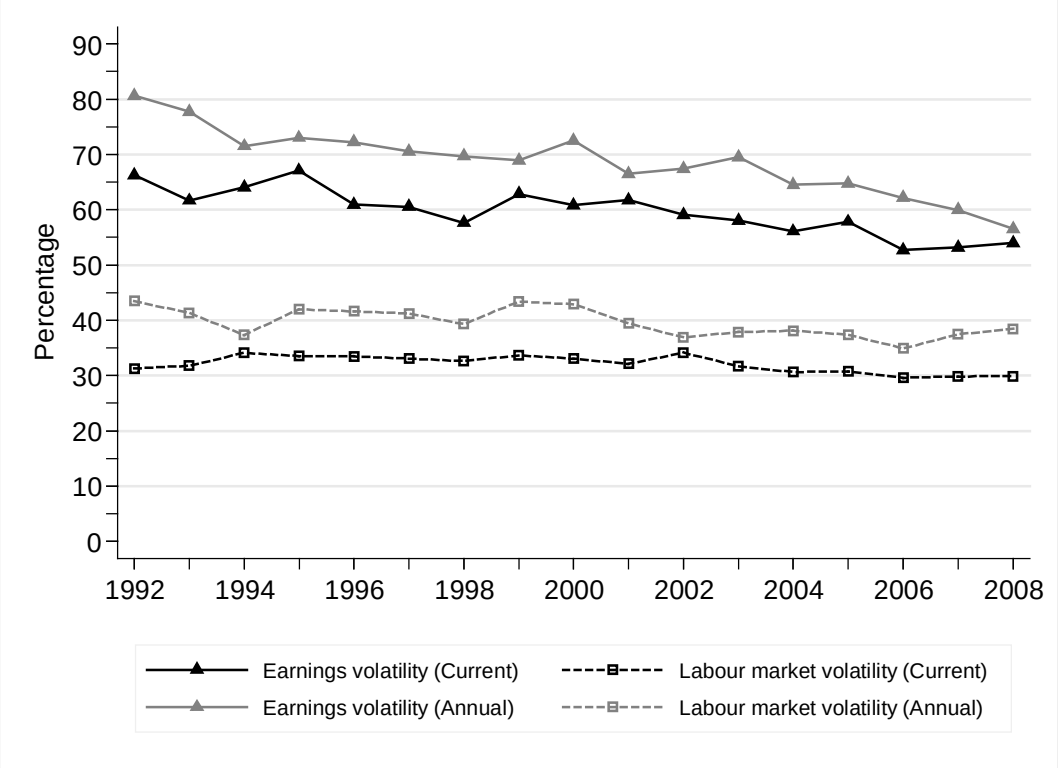
Notes: As for Appendix Figure A1.

Appendix Figure A3. Volatility trends for British men: comparison of estimates based on current and annual earnings measures



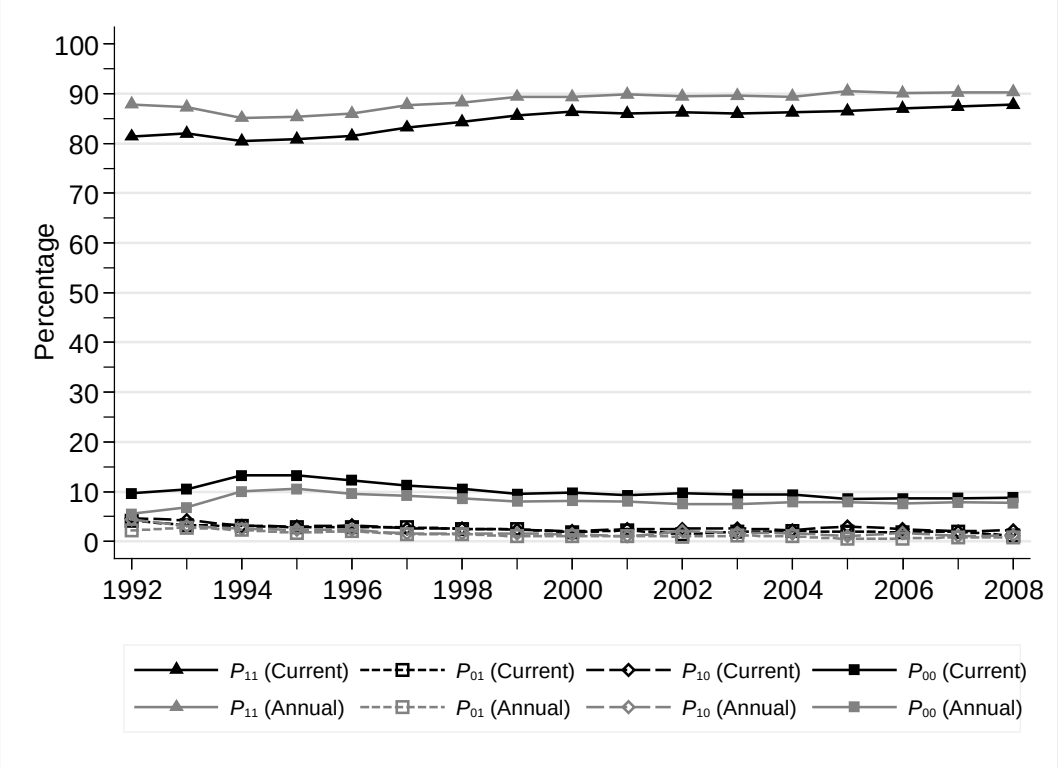
Notes: The current earnings estimates are those shown in Figure 1. The annual earnings estimates are derived using BHPS variable fyrl (annual labour income), and calculated for the same samples as for the current earnings measures.

Appendix Figure A4. Volatility trends for British women: comparison of estimates based on current and annual earnings measures



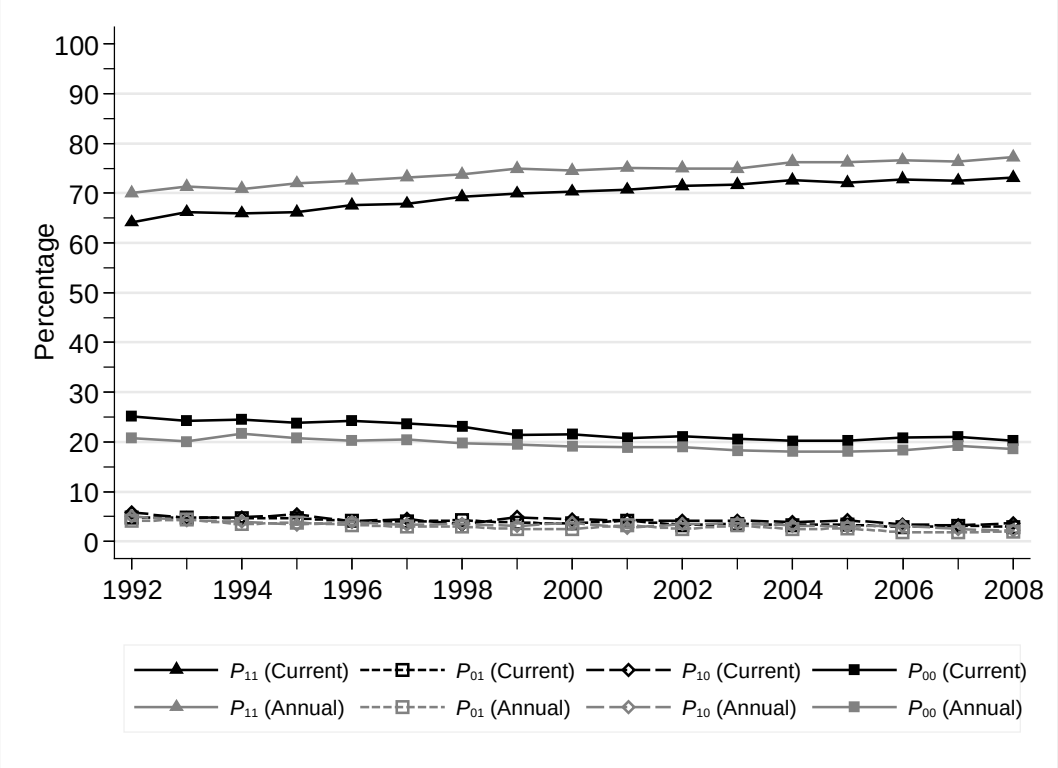
Notes: The current earnings estimates are those shown in Figure 2. The annual earnings estimates are derived using BHPS variable fyrl (annual labour income), and calculated for the same samples as for the current earnings measures.

Appendix Figure A5. Labour market attachment rates (%) for British men: comparison of estimates based on current and annual earnings measures



Notes: The current earnings estimates are those shown in Figure 9. The annual earnings estimates are derived using BHPS variable fyrl (annual labour income), and calculated for the same samples as for the current earnings measures.

Appendix Figure A6. Labour market attachment rates (%) for British women: comparison of estimates based on current and annual earnings measures



Notes: The current earnings estimates are those shown in Figure 10. The annual earnings estimates are derived using BHPS variable fyrl (annual labour income), and calculated for the same samples as for the current earnings measures.

Appendix Table A1. Decomposition of labour market volatility, British men and women: variance contributions

Year	V	$P_{11}V_{11}$	(Share, %)	$P_{00}M^2$	(Share, %)	$P_{01}(200 - M)^2$	(Share, %)	$P_{10}(200 + M)^2$	(Share, %)	$P_{11}(M_{11} - M)^2$	(Share, %)
						Men					
1992	4169	596.8	(14.3)	0.0	(0.0)	1677.5	(40.2)	1890.7	(45.4)	3.8	(0.1)
1993	3573	572.9	(16.0)	0.0	(0.0)	1304.2	(36.5)	1695.4	(47.4)	0.8	(0.0)
1994	3095	561.8	(18.2)	1.8	(0.1)	1208.9	(39.1)	1321.5	(42.7)	0.9	(0.0)
1995	2890	539.5	(18.7)	0.2	(0.0)	1143.0	(39.6)	1206.1	(41.7)	1.0	(0.0)
1996	3044	572.8	(18.8)	0.2	(0.0)	1155.1	(37.9)	1312.3	(43.1)	3.9	(0.1)
1997	2789	581.5	(20.9)	3.3	(0.1)	1087.5	(39.0)	1116.5	(40.0)	0.0	(0.0)
1998	2671	631.8	(23.7)	2.3	(0.1)	961.5	(36.0)	1074.9	(40.2)	0.5	(0.0)
1999	2552	608.0	(23.8)	2.8	(0.1)	944.8	(37.0)	995.9	(39.0)	0.3	(0.0)
2000	2129	577.2	(27.1)	1.4	(0.1)	691.1	(32.5)	856.8	(40.2)	3.0	(0.1)
2001	2495	597.9	(24.0)	0.7	(0.0)	874.3	(35.0)	1016.6	(40.7)	5.8	(0.2)
2002	2238	619.9	(27.7)	0.0	(0.0)	588.7	(26.3)	1021.4	(45.6)	8.0	(0.4)
2003	2414	567.8	(23.5)	0.3	(0.0)	769.7	(31.9)	1073.0	(44.5)	2.8	(0.1)
2004	2372	634.8	(26.8)	0.2	(0.0)	814.5	(34.3)	920.9	(38.8)	2.0	(0.1)
2005	2586	596.3	(23.1)	0.0	(0.0)	770.4	(29.8)	1212.7	(46.9)	6.2	(0.2)
2006	2379	610.8	(25.7)	0.1	(0.0)	749.3	(31.5)	1016.0	(42.7)	3.1	(0.1)
2007	2192	612.4	(27.9)	0.6	(0.0)	747.9	(34.1)	830.4	(37.9)	0.4	(0.0)
2008	1925	544.1	(28.3)	0.2	(0.0)	480.9	(25.0)	894.2	(46.5)	5.6	(0.3)
						Women					
1992	4881	610.4	(12.5)	0.0	(0.0)	1935.0	(39.6)	2328.7	(47.7)	6.7	(0.1)
1993	4459	646.3	(14.5)	0.3	(0.0)	1897.1	(42.5)	1914.9	(42.9)	0.0	(0.0)
1994	4580	757.1	(16.5)	0.5	(0.0)	1853.6	(40.5)	1965.0	(42.9)	4.0	(0.1)
1995	4717	699.7	(14.8)	0.4	(0.0)	1827.8	(38.8)	2183.5	(46.3)	5.4	(0.1)
1996	3978	712.7	(17.9)	1.8	(0.0)	1594.7	(40.1)	1668.1	(41.9)	0.6	(0.0)
1997	4113	715.9	(17.4)	2.1	(0.1)	1544.1	(37.5)	1846.1	(44.9)	4.3	(0.1)
1998	3741	677.8	(18.1)	6.2	(0.2)	1619.6	(43.3)	1437.3	(38.4)	0.0	(0.0)
1999	4241	770.1	(18.2)	1.7	(0.0)	1454.2	(34.3)	2008.0	(47.4)	6.7	(0.2)
2000	3992	739.6	(18.5)	0.5	(0.0)	1442.8	(36.1)	1796.2	(45.0)	12.8	(0.3)
2001	4116	720.0	(17.5)	1.3	(0.0)	1622.4	(39.4)	1766.1	(42.9)	6.5	(0.2)
2002	3794	808.7	(21.3)	0.0	(0.0)	1327.7	(35.0)	1652.6	(43.6)	5.1	(0.1)
2003	3798	694.8	(18.3)	0.0	(0.0)	1413.0	(37.2)	1678.6	(44.2)	11.4	(0.3)
2004	3560	668.2	(18.8)	1.1	(0.0)	1294.2	(36.4)	1593.0	(44.8)	3.1	(0.1)
2005	3708	641.7	(17.3)	0.0	(0.0)	1358.3	(36.6)	1700.5	(45.9)	7.9	(0.2)
2006	3155	616.4	(19.5)	0.0	(0.0)	1161.8	(36.8)	1375.3	(43.6)	1.7	(0.1)
2007	3148	591.4	(18.8)	0.1	(0.0)	1255.1	(39.9)	1299.9	(41.3)	1.9	(0.1)
2008	3288	637.8	(19.4)	0.2	(0.0)	1179.1	(35.9)	1468.4	(44.7)	2.4	(0.1)

Notes: authors' estimates from BHPS data. The measure of volatility is $V = I^2$ (see main text). The decomposition formula is shown in equation (3). The variance contributions are as plotted in Figures 7 and 8. The 'share' estimates are the variance contributions expressed as a percentage of the total variance for the relevant year and sex.