Employment Adjustment and Part-time Jobs: The US and the UK in the Great Recession

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Abstract

We document a new fact about the cyclical behavior of aggregate hours. Using microdata for the US and the UK, we show that changes in hours per worker are driven by fluctuations in part-time employment, which are in turn explained by the cyclical behavior of transitions between full-time and part-time jobs. This reallocation occurs almost exclusively within firms and entails large changes in employees' schedules of working hours. These patterns are consistent with the view that employers adjust the hours of their employees in response to shocks, and they partly account for the poor recovery that followed the Great Recession.

Keywords: Employment; Hours; Part-time Work; Great Recession.
JEL codes: E24; E32; J21.

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1 Introduction

The decomposition of the variation in total hours into the variation of employment and hours per worker is a central pillar of modern business cycle analysis. A common finding is that fluctuations in employment (the extensive margin) dominate fluctuations in hours per worker (the intensive margin) (see Rogerson and Shimer [2011] and van Rens [2012]). This fact is usually invoked to justify abstracting from the intensive margin in macro-labor models.[1] While useful to gain tractability, this simplification is not immaterial since fluctuations at the intensive margin explain a nontrivial share of the variation in total labor input.[2] Perhaps more crucially, recent work by Chang et al. [2014] shows that abstracting from the intensive margin may imply misrepresenting the behavior of the extensive margin, even if hours per worker exhibit low cyclical variation. In this paper, we show that the cyclical behavior of the intensive margin admits a simple empirical representation. We build on this insight to develop a measurement framework that is able to describe both margins of labor adjustment in tandem. The empirical success of our framework offers a solution to characterize jointly the role of the two margins of labor adjustment.

We ground our analysis on microdata covering twenty years of labor market activity in the United States (US) and the United Kingdom (UK). Our focus is on the Great Recession and the ensuing (sluggish) recovery. In this recessionary episode (the largest in the postwar era) the variation in hours per worker accounts for about 30% of labor adjustment in the UK and the US, a nonnegligible fraction of the variation in total labor input.

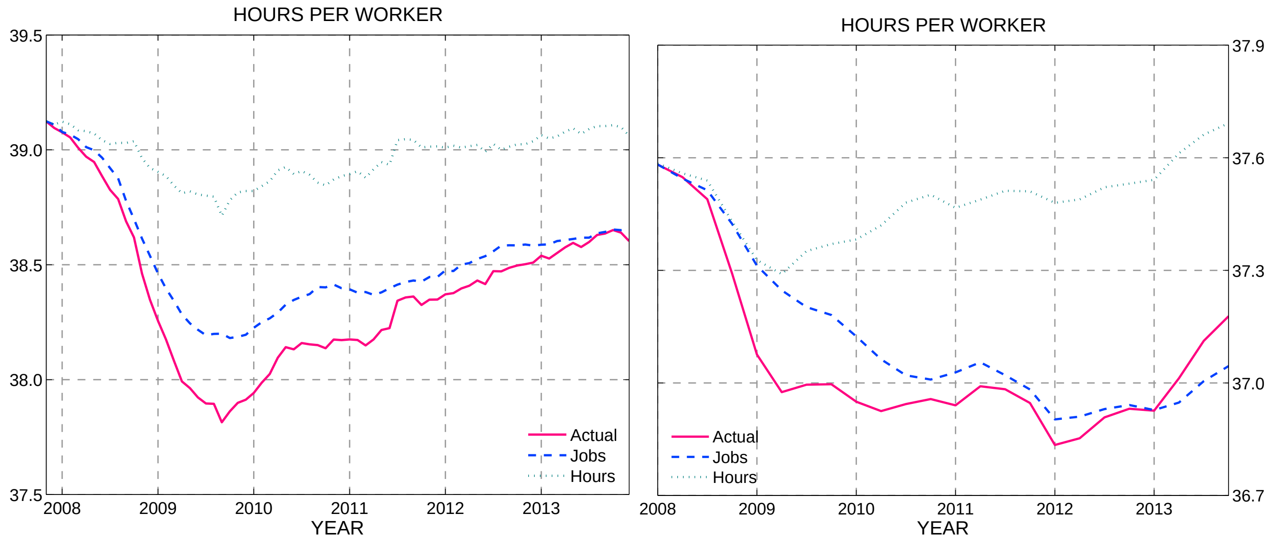
We start by documenting a new fact. The recessionary fall in hours per worker is readily described by breaking down employment into part-time and full-time work. That is, the fall in hours per worker is almost exclusively driven by the evolution of the part-time employment share, which is very strongly countercyclical. Conversely, hours per worker in part-time and full-time jobs fluctuate relatively little and hence they explain but a small part of the fall in aggregate hours per worker. Figure 1 illustrates this point both for the US and UK. The solid lines depict the observed series of hours per worker. The dashed (resp. dotted) lines denote counterfactual hours per worker driven by changes in the part-time employment share (resp. changes in hours per worker in both types of jobs). As can be seen in both plots, the dashed lines behave very similarly to the solid lines, both at the start of the recession and even more so in the recovery period. By contrast, after an initial drop the dotted lines quickly resume their pre-crisis levels.

Motivated by this observation, we analyze the dynamics of the part-time employment share using a Markov chain model. We draw on an extensive literature that uses this modeling framework to describe the dynamics of unemployment as the result of the cyclical behavior of transition probabilities across labor market states (see e.g. Abowd and Zellner [1985], Poterba and Summers [1986], Shimer [2012], Fujita and Ramey [2009] and Elsby et al. [2009]). We specify a rich model in which, in addition to unemployment and non-participation, workers can be in part-time or full-time employment in the private sector.[3] This framework has two important features. First, it builds on the well-known fact that modern labor markets are subject to high-frequency dynamics, and hence that worker flows are more informative than stocks to study the aggregate dynamics of the labor market. Second, it incorporates a salient feature of the two labor markets that we analyze, namely the empirical relevance of part-time employment as an autonomous labor market state. Indeed, as we document in this paper, part-time

[1] See the recent chapter of the *Handbook of Labor Economics* by Rogerson and Shimer [2011], and the discussion in Chang et al. [2014]. There are of course prominent examples of papers that model both margins of labor adjustment. We mention them explicitly in Section 7.

[2] In fact, using new data sources covering several OECD countries over a long period of time, Ohanian and Raffo [2012] document that both movements in employment and hours per worker are quantitatively important to explain the variation in total hours. The variation in employment remains the dominant factor in their data: it accounts for more than 50% of total labor adjustment from peak to trough in the average recession since the 1960s, both for the US and the largest European economies.

[3] For completion, we also allow for a fifth labor market state, which lumps together all jobs provided outside private-firm salaried work. This allows us to avoid the confounding factors that arise from the distinct patterns of turnover across different forms of employment (e.g. public sector, self-employment).



(a) United States (b) United Kingdom

Figure 1: Actual and Counterfactual Hours per Worker in the Great Recession
The solid line is the actual time series of weekly hours per worker. The dashed (dotted) line is the counterfactual series measuring the effects of changes in part-time and full-time jobs (in hours worked in part-time and full-time jobs). It is obtained by fixing hours in each job type to their pre-recession levels (the fraction of part-time and full-time jobs) and allowing only the fraction of part-time and full-time jobs (hours in each job type) to change.

jobs represent a nontrivial share of employment in both the UK and the US, and entail a schedule of weekly hours of work which is about half that of full-time jobs. More importantly, the share of employment accounted for by part-time jobs is prominently cyclical.

We use our measurement framework and the wealth of auxiliary information available in the labor force surveys of both countries to uncover the mechanisms underlying the dynamics of part-time employment. We establish the following facts for the US and the UK:

1. The recessionary increase in part-time work accounts for the bulk of changes in hours per worker during the Great Recession. That is, it explains two-thirds of the peak-to-trough change in hours per worker, and virtually all of the persistence (sluggish recovery) in the years that follow the initial shock.

2. Changes to the demographic, occupation and industry composition of employment play a minor role in the evolution of part-time work. After taking them into account, more than five-sixths of the increase in part-time work remains unexplained.

3. Cyclical fluctuations in transition rates between full-time and part-time jobs explain most of the variation in part-time employment. Hence, the analysis of worker flows between these two job categories provides an account of the behavior of aggregate hours per worker over the business cycle.

4. The reallocation between full-time and part-time jobs is almost entirely a within-firm phenomenon. Several features of this reallocation process are consistent with the view that firms use the intensive margin of employment (hours per worker) in response to shocks.

5. The patterns that characterize the Great Recession are still present several years later. They explain why part-time employment remains presently at historical highs, and why hours per worker are still below pre-recession levels. These facts suggest that economic activity in the labor market has not yet fully recovered.

Our analysis also sheds light on some differences in the functioning of the US and UK labor markets:

1. Employment inflows (in both full-time and part-time jobs) are an order of magnitude larger in the US relative to the UK. This fact is consistent with previous findings regarding the greater relative importance of unemployment outflows in the US vs the UK.

2. Employment provided outside private-sector firms is relatively larger in the UK labor market. Transitions in and out of this form of employment are quantitatively more important to account for the variation in part-time work in this country.

3. The degree of churning between full-time and part-time jobs is much larger in the US, while part-time employment is more pervasive in the UK. Nevertheless, transition rates between full-time and part-time jobs play a similar role in explaining variations in part-time employment in the two countries.

Beyond the empirical literature on the measurement and description of worker flows, the facts documented in the paper relate to at least three strands of the macro-labor literature. First, we contribute to the literature documenting business cycle facts by providing a new set of results regarding the behavior of hours per worker. Second, our findings are informative to assess, develop and calibrate search models of the labor market. More generally, the patterns of employment adjustment that emerge from our analysis contrasts in many respects with those featuring in conventional macro-search models of the labor market. Third and last, by comparing the behavior of US and UK labor markets, we add to the literature on cross-country differences in labor market performance. Such comparative analyses have proved fruitful to understand the interaction between institutions and the Great Recession. After laying out our main results, we return to (and discuss more formally) the contribution of our paper to each of these lines of research.

The paper is organized as follows. Section 2 presents our data, definitions and sample dispositions. Section 3 elaborates on the initial empirical fact that motivates our analysis. Section 4 examines a first candidate explanation for the cyclicality of part-time employment, namely the importance of composition effects. Having discarded its relevance, in Section 5 we study the contribution of labor market flows to the evolution of part-time employment. The results of this section are substantiated in Section 6, where we characterize fluctuations in part-time work as a within-firm phenomenon. Section 7 discusses implications of our findings and concludes.

2 Data, Definitions and Measurements

This section describes our datasets, sample dispositions and calculations of the key labor market objects analyzed in the rest of the paper.

2.1 Datasets

We use microdata from labor force surveys conducted in the US and the UK. Before presenting each of our two sources of data, we emphasize a number of common features between them. First, our two datasets span the period 1994-2013 and are available at a relatively high frequency (monthly for the US, quarterly for the UK), thus effectively covering two decades of labor market activity with different phases of the business cycle. Second, both have a longitudinal component that can be used to match respondents in two consecutive surveys. In so doing, we are able to identify workers' transitions across labor market states and construct measurements of gross labor market flows. Third, the individual variables used to circumscribe the sample can be made consistent across surveys. This ensures comparability between the figures we report for the US and the UK.

The US Current Population Survey

For the United States we use data from the monthly Current Population Survey (CPS). The CPS is a well-known labor force survey that has informed the majority of studies on worker flows in the US labor market. Each month, the CPS surveys about 60,000 households and collects demographic and employment information on the civilian noninstitutional population aged 16 and older. Before January 1994, the CPS was only measuring the number of hours an individual had actually been working during the reference week. Following the 1994 re-design of the survey, the CPS started collecting information about the number of hours an individual would usually work at her current job. As explained in Subsection 2.4, only the latter allows accurate measurement of part-time work. For this reason we use data from January 1994 onwards.[4]

In each monthly file of the CPS, about three-quarters of respondents were already in the sample in the previous month. The underlying rotational structure is as follows: CPS respondents are interviewed for four consecutive months, are rotated out of the survey for eight months, and are then included in the survey again for four consecutive months. By matching individuals from the non-rotation groups across surveys,[5] we can observe transitions over a time horizon of one month and measure monthly labor market flows. To be precise, our CPS-based calculations of labor market stocks use the so-called final weights and our calculations of flows use the longitudinal weights of the survey.

The UK Labor Force Survey

Our source of data for the UK is the Labor Force Survey (LFS). The LFS came into existence in 1973, but fundamental changes were introduced in the Spring quarter of 1992, in 1996 and again in 2006.[6] The LFS collects demographic and employment information on around 44,000 responding households per quarter.[7] Due to the extension of the survey to Northern Ireland in 1996, the sample is representative of households living in private addresses in Great Britain until 1995, and of the UK thereafter. The LFS is divided into five waves of equal size and each household remains in the sample for five consecutive quarters. The rotational structure determines that, in every quarter, one wave exits the sample and is replaced by a wave of entering households.

We use two types of data extracts from the LFS made available by the UK Data Service.[8] To calculate labor stocks we use series of quarterly cross sections, starting in the second calendar quarter of 1992 (1992q2) and running until the present day. The series of labor market stocks we analyze in the paper begins in first quarter of 1994 (1994q1). To calculate labor flows we use two-quarter longitudinal data extracts (also made available by the UK Data Service). The latter provide information on a subset of variables for the same group of individuals in two consecutive quarters. The rotational structure of the survey implies that about 80% of the individuals from the corresponding cross-sectional dataset are included in these extracts. Finally, the Office of National Statistics (ONS) produces personal weights designed to account for non-response bias and obtain population estimates, as well as longitudinal weights that further account for sample attrition. These weights are included in the microdata files

[4]In Appendix B we use data from the March CPS to obtain time-series for part-time employment and hours worked in part-time and full-time jobs over a longer period of time. This enables us to verify that our figures based on the monthly files of the survey line up with the contemporaneous March survey. Moreover this allows to check consistency with long-run evolutions.

[5]We match individuals using the household and person identifiers along with the age/sex/race filter described by Madrian and Lefgren [2000]. The matching rates we obtain in the non-rotation groups are typically between 94% and 96%.

[6]Until 1983 the frequency was biennial, and annual from 1984 until 1992. In 1996 the survey was extended to include Northern Ireland. Finally, in 2006 the survey moved from seasonal to calendar quarters. LFS seasonal quarters are: Winter (December to February), Spring (March to May), Summer (June to August) and Autumn (September to November), while calendar quarters are 1 (January to March), 2 (April to June), 3 (July to September) and 4 (October to December).

[7]The number of responding households was slightly higher (by about 5,000 households) before the changes introduced to the sample design in 2010.

[8]See the website http://ukdataservice.ac.uk/.

and we use them in our calculations.

2.2 Measurements

We now introduce some notions and notations regarding our main objects of interest, and outline the adjustments we apply to our main time series.

Labor Market Stocks and Flows

Throughout the paper we report analysis based on labor market rates (or shares) and transition probabilities. The ingredients necessary to compute them are labor stocks and gross labor flows. Each country's dataset is composed of a set of cross-sections ordered by time $t = 1, \ldots, T$. Each cross section contains information (demographic characteristics, labor market status and population weights) on a number of individuals, indexed by $i = 1, \ldots, N_t$. Individuals' personal characteristics and labor market states are captured in the data by a set of indicator variables $\alpha_{i,t}$ and $s_{i,t}$ respectively, where the indicator variable takes value of one if the individual has a certain individual characteristic (or is in a particular labor market state) and is zero otherwise.

At any point in time, the stock of individuals with characteristic α in labor market state s is given by the weighted sum $S_{\alpha,t} = \sum_{i=1}^{N_t} s_{i,t}\alpha_{i,t}\omega_{i,t}$, where $\omega_{i,t}$ is the cross-sectional weight of individual i at time t. To obtain gross labor flows, we sum the number of individuals who are in state b in the current period and were in state a in the previous period, where the weight of each individual in the sum is given by the longitudinal weight, $\ell_{i,t}$. Formally, the gross labor flow from state a to state b at time t is given by $AB_t = \sum_{i=1}^{N_t} a_{i,t-1}b_{i,t}\ell_{i,t}$.

After creating time series of labor stocks and gross flows, the measurements of interest are obtained as follows. A labor market rate (or share) is defined as the ratio between two labor stocks. A transition probability is defined by the ratio of a gross flow over a stock. For instance, the transition probability from unemployment to employment at time t is given by the ratio of the gross flow from unemployment to employment at time t over the stock of unemployed at $t-1$, i.e. $p_t^{UE} = UE_t/U_{t-1}$.

Adjustment Procedures

We apply several consecutive adjustments to the resulting time series before analyzing them. We summarize these procedures below and provide a detailed description in Appendix A.

For both labor stocks and gross flows, the first adjustment consists in removing systematic seasonal variation. To this end, we use the Census bureau's X-13ARIMA-SEATS program.[9] We also use the program to trim the data from potential outliers (additive and transitory).

Second, we adjust the time series of gross flows to account for margin error. The gross flows obtained from longitudinally-matched survey respondents do not fully account for sample attrition and they ignore entry and exit from the working-age population. As a result, the series of labor stocks implied by gross flows are not necessarily consistent with the labor stocks computed using cross-sectional weights. To ensure consistency between stocks and flows, we adapt the adjustment procedure described by Elsby et al. [2013] (henceforth EHS) which itself builds on similar strategies previously employed in the literature (see Poterba and Summers [1986]).

The third adjustment addresses time aggregation bias. The transition probabilities obtained in the previous step provide information on the labor market at discrete points in time. However, if the underlying worker mobility processes occur at a higher frequency, then these discrete measurements will miss transitions reversed between between those two points in time. We account for this possibility by means of the continuous-time correction developed by Shimer [2012]. To summarize, these consecutive adjustments provide us with time series of transitions probabilities that are not subject to either systematic seasonal variation, margin error or time aggregation bias.

[9] For more information see https://www.census.gov/srd/www/x13as/.

2.3 Sample Disposition

Worker stocks and flows are measured in the sample of civilians of working age – that is, men and women between 16 and 64 years of age – who are not unpaid family workers or workers on a Government Training Scheme.[10] This sample restriction is dictated by the lack of comparability between the hours of unpaid family workers and those of other employed workers, and by the lack of information on hours worked for individuals on a Government Training Scheme. These two categories represent a tiny proportion of the workforce, which makes the sample restriction innocuous. For instance, in the UK, where they are more numerous, the sum of these categories accounts for less than 1.5% of total employment in any given quarter.

We measure the part-time employment share in the sample of individuals who hold a primary (or main) private-firm salaried job. For the US, this definition comprises salaried workers in the nonfarm business sector. In the UK, the ONS does not report results for the nonfarm business sector . However, a very close counterpart can be obtained by restricting the sample to employees whose current job is provided by a private-sector firm (excludes non-governmental organizations that are not classified as private firms or businesses, such as charities and trade unions). The resulting samples of private-firm salaried workers represent, on average over the sample period, 67 and 59% of total employment respectively in the US and the UK.

2.4 Definition of Part-time Work

A key operational definition in this paper is that of part-time, as opposed to, full-time jobs. A part-time job is one in which the usual number of hours worked per week is below a specified threshold. We base our choice of a metric of hours worked and the relevant threshold on definitions used by Bureau of Labor Statistics (BLS) in the US and the ONS in the UK. These allow us to employ a consistent definition of part-time status.

For the US, we use total usual hours per week, which includes usual paid and unpaid overtime hours, and a cutoff of 34 (usual) hours. This is the definition used by the BLS, which differs from the legal definition of part-time work. Indeed, the Fair Labor Standards Act (FLSA) defines overtime as any hours of work after 40 hours of work in a workweek.[11] Using a threshold of 39 hours of work per week shifts the number of part-time workers downwards in our sample but does not affect the main patterns we document (transitions, business cycle fluctuations, etc.).

In the UK we define a part-time job as one in which the number of basic usual hours worked in the reference week was less than 30 hours (inclusive). This metric of hours worked (basic usual hours) excludes hours of paid and unpaid overtime work and is close to the notion of contracted working hours. Other definitions of part-time work are available in the LFS, but our definition is preferable for two reasons. First, self-reported measures leave more discretion to the worker as to the definition of part-time work. Second, this definition is also used in UK employer surveys like the Annual Business Inquiry and the Quarterly Public Sector Employment Survey. Using alternative definitions of part-time status moderately affects the level of the part-time employment share, but not its cyclical patterns.

3 Part-time Employment and Hours per Worker

This section expands on our motivating observation of a close relationship between the cylical behavior of part-time employment and aggregate hours per worker. We show that this observation can be

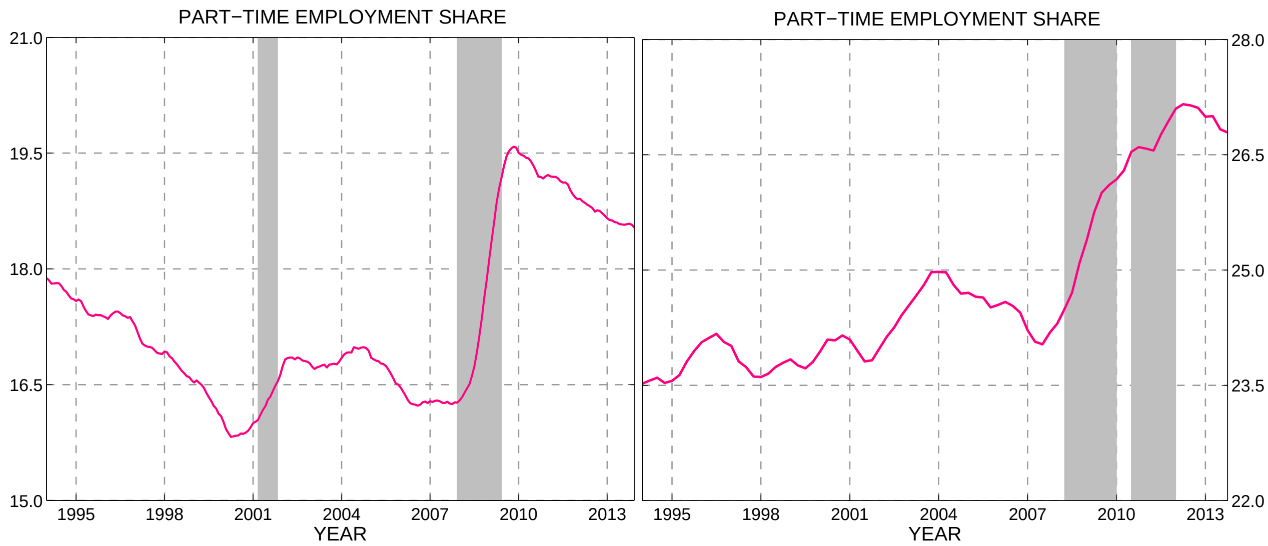
[10] Until recently in the UK working-age men were those between the ages of 16 and 64, and working-age women those between the ages of 16 and 59. In August 2010 the ONS moved to a definition of working-age that is uniform across men and women (see Clegg et al. [2010]). This does not affect our analysis of labor market stocks, but needs to be taken into account when we calculate labor market flows. Indeed, until 2011q2 the two-quarter microdata files only contain information on individuals who belong to the working-age population according to the old definition. Therefore, we can only obtain consistent time series for labor market flows by restricting the sample accordingly.

[11] See `http://www.dol.gov/whd/regs/compliance/whdfs22.pdf`.

described as the result of three related facts: (i) part-time employment accounts for a non-negligible share of total employment, (ii) there are large differences betweem part-time and full-time jobs in terms of hours worked, and (iii) the share of part-time employment is prominently countercyclical, and dominates cyclical variations in hours worked both in full-time and part-time jobs.

Scope and Cyclicality of Part-time Employment

Figure 2 tracks the evolution of the share of workers employed in part-time jobs – what we refer to as the *part-time employment share* – over the past two decades. The first remark concerns the extent of part-time work. Part-time work represents a large fraction of total employment in both labor markets: no less than 17% in the US and about 25% in the UK. The cross-sectional relevance of part-time employment is well-known in the United Kingdom (see e.g. the 2008 special issue of *The Economic Journal* on Women's part-time work). By contrast, in light of the high levels of part-time employment reported for the US, it is surpring that hitherto this feature of the US labor market has not been highlighed.



(a) United States

(b) United Kingdom

Figure 2: Part-time Employment Shares
Sample: private-firm salaried workers. Centered moving average of seasonally adjusted series. Gray-shaded areas indicate recessionary periods.

The gray-shaded areas in Figure 2 indicate the recessionary episodes covered by our datasets.[12] The patterns are quite striking: recessions are periods in which the composition of employment shifts markedly towards part-time jobs. The cyclicality of the part-time employment share is somewhat more pronounced in the US compared to the UK. Focusing on the Great Recession, from trough to peak the part-time employment share in the US rose by more than 3 percentage points (from 16.3% to 19.4%). The UK labor market witnessed a similarly large increase in levels, from 23.1% to 25.8%, and even slightly larger (3.3 pp) when we consider the quarters immediately before the beginning of the recession (namely since 2007q3, when the part-time employment share reached its nadir). A second remarkable feature of Figure 2 is the behavior of the part-time employment share *after* the Great Recession. After reaching its peak in a decade at the end of the recession, part-time employment shares were still very

[12]For the US we use recession dates as identified by the National Bureau of Economic Research. The corresponding dates are 2001m03–2001m11 for the 2001 recession and 2007m12–2009m06 for the Great Recession. We use recession dates from the Economic Cycle Research Institute for the UK as these are obtained through a similar methodology (see `https://www.businesscycle.com/`). The four dates of the so-called double dip recession in the UK are 2008m08–2010m01 followed by 2010m08–2012m02.

high by the end of 2013. This is consistent with the evolution of other labor market indicators (such as the high levels of the unemployment rate) and supports the notion that the current recovery is a sluggish one.

In Appendix B we put the findings in historical perspective for the US by looking at data from the March CPS. We show that the high levels of part-time employment in the aftermath of the Great Recession are not unprecedented, but they appear to be more persistent than in previous recessions.

Hours Worked in Part-time and Full-time Employment

In order to establish the link between the cyclical behavior of part-time employment and hours per worker, there remains to show that: (i) differences in hours worked in full-time and in part-time jobs are large, and (ii) fluctuations in hours per worker in each type of job do not offset the recessionary increase in part-time employment. Table 1 reports results that substantiate these claims.

Table 1: Part-Time Employment and Hours per Worker across Job Types

	Part-time	Hours per worker		
	Employment	All Jobs	Full-time Jobs	Part-time Jobs
	(1)	(2)	(3)	(4)
A. United States				
Average	17.3	39.1	43.0	21.7
Sd. HP-filtered	5.1	0.79	0.37	0.66
Peak-to-trough (%)	15.9	-3.34	-1.16	1.02
B. United Kingdom				
Average	24.8	37.7	43.9	19.0
Sd. HP-filtered	1.86	0.48	0.41	0.64
Peak-to-trough (%)	8.73	-2.25	-0.59	0.19

Notes: Sample: private-firm salaried workers. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4. Sd. HP-filtered report standard deviations of the series taken in logarithm as deviations from their HP trend. Peak-to-trough are peak-to-trough changes (in percentage points) during the Great Recession.

The numbers in the first row of Columns (3) and (4) of panels A. and B. of Table 1 display respectively average hours worked in full-time and part-time jobs over the whole sample period. In both countries, workers employed in full-time jobs work on average twice as many hours as those in part-time jobs. The figures are remarkably consistent across the US and UK, particularly in full-time jobs (resp. 43 vs 43.9). On the other hand, part-time workers in the UK work on average fewer hours than their US counterparts. This, and the fact that part-time workers are relatively more numerous in that labor market, explains the lower level of aggregate hours per worker in the UK vs the US (Column (2)). Further inspection of the data (not reported in the table) also reveals that hours per worker in full-time (part-time) jobs has diminished (increased) over the past two decades in both countries.

The second rows of panels A. and B. of Table 1 show statistics that inform a conventional business cycle analysis of the labor market. They report, for each series, its average standard deviation (expressed in logarithmic deviations from its Hodrick-Prescott trend).[13] Comparing values across columns for each panel, the first notable feature is that the volatility of the part-time employment share is an order of magnitude greater than the volatility of hours per worker. Second, hours per worker in part-time jobs are more volatile than in full-time jobs. Noticeably, their levels are similar across the two labor markets. Third, both the part-time employment share and aggregate hours per worker (resp. Columns (1) and (2)) are more volatile in the US compared to the UK.

Last, we circumscribe the analysis to the Great Recession by computing peak-to-troughs in hours per worker and trough-to-peaks in part-time employment shares. The following features stand out. Aggregate hours per worker dropped by similar magnitudes in both economies (3.34 and 2.25 pp respectively for the US and the UK). Clearly, peak-to-troughs in hours per worker within each job type cannot account for those drops. In both the US and the UK, although the falls in hours in each job type have similar orders of magnitude, they have different signs: hours per worker in full-time jobs declined 1.16 and 0.59 pp whereas hours per worker in part-time jobs increased by 1.02 and 0.19 pp, respectively for the US and the UK. By comparison, the increase observed in the part-time employment share in each country (expressed in relative terms) were much larger (15.9 and 8.73 resp. for the US and the UK). This suggests that the fall in aggregate hours occurred mostly due to the reallocation of workers across job types, rather than by changes in hours within each job type. However, there is one important caveat: the behavior of hours per worker in full-time and part-time jobs may have dampened the effect of the recessionary increase in the part-time employment share. To take this possibility into account, we turn to a more formal assessment of changes in aggregate hours per worker.

Decomposing Changes in Hours per Worker

Hereafter we quantify the contribution of two sources of changes in aggregate hours per worker (the part-time employment share and hours per worker in each job type). Consider first the counterfactual series displayed in Figure 1 in the Introduction. There, to compute each counterfactual series of hours per worker we fixed hours per worker (resp. the part-time share) at their pre-recession levels, and let the evolution of the part-time share (resp. hours per worker) drive that of aggregate hours. This follows from writing hours per worker at time t, $\overline{h}_t$, as the weighted average

$$\overline{h}_t = \sum_{i=F,P} \omega_t^i h_t^i, \tag{1}$$

where ω_t^F (resp. ω_t^P) is the share of workers in full-time (resp. part-time) jobs and h_t^F (resp. h_t^P) is hours per worker in full-time (resp. part-time) jobs. By definition, $\omega_t^F + \omega_t^P = 1$. Then, fixing the ω_t's (resp. h_t's) to their pre-recession levels, we can obtain the dashed (resp. dotted) lines in Figure 1. As we highlight in the Introduction, the close behavior of the solid and dashed lines in Figure 1 indicates that changes in hours per worker since the beginning of the Great Recession are closely related to changes in the part-time employment share.

To lend more precision to that exercise we compute chain-weighted series, which allow us to decompose exactly the change in aggregate hours into the two components. Starting from equation (1), changes in hours per worker between period t_0 (the beginning of the recession) and any future time period t (denoted Δ_{t,t_0}), can be decomposed into two chain-weighted series: (i) changes in hours per worker within job types $\Delta_{t,t_0}^{\text{hours}}$ and (ii) changes in the employment share of each job type $\Delta_{t,t_0}^{\text{job}}$. That is:

$$\Delta_{t,t_0} \equiv \overline{h}_t - \overline{h}_{t_0} = \Delta_{t,t_0}^{\text{job}} + \Delta_{t,t_0}^{\text{hours}}, \tag{2}$$

where the two chain-weighted series are defined in the following way:

[13] We use a Hodrick-Prescott filter with a smoothing parameter of 10^5 for the UK since we are working with quarterly data. To ensure comparability when estimating HP trends in the monthly US data, we use a smoothing parameter of $10^5 \times 3^{5.75}$. That is, when using smoothing parameters of the form $10^5 \times 3^n$, we find that $n = 5.75$ maximizes the (negative) correlation between unemployment and productivity over the 1948-2007 period.

$$\Delta^{\text{job}}_{t,t_0} \equiv \sum_{\tau=t_0}^{t-1} \sum_{i=F,P} \left(\omega^i_{\tau+1} - \omega^i_\tau\right) \frac{h^i_\tau + h^i_{\tau+1}}{2} \text{ and } \Delta^{\text{hours}}_{t,t_0} \equiv \sum_{\tau=t_0}^{t-1} \sum_{i=F,P} \left(h^i_{\tau+1} - h^i_\tau\right) \frac{\omega^i_\tau + \omega^i_{\tau+1}}{2}.$$

The results are displayed in Table 2. At each point in time, the deltas measure the *cumulative* effect of changes in each sources to changes in aggregate hours per worker since the beginning of the Great Recession. We consider various point in time: by the end of the recession, two years after and finally four years after the end of the recession.[14] Focusing on the last row of each panel first, which captures the relative importance of changes in the part-time employment share, the message conveyed by this exercise is a strong one. For both labor markets, the evolution of the part-time share explains the lion's share of the fall in hours per worker: two-thirds of the fall from the beginning to the end of the recession. Moreover, the recessionary increase in part-time employment accounts for virtually all of the persistence in hours per worker: more than 80 percent after two years, and about 95 percent after four years. Thus, had the share of part-time jobs remained at its pre-recession levels, hours per worker would have fully recovered by the mid-2013.

Table 2: Cumulative Change in Aggregate Hours per Worker

A. United States

	End of recession (2007m12 – 2009m06)	Two years later (2007m12 – 2011m06)	Four years later (2007m12 – 2013m06)
Δ_{t,t_0}	-1.26	-0.91	-0.53
$\Delta^{\text{job}}_{t,t_0}$	-0.91	-0.75	-0.51
$\Delta^{\text{hours}}_{t,t_0}$	-0.35	-0.16	-0.02
$\Delta^{\text{job}}_{t,t_0}/\Delta_{t,t_0}$	0.72	0.83	0.96

B. United Kingdom

	End of 1st recession (2008q1 – 2010q1)	End of 2nd recession (2008q1 – 2012q1)	One year later (2008q1 – 2013q1)
Δ_{t,t_0}	-0.64	-0.76	-0.69
$\Delta^{\text{job}}_{t,t_0}$	-0.41	-0.64	-0.66
$\Delta^{\text{hours}}_{t,t_0}$	-0.24	-0.13	-0.05
$\Delta^{\text{job}}_{t,t_0}/\Delta_{t,t_0}$	0.65	0.84	0.95

Notes: Sample: private-firm salaried workers. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4.

[14] Because the Great Recession in the UK involved a double-dip, we measure cumulative changes in different periods. In particular, we report results for three periods: after the end of the 1st recession, after the end of the 2nd recession and one year after the second recession.

4 The Composition Effect Hypothesis

To our knowledge, the very pronounced countercyclical pattern of part-time employment in both the US and the UK labor markets has not been previously documented. In this section we discuss a candidate explanation of this pattern, namely composition effects originating from changes in the demographic, occupation and industry structure of employment. This *composition effect hypothesis* builds on the observation that certain groups of workers are more inclined to work part-time and that certain occupations and industries use part-time work more intensively. If the recession shifts the composition of the employment pool towards groups of workers, industries and occupations that are more part-time intensive, then the increase in the aggregate part-time employment share obtains mechanically.[15] Below we assess the explanatory power of this hypothesis.

Heterogeneity in Part-time Employment

A prerequesite for this hypothesis to hold is that the distribution of part-time employment is heterogeneous across different partitions of the employed population (e.g. by gender, age etc.). Table 3 reports summary statistics on some of the characteristics that may underlie possible composition effects (Subsection B.6 of Appendix B complements this information). For each country, the Table contrasts the composition of overall employment with part-time employment, and describes the incidence of part-time employment in different groups of workers.

We first remark on cross-country similarities. Perhaps unsurprisingly, the composition of employment in terms of gender, age and education categories is remarkably similar across the two labor markets (Columns (1) and (3)). The main difference is the larger fraction of employment covered by workers with low education in the UK vs the US. Second, despite some differences, the composition of part-time employment is also quite similar across the two countries (cf. Columns (2) and (4)). Both in the US and the UK, part-time workers differ from full-time workers along several dimensions (cf. Columns (1)–(2) and (3)–(4)). The most obvious concerns the overrepresentation of women. Part-time workers are also more likely to be younger (aged 16 to 24) and less-educated. The cross-country differences pertain to a larger share of part-time employment covered by men and highly-educated workers in the US vs the UK (resp. 33.5 vs 23.1% and 18.6 vs 14%). From the perspective of job characteristics, part-time employment is also different from full-time employment.[16] In particular, part-time jobs are more concentrated in specific industries and occupations.

The incidence of part-time work in different groups of workers is summarized in Columns (3) and (6). Part-time employment is a widespread form of employment, affecting workers in all groups. The largest differences across partitions are men vs women, the young vs the old, and the low vs the very highly educated. In terms of the incidence of part-time across occupations, we observe similar patterns: part-time employment shares are positive in all occupation groups, but are lower in managerial and professional occupations (below 10% in both countries) and higher in sales occupations (above 30% in both countries). A similar picture emerges when looking at the incidence of part-time employment across different industries. Part-time work is present in all industries, but it is more intensively used in service-based industries (namely retail trade, with part-time shares close to 30% in the US and 40% in the UK during the pre-recession period). It is less common in manufacturing and construction, with pre-recession average part-time employment shares around 5-6% in the US and 8% in the UK. We provide more details on the distribution of part-time employment across industries and occupations in Tables B3 and B4 in Appendix B.

[15] A simple and telling example concerns employment in construction, which tends to be more responsive to the business cycle than employment in service-sector industries. Since part-time contracts are used more intensively in service-based industries relative to the construction sector, the part-time employment share may increase simply because the recession leads to an increase in the share of employment that is accounted for by service-based industries.

[16] See Appendix B for a more complete version of Table 3.

Table 3: Part-time Employment: Descriptive Statistics

	United States			United Kingdom		
	% of population		Part-time	% of population		Part-time
	total	part-time	employment share	total	part-time	employment share
	(1)	(2)	(3)	(4)	(5)	(6)
All	–	–	16.7	–	–	24.6
a. Gender						
Men	56.0	33.5	10.0	58.0	23.1	9.88
Women	44.0	66.5	25.2	42.0	76.9	45.1
b. Age						
16 to 24 years	18.1	45.4	41.9	19.9	31.0	38.6
25 to 34 years	24.4	16.6	11.3	24.1	17.0	17.4
35 to 44 years	24.9	15.3	10.2	24.9	22.2	22.0
45 to 54 years	21.7	12.8	9.8	17.3	14.2	20.2
55 to 64 years	10.9	9.8	15.1	12.0	14.1	29.0
c. Education						
Low	13.9	23.2	27.8	24.2	28.3	28.9
Middle	32.5	27.0	13.8	52.0	57.7	27.4
High	24.5	31.2	21.2			
Very high	29.1	18.6	10.6	23.7	14.0	14.6

Notes: Sample: private-firm salaried workers. Period: Years 2004-2006. **Education categories.** **US**: Low is "Less than high-school", Middle is "High-school graduates", High is "Some college", Very high is "College or higher education". **UK**: Low is "Primary education (below GCSE)", Middle and high is "Secondary Education (A-level, GCSE or equivalent)" and Very high is "Higher Education or more".

Empirical Approach

Our approach to measure the role of potential composition effects is as follows. We pool together the cross-sections spanning the period of the Great Recession along with the cross-section for the period immediately before the start of the Great Recession (our "control group"). We then reweight each individual observations from the cross-sections of the Great Recession by calculating adjustment factors that hold constant to their pre-recession levels a set of observable characteristics.[17] We use these adjusted weights to obtain counterfactual time series of the part-time employment share. Finally, we compare the actual trough-to-peak change in the part-time employment share with trough-to-peaks changes that would have obtained had the demographic, occupation or industry structure of the economy not changed since the beginning of the Great Recession.[18] An advantage of this reweighting method is to avoid small sample problems that typically arise when the population of interest is broken into many smaller subpopulations.

In accordance with the above description of heterogeneity in part-time employment, we analyze the contribution of three main sets of observable characteristics: demographic covariates, occupation and industry of employment. To begin with, we consider the role of changes in the age, sex or education structure of employment. We then look at the role of occupations and industries, which we first study in isolation and then control for jointly with demographic covariates. The exercise is repeated in our broad sample (i.e. effectively considering all forms of employment) and in our sample of interest (private-firm salaried workers). The findings are similar in the two samples, which indicates that selection into our preferred sample does not drive the results. For brevity we only comment on the latter set of results.

Results

Table 4 reports actual and counterfactual trough-to-peaks in the part-time employment share in the US (panel A.) and the UK (panel B.). Beginning with the US, the reference point is the observed trough-to-peak increase in the part-time employment share, of 3.05 pp (Column (1)). As can be seen in Columns (2)–(4), controlling for changes in the demographic characteristics of employed workers entails very similar trough-to-peak changes. As a matter of fact, changes in the age and education structure of employment since the beginning of the Great Recession seem to have dampened the measured increase in the part-time employment share. On the other hand, the increase in the share of female workers has had the opposite effect. In any case, both effects are quantitatively negligible.

Columns (5)–(8) and (9)–(12) of Table 4 respectively assess the contribution of labor reallocation across occupations and industries to the evolution of the part-time employment share. Changes to the industry structure of employment have had a larger effect on the part-time employment share. When we shutdown this channel, the increase in the part-time employment share is lower by about 0.5 pp. This figure is 0.4 pp when labor reallocation across occupations is shut down. This, however, is a rather modest composition effect when measured in relative terms: it amounts to only about one-sixth of the actual increase in the part-time employment share (2.52 vs 3.05 percent). Moreover, when one controls simultaneously for demographic characteristics and industry of employment, the counterfactual peak-to-troughs tend to revert to their actual value. These findings all point to the conclusion that changes in the part-time employment share are not driven by composition effects.

The results for the United Kingdom displayed in panel B. of Table 4 convey a similar picture.

[17]Formally, denote by t_0 the before-recession cross-section and by t_1 a given cross-section for the period of the Great Recession. Pooling these two cross-sections together, we define an indicator that takes the value of one if the observation is in cross-section t_1 and is zero if in cross-section t_0. We run a Logistic regression of this indicator against a set of individual controls and use this model to compute π_i, the predicted probability that an observation i is in cross-section t_1. The adjustment factor is given $(1-\pi_i)\,\pi_i^{-1}$. Multiplying the original weight of observation i by this number gives the adjusted weight.

[18]This reweighting approach resembles propensity score estimation in that, for each observation in the "control group", the adjustment factors measure the relative probability of inclusion in any given cross-section from the period of the Great Recession (our "treatment group").

Table 4: Part-time employment during the Great Recession: The Role of Composition effects

		Demographics			Occupation				Industry			
						Controlling for:				Controlling for:		
	Actual	Age	Sex	Educ.	Only	Age	Sex	Educ.	Only	Age	Sex	Educ.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
A. United States												
All jobs	2.69	3.12	2.54	2.81	2.38	2.75	2.41	2.42	2.33	2.75	2.34	2.4
Private-firm salaried jobs	3.05	3.61	2.91	3.22	2.62	3.11	2.66	2.66	2.52	3.11	2.55	2.63
B. United Kingdom												
All Jobs	2.36	3.01	2.76	3.45	1.81	1.98	2.02	2.08	3.6	3.98	3.94	5.06
Private-firm salaried jobs	2.69	3.83	3.62	4.52	2.27	2.35	2.45	2.46	4.89	5.45	4.72	4.26

Notes: An entry in the table is the maximum percentage point difference between the part-time employment share during the Great Recession and its pre-recession value. **Columns**: (1) Actual peak-to-trough change in the part-time employment share. (2)–(4) Counterfactual peak-to-trough changes controlling for a quartic in age, sex, educational attainment, respectively. (5) Counterfactual peak-to-trough change controlling for the occupational composition of employment. (6)–(8) Counterfactual peak-to-trough changes controlling for occupation and respectively age, sex and educational attainment. (9) Counterfactual peak-to-trough change controlling for industry of employment. (10)–(12) Counterfactual peak-to-trough changes controlling for industry and respectively age, sex and educational attainment. **Education categories. US**: "Less than high-school", "High-school graduates", "Some college" and "College or higher education". **UK**: "Primary education (below GCSE)", "Secondary Education (A-level, GCSE or equivalent)" and "Higher Education or more". **Occupations and Industries. US**: Two-digit categories of the corresponding 2000 Census classification schemes. **UK**: Two-digit occupation groups of the Standard Occupational Classification (SOC) 2000. Since a new SOC was introduced in 2011q1 (SOC 2011), peak-to-troughs reported in Columns (6) – (10) of panel B. are computed in the period 2008q2 – 2010q4. Industries are the 17 sections of the Standard Industry Classification (SIC) 92.

This said, some remarks are in order. First, while the observed trough-to-peak in the part-time employment share is similar *in levels*, in relative terms the increase was smaller in the UK. This means the recessionary response of part-time employment was more modest in the UK, which is consistent with the more modest response of unemployment in this country.[19] Second, even more so than in the US, shifts in the composition of employment by worker characteristics dampened the increase in the part-time employment share in the UK. Third, although the trough-to-peaks when we control for occupational reallocation seem somewhat lower (cf. Columns (5)–(8)), this mainly reflects the fact that it is calculated on a shorter time window due to data constraints (from 2008q2 to 2010q4).[20] In this period the actual trough-to-peak in the part-time employment share is 1.91 pp. Fourth, for some specifications counterfactual trough-to-peaks can be quite a lot larger than the observed one (up to 5.06 in Column (12)). If anything these results offer a stronger rejection of the composition effect hypothesis.

In conclusion, the picture that emerges from this accounting exercise is a clear one: the composition effect hypothesis explains a negligible part of the recessionary increase in part-time work. Although perhaps surprising, this finding dovetails with the pervasive lack of evidence in support of sector-driven shifts in the cyclical behavior of aggregate unemployment (see Abraham and Katz [1986]). Our evidence is also consistent with recent findings by Herz and Van Rens [2011] for the US and Şahin et al. [2012] for both the US and UK labor markets. These authors develop new frameworks to measure the effects of "mismatch" across submarkets. Circumscribing submarkets using detailed occupation or industry categories, they find that mismatch was not a first-order contributor to the surge in unemployment during the Great Recession. Finally, Elsby et al. [2010] report that unemployment outflow rates behave similarly across industries in the US. These results are consistent with the small role of composition effects we uncover.

5 A Flow Decomposition of Part-time Employment

Having found no evidence that the recessionary increase in the part-time employment share is driven by changes in the composition of employment in terms of worker and job characteristics, we now study its behavior based on the dynamics of worker flows across different labor market states.[21] A flows-based analysis explicitly accounts for the high levels of turnover displayed by the US and UK labor markets. Thereby, it provides a richer and more accurate understanding of the evolution of labor market stocks, and may reverse misguided conclusions resulting from stock-flow fallacies. In this section we first lay out the framework of our flows-based analysis. Next, we summarize the long-run and cyclical behaviors of transitions into and out of part-time and full-time work. Last, we employ a dynamic variance decomposition to measure the contributions of the various transition rates to the evolution of the part-time employment share.

5.1 Preliminaries

Our description of the labor market classifies employed workers into one of three categories: in a private-firm salaried job on a part-time basis (P) or on a full-time basis (F), or in any other form of employment (X). This residual state includes all other jobs in our sample.[22] That is, whenever a worker is employed in the public or third sectors, or is self-employed, we count her in the stock of workers in state X. This extra category is useful because it allows to distinguish part-/full-time reallocation that occurs within private-firm salaried jobs from that taking place through different employment sectors.

[19] The peak-to-trough of the unemployment rate was 5.7 pp for the US and 3.2 pp in the UK.

[20] The Standard Occupations Classification was updated in 2011q1 and a large number of two-digit occupational categories are not consistent across the two periods. For this reason the occupation-based counterfactuals are computed on a shorter window of time.

[21] The results in Section 4 suggest that abstracting from labor reallocation across industries and occupations is not problematic to study the dynamics of the part-time employment share.

[22] We ignore unpaid family workers and workers on a Government Training Scheme; see Subsection 2.3.

When not employed individuals can be either unemployed (U) or not participating in the labor market (N). Formally, labor market stocks in period t are stacked in vector $\boldsymbol{s}_t = \begin{bmatrix} P & F & U & N & X \end{bmatrix}_t'$.

We characterize the dynamics of labor market stocks by means of a five-state Markov chain model. That is, we assume that the evolution of $\boldsymbol{s}_t$ is governed by a discrete-time Markov chain:

$$\boldsymbol{s}_t = \boldsymbol{M}_t \boldsymbol{s}_{t-1}, \tag{3}$$

where $\boldsymbol{M}_t$ is a matrix whose elements are transition probabilities p^{ij} between labor market states i and j. These probabilities satisfy $\sum_j p^{ij} = 1$ for any i.

5.2 Part-time vs Full-time Employment: The Complete Picture of Worker Flows

Table 5 portrays the dynamics of the US and UK labor markets in terms of the underlying worker flows. The focus is on private-firm salaried employment, which we characterize by means of inflow and outflow probabilities. The inflow transition from state i to j at time t, denoted q_t^{ij}, is the ratio of the gross flow from state i to j over the stock of workers in state j. That is, $q_t^{ij} = \frac{ij_t}{j_t}$. Inflow transition probabilities are informative in that they measure the importance of the labor market states of origin to the labor market states of destination. Outflow transition probabilities are the empirical counterparts of the elements contained in the Markov transition matrix (Equation (3)). In Table 5 both of these objects are reported as averages over the whole sample period, and also as changes over the course of the Great Recession.

Long-run Averages

We first remark on cross-country similarities. In the US and the UK, part-time work appears as a transitory form of employment. In every month (quarter) in the US (UK), roughly 30% (15%) of those working part-time were previously in a different labor market state, and about the same number of part-time workers moves to a different labor market state in the following period. Second, the most likely transition of a part-time worker is towards a full-time position (17.6% in the US, 6.0% in the UK), followed by transitions out of the labor force (6.7% in the US, 4.6% in the UK). Third, part-time workers account for a large fraction of new entrants into full-time employment. The corresponding figures are 3.7% for the US (monthly) and 1.9% for the UK (quarterly). Fourth, full-time workers are subject to lower mobility. That is, whatever the labor market state of destination, full-time workers face a lower outflow risk compared to part-time workers.

Table 5 also reveals a number of differences between the US and the UK. The most visible and striking feature is the different degrees of churning displayed by the two labor markets. In both full-time and part-time employment, workers in the US are significantly more mobile compared to workers in the UK. This is consistent with other studies on cross-country differences in labor mobility (see e.g. Jolivet et al. [2006]). On a related note, inspection of the transition probabilities in the bottom panel shows that employment inflows are larger in the US. Second, nonparticipation is closely related to part-time employment, which lines up with the view that part-time employment reflects lower forms of labor force attachment. The relationship is stronger in the UK where the inflow from nonparticipation dominates other flows into part-time work: the quarterly figure is 5.4% (7.1% monthly in the US). Third, other forms of employment (X) is a more important contributor to turnover in part-time and full-time work in the UK. For instance, it accounts for about one-third of both inflows and outflows to full-time employment (close to 2%, to be compared with 6% for the sum of flows), whereas it explains less than one-tenth of the corresponding flows in the US (0.5%, to be compared with 7% for the sum of flows). Table C2 in Appendix C shows that this mainly the result of the different incidence of self-employment in the two labor markets.

Table 5: Transition Probabilities: Average and Changes over the Recession

	United States		**United Kingdom**	
	Average	Change in GR (%)	Average	Change in GR (%)
(i) Part-time inflows and outflows				
q^{FP}	16.39	4.41	4.88	5.95
q^{UP}	4.08	10.20	3.33	13.84
q^{NP}	7.10	-13.22	5.40	-19.38
q^{XP}	0.83	10.37	2.27	-1.42
$\sum_{i \neq P} q^{iP}$	28.40	0.73	15.88	-2.58
p^{PF}	17.55	-0.39	6.01	-6.54
p^{PU}	3.16	15.39	2.32	11.67
p^{PN}	6.74	-8.62	4.55	-12.10
p^{PX}	0.88	12.84	2.67	-1.96
$\sum_{i \neq P} p^{Pi}$	28.33	-0.42	15.56	-4.87
(ii) Full-time inflows and outflows				
q^{PF}	3.68	5.48	1.92	0.45
q^{UF}	1.43	4.86	1.60	5.33
q^{NF}	1.39	-12.70	0.68	-23.67
q^{XF}	0.50	29.39	1.93	-2.04
$\sum_{i \neq F} q^{iF}$	7.01	3.14	6.13	-2.16
p^{FP}	3.44	10.57	1.56	13.88
p^{FU}	1.43	31.32	1.41	16.04
p^{FN}	1.54	-3.59	1.00	-14.49
p^{FX}	0.53	25.41	2.00	4.87
$\sum_{i \neq F} p^{Fi}$	6.94	12.41	5.98	6.18
(iii) Unemployment, nonparticipation and other employment outflows				
p^{UP}	7.37	-10.03	6.71	-21.13
p^{UF}	12.64	-18.23	10.22	-32.23
p^{NP}	2.51	-13.20	2.60	-18.29
p^{NF}	2.36	-16.94	1.04	-27.81
p^{XP}	0.32	13.56	0.78	-2.63
p^{XF}	0.92	25.96	2.09	-9.76

Notes: Sample: private-firm salaried workers. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4. The raw series of transition probabilities have been seasonally adjusted and corrected for time aggregation and margin error.

Great Recession

To describe the dynamics of worker flows, we compare the mean behavior of transition probabilities during the Great Recession (GR hereafter) with that in the five-year period that preceded the downturn. Given the richness of our model, the picture of cyclical adjustment that emerges is complex and diverse. In spite of this, both labor markets exhibit rather similar dynamics during this period. As vastly documented in the literature (see e.g. Elsby et al. [2013] and Smith [2011]), the dynamics of unemployment (which captures the extensive margin of labor adjustment) in quite similar in both countries during the GR. Like in previous recessions, in the GR: (i) transition probabilities from non-employment (nonparticipation and unemployment) to employment (part-time or full-time) decreased, (ii) transition probabilities from employment (part-time or full-time) to unemployment increased, and (iii) transition probabilities from employment (part-time or full-time) to nonparticipation decreased.

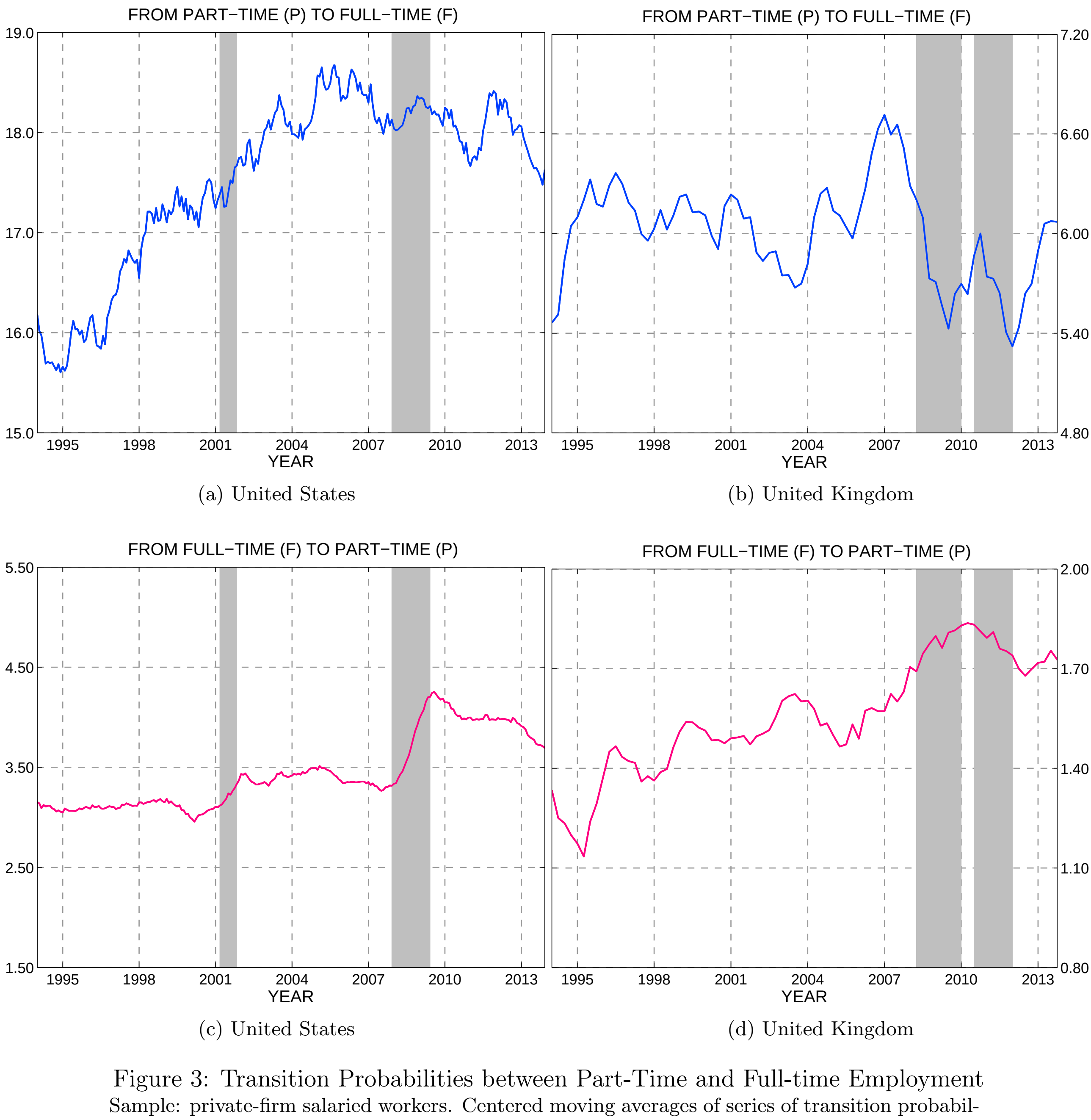
Perhaps surprisingly, the similaries across countries also extend to some aspects of the dynamics of part-time and full-time employment during the GR. First, transitions out of part-time employment decreased in both countries. The fall is considerably higher in proportional terms in the UK compared to the US (4.87 vs 0.42%). On the other hand, transitions into part-time employment increased in the US, whereas they decreased in the UK (0.73 vs 2.58%). Second, in both countries the transitions out of full-time employment increased in the recession (12.14 and 6.18% resp. in the US and the UK). Then again, transitions into full-time employment also increased in the US, whereas the opposite occurred in the UK (3.14 vs -2.16%). Third, and more importantly, looking at the evolution of transition rates at a more disaggregated level, it is most noticeable that, in both countries, the economic downturn is accompanied by a jump in p^{FP} and a fall in p^{PF}. Given the quantitative prominence of full-time flows to the dynamics of part-time employment (cf. previous subsection), these two movements are likely to have played an important role in the recessionary increase in the part-time employment share.

Figure 3 display the time series of these transition probabilities. The upper plots in Figure 3 reveal substantial movements in the transition rates from part-time to full-time work. In the US, the first decade of the period is characterized by an upward trend in p^{PF}, thus explaining the steady decline in the part-time employment share over the same period (cf Figure 2). The behavior of p^{PF} in the UK is more unstable during the pre-recession period and exhibits large high-frequency variation. It increases quite sharply a year before the recession sets in and experiences two very large drops during the recession. The lower plots in Figure 3 highlight substantial changes in p^{FP} during recessions. In the US, the two recessions in the observation period witnessed an increase in the transition probability from full-time to part-time jobs. In the UK, this probability experienced a sharp increase in 2007q2, reached a peak in 2010q3, at which point it started falling back. In both countries, several years after the beginning of the Great Recession transitions from full-time to part-time employment were still above their pre-recession levels.

Returning to the analysis of Table 5, a fourth salient feature of the dynamics of part-time and full-time employment is that, in both countries, full-time outflows to unemployment and inflows from unemployment and nonparticipation (i.e. p^{FU}, p^{UF} and p^{NF}) are more cyclically sensitive than their part-time counterparts.[23] That is, for non-employed individuals, recessions are periods in which, not only jobs in private salaried employment become scarcer, but this scarcity affects full-time positions proportionally more. This suggests a competing explanation for the countercyclicality of the part-time employment share. Rather than the result of cyclical changes in reallocation within private-sector salaried employment (captured by movements in p^{FP} and p^{PF}), the increase in the part-time employment share may be the result of reallocation through non-employment. In other words, during recessions firms take hiring and firing decisions that affect full-time jobs relatively more, thereby leading to an increase in the part-time employment share.

A final remark on Table 5 concerns cross-country differences in the dynamics of part-time and full-time employment. As was the case with the long-run behavior of transition rates, these differences

[23] That is, the proportionate increase in p^{FU} was higher than that in p^{PU}, and the proportionate drops in p^{NF} and p^{UF} were higher than those in p^{NP} and p^{UP}.



(a) United States (b) United Kingdom

(c) United States (d) United Kingdom

Figure 3: Transition Probabilities between Part-Time and Full-time Employment
Sample: private-firm salaried workers. Centered moving averages of series of transition probabilities previously adjusted for seasonal variation, margin error and time aggregation bias. Gray-shaded areas indicate recessionary periods.

chiefly concern the dynamic interaction between other forms of employment (X) and private-firm salaried employment. We have already emphasized that the composition of other employment is quite different in both countries. In particular, in the UK the third sector and self-employment represent a larger share of employment compared to the US.

5.3 Dynamic Variance Decomposition

The richness of the dynamic interactions across all labor market states (noticeable in the high levels of transition probabilities between them) poses a significant challenge to describe the economic forces that govern the evolution of part-time employment. Our previous analysis singled out two competing hypothesis to describe the recessionary increase in part-time work. One, that it was mainly driven by transitions out of and towards non-employment and, two, that instead it was driven by reallocation of workers between part-time and full-time positions. To quantify the relative importance of the two hypothesis we combine information on the magnitude of changes in each transition hazard with their impact on the variation of the part-time employment share.[24] Ultimately, this provides us with estimates of the share of variation in the part-time employment share accounted for by changes in each flow hazard. Hereafter, h^{ij} denotes the hazard rate associated with the transition probability p^{ij}, i.e. its continuous-time analog (see Appendix A). We obtain these estimates by means of the dynamic variance decomposition developed by EHS. This method presents several advantages that make it particularly suitable for our application. First, it works with any number of labor market states.[25] Second, it relies on approximating changes in current stocks by current and past changes in steady-state stocks. This obviates concerns with poor approximations that result from relying only on contemporaneous steady-state approximations to the behavior of actual stocks.[26] Third, conditional on the modeling assumptions, this method provides an exact decomposition that accounts for the nonlinear relationship between all transition hazards and steady-state stocks.[27]

Methodology

Formally, the contribution of flow hazard h^{ij} to the variation in the part-time employment share ρ_t is defined in the following way:

$$\beta_{\rho}^{ij} = \frac{\text{Cov}\left(\Delta\rho_t, \Delta\tilde{\rho}_t^{\,ij}\right)}{\text{Var}(\Delta\rho_t)}. \tag{4}$$

$\Delta\tilde{\rho}_t^{\,ij}$ denotes changes in the counterfactual part-time employment share whose evolution is *only* based on the past and contemporaneous changes in a particular flow hazard h^{ij}. In Appendix A.2 we

[24] We obtain time series of estimates of flow hazards by applying the the time aggregation correction described in Subsection A.1 in Appendix A.

[25] Alternative methods are based on a two- or three-state model.

[26] Many variance decomposition methods are based on steady-state approximations. These decompositions are accurate only when current stocks are well approximated by their steady-state counterparts. As pointed out in many papers (see e.g. Hall [2005] and Smith [2011]), this approach works well if the dynamics of labor stocks is *fast*. That is, if the fraction of adjustment towards steady-state is mostly covered over the relevant frequency of observation. This is the case for the unemployment rate in the US labor market, but is not true in general of all states in labor markets with fast dynamics. It is also not true in most states in labor markets exhibiting slow dynamics, like those of most European countries, including the UK (see Smith [2011]). In fact, in both the US and the UK, the part-time employment share exhibits much slower dynamics compared to the unemployment rate.

[27] This stands in contrast to variance decomposition methods that rely on regressing counterfactual on actual labor market rates, where counterfactual rates are computed by holding one or more transition hazards fixed to their sample means or some other arbitrary value, and which ignore the highly nonlinear relationships between flow hazards and labor market stocks. To be fair, variance decompositions used in previous papers had to some extent addressed the nonlinear relationship between flows hazards and stocks and considered the effect on stocks of past steady-states. However, they are restricted to two- or three-state models. For example, Fujita and Ramey [2009] and Smith [2011] offer exact variance decompositions that account for the effect of past changes in transition hazards on current labor stocks, but they work with (at most) a three-state model.

show that the variation in the part-time employment share can be approximately decomposed into the variance contributions of each flow hazard. That is:

$$\sum_{i \neq j} \beta_{\rho}^{ij} \approx 1. \tag{5}$$

In practice, to calculate each beta coefficient β_{ρ}^{ij}, we regress the series of counterfactual changes in the part-time employment share $\tilde{\rho}_t^{ij}$ (calculated as described in Appendix A.2) on the series of observed changes in the part-time employment share.

Results

We now report and comment on estimates of the contribution of changes in each flow hazard to changes in the part-time employment share, what the literature refers to as *beta coefficients*. Table 6 displays beta coefficients estimated using the whole sample period for the US and the UK labor markets.[28] To assess the robustness of these results, in Appendix C we show results for alternative samples.

The first observation is that the variance decomposition works extremely well. For both countries, the amount of overpredicted variance in the part-time employment share is under 5% (cf. third row of last panel of Table 6). The first panel of Table 6 displays the variance contributions of flow hazards across part-time and full-time jobs, as well as their joint variance contribution. These beta coefficients measure the importance of *within-reallocation* to the evolution of the part-time employment share. Compared to the other individual beta coefficients, they stand out by being much higher (all other transitions have betas no higher than 10%). Together, fluctuations in these two transition hazards account for just over three-quarters of the observed variation in the part-time employment share in the US (76%), and just above 60% in the UK. These estimates show that the predominant force is direct reallocation of workers between part-time and full-time positions. The estimates of β^{PF} are remarkably close for the two countries at 34-35%. On the other hand, the estimate of β^{FP} is much higher in the US (40.1 vs 27.6%). One possible explanation for this difference resides in the fact that the UK escaped the 2001 recessions. As we pointed in the previous subsection, both p^{FP} and ρ co-move strongly with the business cycle.

By definition, the remaining variation in the part-time employment share is accounted for by variation in hazards between private-firm salaried jobs and the other three labor market states. The middle panels of Table 6 display the beta coefficients associated to transitions hazards between private-firm salaried jobs and unemployment, nonparticipation and other employment, as well their joint contributions. In the US, the highest source of between-reallocation is nonparticipation (14.5%), followed by unemployment (8.2%) and other employment (6.1%). In the UK, the main driver of between-reallocation is unemployment (15.4%), followed closely by nonparticipation (11.9%) and other forms of employment (12.1%).

Focusing first on reallocation with unemployment, the differential behavior of inflow transitions to private-firm salaried jobs accounts for 7.1 and 4.1% of the variation in the part-time employment share respectively for the US and the UK. Thus, the source of cross-country differences in unemployment reallocation is due to differences in ouflows from private-firm salaried jobs to unemployment. In particular, the outflow transition from full-time jobs to unemployment is much more strongly correlated with the part-time employment share in the UK. While the overall explanatory power of reallocation through nonparticipation is quantitatively similar across countries (14.5 and 11.9% resp. for the US and the UK), further inspection shows the anatomy of this form of reallocation is quite distinct. In the US, inflows to private-firm salaried jobs are dominant (11.8%), while outflows are more important in the UK (7.31%). Interestingly, the flows across nonparticipation and part-time jobs deliver the highest variance contributions. This reiterates the finding that part-time employment entails a more marginal form of labor market participation. Last, reallocation via the Other employment category is relatively

[28] To economize on space we only report beta coefficients associated with transition hazards to or from part-time and full-time employment.

more important in the UK vs the US (resp. 12.1 and 6.1%), and that difference is largely explained by the much higher estimate of β^{FX}. This is due to the fact that self-employment, public and third sector represent a larger share of employment in the UK vis-a-vis the US.

To conclude the description of Table 6, we focus on the second and third rows of the bottom panel. They report two aggregates of beta coefficients: inflows from U, N and X to private-firm jobs (second row) and outflows from private-firm salaried jobs to U, N and X (third row).[29] These figures paint a very different picture of the dynamics of part-time employment across the two labor markets. Consistent with findings on the dynamics of the unemployment rate (the extensive margin) based on estimates of two- and three-state Markov chain models (see Elsby et al. [2009] and Shimer [2012]), the inflows to private-firm salaried jobs (which are the same worker flows as unemployment outflows) play a more important role in the dynamics of the part-time employment share in the US (24 and 4.4% resp. for inflows and outflows). The same figures for the UK are respectively 13 and 26%, suggesting that the job destruction margin plays a more prominent role in the UK. This is consistent with evidence documented by Pedro Gomes and Jennifer Smith (see Gomes [2012] and Smith [2011]).

6 Why is Part-time Work Cyclical? An Alternative Hypothesis

In this section, we return to the question first examined in Section 4: why is the part-time employment share cyclical? To recap, we discarded the hypothesis that the countercyclicality of part-time work originates from the reallocation of employment across groups of workers and/or sectors of the economy with different intensities of part-time work. In the previous section, we further showed that reallocation via transitions in and out of unemployment and nonparticipation explains but a small part of the variation in the part-time employment share. Conversely, we established that the reallocation of workers between part-time and full-time jobs in private-firm salaried employment accounts for the bulk of fluctuations in the part-time employment share in this sector.

These findings motivate an alternative hypothesis, which we label the *variable labor utilization hypothesis*. It is premised on the idea of labor reorganization within the firm operating as a channel of adjustment to shocks. Consider for instance a firm that is subject to adjustment costs along the extensive margin (i.e. hiring or firing costs) and is hit by a negative shock. Under such circumstances, the intensive margin of employment (hours per worker) may well serve as an adjustment channel to smooth out the adverse shock. More specifically, this hypothesis posits that recession are periods in which workers who retain their current employer are: (i) more likely to have their full-time contract converted into a part-time one, and (ii) face a lower probability to have their part-time job upgraded to a full-time one. The former prediction is reminiscent of the labor hoarding hypothesis (see Okun [1963] for an early discussion). However, different from its standard formulation, ours does not necessarily imply that firms pay labor services in excess of those being provided by its employees. The latter is consistent with a well-known notion of cyclical labor upgrading (see Okun [1973]). Our hypothesis specializes this phenomenon to the firm-level, and predicts that this channel is scaled down during recessions.

In this section we present evidence that is consistent with the labor adjustment story described in the previous paragraph. First, we document evidence on the importance (level) and countercyclicality of transitions between full-time and part-time jobs occurring at the firm/employer level. Second, we show that transitions between full-time and part-time positions entail large changes in hours worked at the individual level.[30]

[29] To be clear, the second row displays the sum of betas corresponding to inflows from unemployment, inactivity and other employment to part-time and full-time jobs, while the third row reports the sum of betas corresponding to outflows from part-time and full-time employment to those three states.

[30] Although we envision the idea of variable labor utilization as a demand-driven phenomenon, it is conceivable that the decision to reduce hours is optimal from the perspective of the worker too. For instance, if human capital is partly firm-specific and accumulated over the duration of the job, then the worker may prefer not to severe the relationship with the current employer and accept a temporarily lower schedule of hours.

Table 6: Part-time Employment Share Variance Contributions

	United States 1994:m02 – 2013:m12	**United Kingdom** 1994:q2 – 2013:q4
β_ρ^{PF}	35.6	34.3
β_ρ^{FP}	40.1	27.6
$\beta_\rho^{PF} + \beta_\rho^{FP}$	75.7	61.9
β_ρ^{PU}	-0.38	0.92
β_ρ^{FU}	1.91	9.82
β_ρ^{UP}	3.66	-7.18
β_ρ^{UF}	3.05	11.8
$\sum_{i=P,F} \beta_\rho^{iU} + \sum_{j=P,F} \beta_\rho^{Uj}$	8.24	15.4
β_ρ^{PN}	2.17	6.75
β_ρ^{FN}	0.38	0.56
β_ρ^{NP}	10	1.98
β_ρ^{NF}	1.88	2.64
$\sum_{i=P,F} \beta_\rho^{iN} + \sum_{j=P,F} \beta_\rho^{Nj}$	14.5	11.9
β_ρ^{PX}	-0.43	1.05
β_ρ^{FX}	0.73	7.06
β_ρ^{XP}	1.95	2.51
β_ρ^{XF}	3.87	1.5
$\sum_{i=P,F} \beta_\rho^{iX} + \sum_{j=P,F} \beta_\rho^{Xj}$	6.12	12.1
$\sum_{i=U,N,X} \sum_{j=P,F} \beta_\rho^{ij}$	24.4	13.2
$\sum_{i=P,F} \sum_{j=U,N,X} \beta_\rho^{ij}$	4.38	26.2
$\sum_{i,i \neq j} \beta_\rho^{ij}$	104.5	101.3
Obs.	238	78

Notes: Sample: private-firm salaried workers. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4. The raw series of transition probabilities have been seasonally adjusted and corrected for time aggregation and margin error.

Within-firm Transitions between Full-time and Part-time Positions

We first quantify the relative importance of employer retention for workers who change between full-time (F) and part-time (P) positions in two consecutive periods. To this end, in Table 7 we compare their retention rates – the probability to remain with the same employer – with those of workers who remain employed in two consecutive periods in either a full-time or a part-time job.

The stark picture that emerges from Table 7 is that the vast majority of transitions between full-time and part-time jobs occurs within firms. For example, in the US in two consecutive months about 93% (resp. 94%) of workers who move from a part-time to a full-time (resp. full-time to part-time) position retain their current employer. Similarly, in the UK in two consecutive quarters 71% (resp. 81%) of transitions from a part-time to a full-time position (resp. full-time to part-time) occur at the same employer. The retention rates of workers who remain in part-time or full-time employment across quarters are only marginally higher in the US, but somewhat higher in the UK.

Surprisingly, Column (2) in Table 7 indicates that, if anything, retention rates became slightly higher during the Great Recession. In the US, for instance, only 5 percent of transitions between full-time and part-time positions occurred through a change in employer during this period. Employer-to-employer transitions are typically lower during recessions (see Rogerson and Shimer [2011] and Gomes [2012]), but the evidence presented in Table 7 suggests that retention rates increased relatively more for those who also experienced a change in their hours schedule relative to other workers. (This is particularly clear when analyzing Table 7 as the result of a difference-in-difference exercise.) This strengthens the idea that the flows associated with the increase in the part-time employment share during the Great Recession seem to be driven mainly by transitions *within*, rather than *across*, the same employer.

Table 7: Fraction of Workers who Retain their Current Employer

	Non-recession period	Great Recession
A. United States		
From P to F	92.66	94.97
From F to P	93.81	95.24
Stay in P	97.26	97.68
Stay in F	98.06	98.50
B. United Kingdom		
From P to F	70.63	80.57
From F to P	81.13	88.32
Stay in P	92.08	97.02
Stay in F	93.57	97.55

Notes: Sample: private-firm salaried workers. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4. The raw series of transition probabilities have been seasonally adjusted.

Before closing this subsection, it is appropriate to underline the similarity of our results across countries. Consider for instance the monthly figures for the US. A rough estimate of the quarterly probability that a full-time worker moves to a different employer is given by: $0.023 + (1 - 0.023) \times 0.023 + (1 - 0.023)^2 \times 0.023 \simeq 0.067$. This figure is remarkably close to the corresponding probability for the UK, which averages 0.064 over the period under study. Repeating the comparison for the other rows of Table 7, one would even conclude that the UK labor market displays a degree of churning similar to the US one. However, a caveat is that differences across surveys in the measurement of employer changes may explain part of this apparently similar picture.[31]

[31]The LFS asks respondents to report the length of time (in months) they have been continuously employed with the same employer. We identify changes in employer by looking at whether the worker reports (i) to be continuously employed with the same employer for 3 months or less (the length of time between interviews) and (ii) to be employed

Changes in Hours Worked at the Worker Level

To complement the previous findings regarding transitions between full-time and part-time positions, in Table 8 we document that these transitions effectively entail a large change in hours worked at the individual level. In addition to those values, Table 8 reports average changes in hours for workers who remain in the same type of position in two consecutive periods and for those who change employers, both during normal times and during the Great Recession (resp. left and right-hand side panels).

The first remark is that average changes in working hours for those moving between full-time and part-time positions are large, both during normal and recessionary periods. They range from 12 to 19 weekly hours in the US and from 13 to 21 weekly hours in the UK. These figures contrast with those measured for workers who remain in the same type of position, with values around zero in full-time jobs and ranging from less than one to two hours in part-time jobs. The latter indicates a more flexible work schedule in these jobs. Overall, these observations sidestep concerns that the increase in the part-time employment share is driven by transitions across an arbitrary cutoff value separating full-time from part-time jobs, and that they would involve small changes in hours worked.[32] Indeed, although the mean change in hours for transitions at the same employer is considerably lower than the difference in mean working hours across the two job categories (cf. Table 1), the figures come very close for transitions accompanied by a change in employer (17-18 weekly hours in the US, 20-21 in the UK).

Table 8: Average Change in Hours across Job Types

	Non-recession period		Great Recession	
	All workers	Employer movers	All workers	Employer movers
A. United States				
From P to F	12.35	17.05	12.06	16.80
From F to P	-12.60	-17.60	-12.38	-18.51
Stay in P	0.05	0.24	0.01	-0.09
Stay in F	-0.25	-0.08	-0.27	-0.11
B. United Kingdom				
From P to F	12.8	19.8	14.0	21.0
From F to P	-13.5	-19.9	-14.0	-19.6
Stay in P	0.05	1.63	0.13	1.72
Stay in F	-0.08	-0.19	-0.15	-0.33

Sample: private-firm salaried workers. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4. The raw series of changes in hours worked have been seasonally adjusted.

We comment on an additional observation that squares with the variable labor utilization story put forward in this subsection (a complete description is provided in Appendix B). For each quarter, we tabulate the fraction of involuntary part-time workers among those who have moved to part-time

in the previous quarter. This measure is arguably more noisy than the variable provided by the CPS. The CPS uses a dependent coding procedure: workers who were employed and were in the survey in the previous month are asked explicitly whether they are working at the same company as in the preceding interview.

[32] Recall that this cutoff is set at 35 and 30 weekly hours respectively for the US and the UK.

employment in that quarter. Analyzing its cyclical behavior, we observe that this fraction increases dramatically during recessions.[33] For instance in the US, the proportion of involuntary part-timers among all part-time workers nearly doubled during the Great Recession (from 14% to 27%). Involuntary part-time work indicates a constraint on workers, as they cannot work as many hours as they would like to. Times of labor market turbulence tend to reduce workers' bargaining power, which explains why labor reorganization within the firm should be more visible during recessions.

Does the employment adjustment story entertained in this section "ring true"? In our view, it is reasonable to argue that employers face incentives to cope with a negative shock by reducing the schedule of current employees from full-time to part-time working hours, and by not upagrading many of its workers from part-time to full-time employment. First, in labor markets where job requirements are increasingly specialized and suitable workers are hard to find, the opportunity cost of firing a worker can be very high. Beyond savings on future hiring and training costs, reducing the hours of currently employed workers would allow employers to save on these costs. Second, jobs that would normally operate on a full-time basis can, in conditions of lower and more uncertain demand, be operated on a part-time basis and be upgraded to full-time hours when the economy picks up. In addition, in the US, part-time jobs spare the employer the costs of various benefits that are associated with full-time jobs (e.g. health insurance, vacation pay, etc.). Keeping jobs alive by re-classifying full-time contracts into part-time ones is therefore cheaper. The evidence presented in this section is consistent with these observations. An avenue for future work is to use panel data on jobs spanning a longer period of time to confront these predictions.

7 Interpretations and Concluding Remarks

In this paper, we have established an empirical connection between the behavior of hours per worker and employment adjustment over the business cycle. Here we interpret our findings in light of the existing literature, and discuss potential implications for future research.

The new empirical facts we document are directly relevant for the literature on business cycle facts. Although the consensus has long been that the intensive margin is of secondary importance, some recent papers have challenged this view (these include Cooper et al. [2007], Ohanian and Raffo [2012] and Trapeznikova [2014]).[34] Our contribution to this literature is both empirical and methodological. We use microdata from labor force surveys to inform a Markov-chain model of labor market dynamics. In so doing, we uncover a relationship between workers' transitions in and out of employment and changes in the hours of those who are working. In addition, our measurement framework explicitly accounts for the high-frequency movements that characterize modern labor markets and the cyclical nature of part-time work in the US and the UK.

At a more theoretical level, these findings are relevant to the analysis of aggregate fluctuations based on either a stand-in household model (see e.g. Prescott and Wallenius [2012]) or a heterogeneous-agent economy (Chang and Kim [2006]). Recent advances in this literature show that abstracting from the intensive margin may result in misguided conclusions, and hence advocate studying both margins of labor adjustment in conjunction.[35] Our paper adds to this line of research at two different levels. First,

[33] In the CPS, involuntary part-time workers are those working part-time for economic reasons, such as slack work, business conditions, or unavailability of full-time work. Similarly in the LFS, involuntary part-time workers are those workers who report that they could not find a full-time job.

[34] Ohanian and Raffo [2012] use aggregate data from several OECD countries and argue that both margins of employment adjustment are quantitatively important to explain the variation in total hours. Cooper et al. [2007] and Trapeznikova [2014] use quarterly establishment-level data (resp. from the US and Denmark) to measure the importance of the two margins of labor adjustment and their interaction at the cross section. They document that changes in hours and employment are both quantitatively important (the standard deviations of hours and employment growth have a similar magnitude) and that there is evidence of a degree of substitution between them (they are negatively correlated at the firm-level).

[35] For instance Chang et al. [2014] establish, in the context of a heterogenous-agent macroeconomy, that "abstracting from the intensive margin can significantly distort inference regarding the volatility of aggregate hours" (p. 2). Prescott and Wallenius [2012] review several applications of the stand-in household model with labor adjustment along

our empirical description of the two margins of labor adjustment is suggestive of mechanisms not yet described in this literature. Our characterization of the behavior of the intensive margin points to a trade-off between operating jobs on a part-time vs full-time basis, which is similar to the trade-off to operate a job or not (i.e. the extensive margin of employment adjustment). Second, we highlight a possible mechanism for this reallocation, namely variable labor utilization at the firm level. In our view, this offers a possible empirical basis for the nonconvex mapping from hours worked to labor services, which has become the standard modeling device to introduce labor adjustment along both margins in this literature (see Prescott and Wallenius [2012] and Chang et al. [2014]).[36] Future work could delve into the sources of this phenomenon. Possible explanations may relate to technological constraints (e.g. structure of the production function, coordination of employees' schedules of working hours within the firm) and/or to individual preferences (disutility of participating in the workforce, valuation of joint leisure time within the household).[37]

The facts that we document have the potential to inform models developed in the macro-search literature, at least on two different levels. Our paper first speaks to the issue of the number of labor market states relevant to understand aggregate dynamics. Specifically, our Markov-chain model indicates that a search model with two employment states (part-time and full-time) could explain fluctuations at the intensive margin. A parallel can be made with recent work by Elsby et al. [2013], who found that fluctuations at the extensive margin are to a nonnegligible extent attributable to labor force participation decisions. Their work provides the basis for an explicit distinction between nonparticipation and unemployment into macro-labor models, as in e.g. Krusell et al. [2011]. Second, the employment adjustment story we put forward – the variable labor utilization hypothesis – appears worth investigating through the lens of a search model with a notion of firm size. Indeed, although the patterns we document are based on worker level data, they point to the firm/employer as the driver of reallocation on the intensive margin. We conjecture that this reallocation channel allows firms to mitigate downsizing during recessions. Thus, an interesting avenue for future research would be to incorporate this margin of labor adjustment into this new vintage of search models developed by e.g. Elsby and Michaels [2013], Kaas and Kircher [2014] and Schaal [2012], and confront them with firm-level data.

We are not the first to suggest that firms vary the intensity with which they use their workforce. In Cooper et al. [2007] and Trapeznikova [2014] firms respond to shocks to their profitability by adjusting both the number of employees and hours per employee at the firm level. In another vein of the literature, Barnichon [2010] and Galí and Van Rens [2014] incorporate variable labor utilization into an otherwise standard New-Keynesian model to explain fluctuations in labor productivity. This said, in all these models variable labor utilization is introduced as a continuous variable. In this paper, we have shown that hours at the worker level can be closely described by a two-valued variable. It is conceivable that aggregation across workers yields a continuous variable of labor adjustment at the firm level. This would provide a mapping between the individual-level patterns of work that we document and the notion of variable labor intensity at the firm level.

Last, our analysis contributes to the literature on cross-country differences in labor market performance. In our view, an avenue for future work would be to study the behavior of the intensive margin along similar lines in countries with more rigid labor markets.[38] This would allow to detect a relationship between the extensive/intensive margins decomposition and institutions that affect labor market flows (see e.g. Jung and Kuhn [2014]). For instance Llosa et al. [2012] argue that the divide between the extensive and intensive margin of work is related to cross-country differences in layoff

both the extensive and intensive margins.

[36] Prescott et al. [2009] use this modeling device to discuss the effects of various government policies, not to study macroeconomic fluctuations. Meanwhile, Prescott and Wallenius [2012] highlight that tools that are relevant for cross-country tax studies are also relevant for business cycle analyses.

[37] A relevant paper in this respect is Erosa et al. [2014]: they discuss the forms of costs in both utility and pecuniary terms that are needed in order to explain the intensive and extensive margin of labor supply decisions.

[38] A comparative analysis with countries characterized by a highly dual labor market would be especially informative; see e.g. Bentolila et al. [2012].

costs. Thus, one expects the intensive margin to play a larger role in countries with institutions that directly prompt the use of part-time work as a margin of employment adjustment.[39] Further work is needed to confront this presumption.

Conclusion

The severity of the Great Recession allows to single out patterns of labor market dynamics that may have gone unnoticed in normal times. Our analysis of the US and UK labor markets highlights the prominent role of part-time work behind the patterns of employment adjustment observed during the recession. We substantiate this conclusion by piecing together several facts regarding the behavior of labor market stocks and flows. The recessionary increase in part-time employment is consistently explained by the hypothesis of variable labor utilization at the firm level.

Several years after the recession, economic activity in the US and UK labor markets is still below trend. In an accounting sense, the recessionary increase in part-time work fully explains why hours per worker have not yet recovered. Yet, there may be more to this than an accounting relationship. Part-time work is typically associated with less productive tasks, less secure employment and hence lower levels of human capital accumulation. One may ask whether the sluggish recovery that followed the Great Recession is partly the result of the massive shift towards part-time work that we document.

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[39] An interesting example in this respect is Germany. German labor market institutions are known for promoting adjustments through variation in hours per worker. Yet, as Burda and Hunt [2011] document, the intensive margin did not play a larger role in Germany during the Great Recession compared to previous recessions.

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A Technical Appendix

The first part of this appendix details the adjustment procedures we implement to obtain our main time series. The second part deals with the theory underlying the dynamic variance decomposition.

A.1 Adjusment Procedures

Our time series of labor stocks and gross labor flows are subject to three consecutive adjustments outlined in Subsection 2.2. We describe these in turn below.

Seasonal Variation

We remove systematic seasonal variation using the Census bureau's X-13ARIMA-SEATS program. This program is a recent merger of the X12-ARIMA program previously used by the US Census bureau and the TRAMO-SEATS program developed by the Bank of Spain. Our preferred method for detecting seasonal variations uses the latter. Specifically, we estimate the seasonal components of our time series by applying the SEATS program, and when estimation fails we revert to the capabilities of X12-ARIMA program to obtain an alternative estimate of seasonal components.[40]

We also use the X-13ARIMA-SEATS program to filter out potential outliers, both additive and transitory. The X-13ARIMA-SEATS computes t-statistics for each observations. Following standard practices, we set the critical level used to detect outliers to the value of 4.0. That is, observations with an absoulte t-value greater than 4.0 are subsequently treated as outliers. We use the model that is automatically detected by TRAMO to replace any outlier value by its predicted value.

Margin Error

To recast the analysis of margin error within the context of Section 5, recall that we describe the dynamics of labor market stocks by means of a five-state Markov chain. We assume that the evolution of the vector of labor stocks at time t, denoted as $\boldsymbol{s}_t = \begin{bmatrix} P & F & U & N & X \end{bmatrix}_t'$, is governed by a discrete-time Markov chain:

$$\boldsymbol{s}_t = \boldsymbol{M}_t \boldsymbol{s}_{t-1}, \tag{6}$$

where $\boldsymbol{M}_t$ is a matrix whose elements are transition probabilities p^{ij} and $\sum_j p^{ij} = 1$.

The purpose of the margin-error adjustment is to reconcile the series of labor stocks implied by gross flows with the series of labor stocks calculated using cross-sectional weights. We follow EHS and rewrite the dynamics of changes in labor stocks in the following way:

$$\Delta \boldsymbol{s}_t = \boldsymbol{S}_{t-1} \boldsymbol{p}_t, \tag{7}$$

where $\boldsymbol{p}_t$ is a column vector containing all p_t^{ij} such that $i \neq j$ and $\boldsymbol{S}_{t-1}$ is a conformable matrix of

[40] Seasonal components estimates using the X12-ARIMA program are based on the older X11 algorithm.

previous period labor stocks, or in explicit form:

$$\underbrace{\begin{bmatrix} \Delta P_t \\ \Delta F_t \\ \Delta U_t \\ \Delta N_t \\ \Delta X_t \end{bmatrix}}_{\boldsymbol{\Delta s_t}} = \underbrace{\begin{bmatrix} -P_{t-1} & P_{t-1} & 0 & 0 & 0 \\ -P_{t-1} & 0 & P_{t-1} & 0 & 0 \\ -P_{t-1} & 0 & 0 & P_{t-1} & 0 \\ -P_{t-1} & 0 & 0 & 0 & P_{t-1} \\ F_{t-1} & -F_{t-1} & 0 & 0 & 0 \\ 0 & -F_{t-1} & F_{t-1} & 0 & 0 \\ 0 & -F_{t-1} & 0 & F_{t-1} & 0 \\ 0 & -F_{t-1} & 0 & 0 & F_{t-1} \\ U_{t-1} & 0 & -U_{t-1} & 0 & 0 \\ 0 & U_{t-1} & -U_{t-1} & 0 & 0 \\ 0 & 0 & -U_{t-1} & U_{t-1} & 0 \\ 0 & 0 & -U_{t-1} & 0 & U_{t-1} \\ N_{t-1} & 0 & 0 & -N_{t-1} & 0 \\ 0 & N_{t-1} & 0 & -N_{t-1} & 0 \\ 0 & 0 & N_{t-1} & -N_{t-1} & 0 \\ 0 & 0 & 0 & -N_{t-1} & N_{t-1} \\ X_{t-1} & 0 & 0 & 0 & -X_{t-1} \\ 0 & X_{t-1} & 0 & 0 & -X_{t-1} \\ 0 & 0 & X_{t-1} & 0 & -X_{t-1} \\ 0 & 0 & 0 & X_{t-1} & -X_{t-1} \end{bmatrix}'}_{\boldsymbol{S}'_{t-1}} \times \underbrace{\begin{bmatrix} p^{PF} \\ p^{PU} \\ p^{PN} \\ p^{PX} \\ p^{FP} \\ p^{FU} \\ p^{FN} \\ p^{FX} \\ p^{UP} \\ p^{UF} \\ p^{UN} \\ p^{UX} \\ p^{NP} \\ p^{NF} \\ p^{NU} \\ p^{NX} \\ p^{XP} \\ p^{XF} \\ p^{XU} \\ p^{XN} \end{bmatrix}}_{\boldsymbol{p}_t}$$

While in Equation (7) $\boldsymbol{p}_t$ denotes stock-consistent transition probabilities, we only observe (compute) the non-adjusted ones, which we denote $\breve{\boldsymbol{p}}_t$. The adjustment procedure consists in finding those vectors of transitions probabilities $\boldsymbol{p}_t$ that satisfy Equation (7) (thereby guaranteeing that changes in stocks implied by the adjusted transition probabilities are consistent with observed changes in labor stocks) and minimize the weighted sum of squares of margin-error adjustments. Formally, the vector of adjusted transition probabilities $\boldsymbol{p}_t$ solves:

$$\min\, (\boldsymbol{p}_t - \breve{\boldsymbol{p}}_t)' \boldsymbol{W}_t^{-1} (\boldsymbol{p}_t - \breve{\boldsymbol{p}}_t) \text{ s.t. } \Delta \boldsymbol{s}_t = \boldsymbol{S}_{t-1} \boldsymbol{p}_t. \tag{8}$$

Note that matrix $\boldsymbol{W}_t$ is proportional to the covariance matrix of $\breve{\boldsymbol{p}}_t$, with entries scaled by the respective departing labor stock. By virtue of the Markov chain properties, the diagonal elements of the covariance matrix of $\breve{\boldsymbol{p}}_t$ have the form, $\breve{p}_t^{ij}.(1 - \breve{p}_t^{ij})$, whereas nondiagonal elements with the same departing state have the form, $-\breve{p}_t^{sj} \breve{p}_t^{sl}$, for all s in $\boldsymbol{s}$ and $j \neq s, l$. By the same token, the remaining entries of that matrix are equal to zero. Specifically in our application $\boldsymbol{W}_t$ is a twenty-by-twenty matrix. To keep the presentation manageable, we only report the first fours rows of matrix $\boldsymbol{W}_t$:

$$\begin{bmatrix} \frac{\breve{p}_t^{PF}(1-\breve{p}_t^{PF})}{P_{t-1}} & \frac{-\breve{p}_t^{PF}\breve{p}_t^{PU}}{P_{t-1}} & \frac{-\breve{p}_t^{PF}\breve{p}_t^{PN}}{P_{t-1}} & \frac{-\breve{p}_t^{PF}\breve{p}_t^{PX}}{P_{t-1}} & \mathbf{0_{16}} \\ \frac{-\breve{p}_t^{PU}\breve{p}_t^{PF}}{P_{t-1}} & \frac{\breve{p}_t^{PU}(1-\breve{p}_t^{PU})}{P_{t-1}} & \frac{-\breve{p}_t^{PU}\breve{p}_t^{PN}}{P_{t-1}} & \frac{-\breve{p}_t^{PU}\breve{p}_t^{PX}}{P_{t-1}} & \mathbf{0_{16}} \\ \frac{-\breve{p}_t^{PN}\breve{p}_t^{PF}}{P_{t-1}} & \frac{-\breve{p}_t^{PN}\breve{p}_t^{PU}}{P_{t-1}} & \frac{\breve{p}_t^{PN}(1-\breve{p}_t^{PN})}{P_{t-1}} & \frac{-\breve{p}_t^{PI}\breve{p}_t^{PX}}{P_{t-1}} & \mathbf{0_{16}} \\ \frac{-\breve{p}_t^{PX}\breve{p}_t^{PF}}{P_{t-1}} & \frac{-\breve{p}_t^{PU}\breve{p}_t^{PX}}{P_{t-1}} & \frac{-\breve{p}_t^{PN}\breve{p}_t^{PX}}{P_{t-1}} & \frac{\breve{p}_t^{PX}(1-\breve{p}_t^{PX})}{P_{t-1}} & \mathbf{0_{16}} \end{bmatrix}_{4,20}$$

Writing the Lagrangean associated with (8) and differentiating with respect to $\boldsymbol{p}_t$ and the Lagrange multipliers $\boldsymbol{\eta}_t$ yields a solution for the adjusted transition probabilities $\boldsymbol{p_t}$ as a function of observable quantities (observed changes in labor stocks $\Delta\boldsymbol{s}_t$, nonadjusted transition probabilities $\breve{\boldsymbol{p}}_t$, a matrix of previous period stocks $\boldsymbol{S}_{t-1}$, and matrix $\boldsymbol{W}_t$, which combines the former and latter set of observables):

$$\begin{bmatrix} \boldsymbol{p}_t \\ \boldsymbol{\eta}_t \end{bmatrix} = \begin{bmatrix} \boldsymbol{W}_t^{-1} & \boldsymbol{S}_{t-1}' \\ \boldsymbol{S}_{t-1} & \mathbf{0} \end{bmatrix}^{-1} \begin{bmatrix} \boldsymbol{W}_t^{-1}\breve{\boldsymbol{p}}_t \\ \Delta\boldsymbol{s}_t \end{bmatrix}. \tag{9}$$

In practice, the application of this margin-error adjustment leads to small changes in the levels of transition probabilities, and has negligible effects on the cyclical properties of the time series of transition probabilities. On the other hand, it turns out to be key to ensure that the dynamic variance decomposition exercise works correctly. In particular, this adjustment ensures that the sum of contributions of changes in hazards h_t^{ij} to the variance of changes in labor stocks is close to 100%. This is intuitive, as the variance of $\Delta\boldsymbol{s}_t$ depends on the level of h_t^{ij}.

Time Aggregation Bias

The final adjustment we perform addresses the fact that discrete transition probabilities are subject to time aggregation bias, when the underlying worker mobility processes occur at a higher frequency. We account for this possibility by adapting the continuous time-correction developed by Shimer [2012] to our setup.

Our goal is to recover a transition matrix containing the unbiased transition probabilities p_t^{ij}, along with the elements of its continuous-time analog, the hazard rates h_t^{ij}. Let $\boldsymbol{H}_t$ denote the continuous-time analog of $\boldsymbol{M}_t$. The time aggregation correction explores the fact that, under certain conditions, there is a unique relationship between the eigenvalues of $\boldsymbol{M}_t$ and $\boldsymbol{H}_t$. If the eigenvalues of $\boldsymbol{H}_t$ are all distinct, it can be decomposed into the following expression $\boldsymbol{H}_t = \boldsymbol{V}_t\boldsymbol{C}_t\boldsymbol{V}_t^{-1}$, where $\boldsymbol{C}_t$ is a diagonal matrix of eigenvalues and $\boldsymbol{V}_t$ the matrix of associated eigenvectors. It can be shown that $\boldsymbol{M}_t = \boldsymbol{V}_t\boldsymbol{D}_t\boldsymbol{V}_t^{-1}$, where $\boldsymbol{D}_t$ is a diagonal matrix whose elements are the exponentiated eigenvalues in $\boldsymbol{C}_t$, and that this relationship is unique if the eigenvalues of $\boldsymbol{D}_t$ are, in addition to distinct, real and nonnegative.

This equivalence can be used to obtain time series of estimates of the hazard rates $h_t^{i,j}$. In practice, for every period, we compute the eigenvalues of the discrete transition matrix $\boldsymbol{M}_t$ and check whether they are all distinct, real and nonnegative. Since fortunately that is the case in our two datasets, we take their natural logarithm to obtain the eigenvalues of its continuous-time analogue $\boldsymbol{H}_t$. We then compute h_t^{ij}, and with these in hand we readily obtain a series of time-aggregation corrected transition probabilities using $p_t^{ij} = 1 - exp(-h_t^{ij})$.

A.2 Dynamic Variance Decomposition

Starting from Equation (6) and recalling that, by definition, at every period t labor stocks sum up to the working-age population ($W_t = P_t + F_t + U_t + N_t + X_t$), we can express the System of equations (6) by a reduced-Markov chain

$$\tilde{\boldsymbol{s}}_t = \tilde{\boldsymbol{M}}_t\tilde{\boldsymbol{s}}_{t-1} + \boldsymbol{q}_t, \tag{10}$$

where $\tilde{\boldsymbol{s}}_t = \boldsymbol{s}_t / W_t$, $\boldsymbol{q}_t = \begin{bmatrix} p^{XP} & p^{XF} & p^{XU} & p^{XN} \end{bmatrix}_t'$ and $\tilde{\boldsymbol{M}}_t$ rearranged accordingly. Equation (10) can be written more explicitly in the following way:

$$\begin{bmatrix} \tilde{P} \\ \tilde{F} \\ \tilde{U} \\ \tilde{N} \end{bmatrix}_t = \begin{bmatrix} 1 - p^{XP} - \sum_{j=-P} p^{Pj} & p^{FP} - p^{XP} & p^{UP} - p^{XP} & p^{NP} - p^{XP} \\ p^{PF} - p^{XF} & 1 - p^{XF} - \sum_{j=-F} p^{Fj} & p^{UF} - p^{XF} & p^{NF} - p^{XF} \\ p^{PU} - p^{XU} & p^{FU} - p^{XU} & 1 - p^{XU} - \sum_{j=-U} p^{Uj} & p^{NU} - p^{XU} \\ p^{PN} - p^{XN} & p^{FN} - p^{XN} & p^{UN} - p^{XN} & 1 - p^{XN} - \sum_{j=-N} p^{Nj} \end{bmatrix}_t \times \begin{bmatrix} \tilde{P} \\ \tilde{F} \\ \tilde{U} \\ \tilde{N} \end{bmatrix}_{t-1} + \begin{bmatrix} p^{XP} \\ p^{XF} \\ p^{XU} \\ p^{XN} \end{bmatrix}_t,$$

where, with some abuse of notation, $-j$ indicates all other states but j.

Solving for system (10)'s steady-state (throughout, steady-states are denoted with upper-bar) we obtain:

$$\bar{\tilde{\boldsymbol{s}}}_t = (\boldsymbol{I} - \tilde{\boldsymbol{M}}_t)^{-1} \boldsymbol{q}_t. \tag{11}$$

After some algebraic manipulation, it can be shown that the System of equations (10) has the following partial-adjustment representation:

$$\Delta \tilde{\boldsymbol{s}}_t = \boldsymbol{A}_t \Delta \bar{\tilde{\boldsymbol{s}}}_t + \boldsymbol{B}_t \Delta \tilde{\boldsymbol{s}}_{t-1}, \tag{12}$$

where $\boldsymbol{A}_t = \boldsymbol{I} - \tilde{\boldsymbol{M}}_t$ and $\boldsymbol{B}_t = \boldsymbol{A}_t \tilde{\boldsymbol{M}}_{t-1} \boldsymbol{A}_{t-1}^{-1}$.

Working backwards from system (12), one can express this system in its distributed lag form:

$$\Delta \tilde{\boldsymbol{s}}_t = \overbrace{\boldsymbol{A}_t \Delta \bar{\tilde{\boldsymbol{s}}}_t}^{\text{effect of current steady-state change, } \boldsymbol{E}_{0,t}} + \underbrace{\sum_{k=1}^{t-2} \prod_{n=0}^{k-1} \boldsymbol{B}_{t-n} \boldsymbol{A}_{t-k} \Delta \bar{\tilde{\boldsymbol{s}}}_{t-k}}_{\text{effect of past steady-state changes, } \sum_{k=1}^{t-2} \boldsymbol{E}_{k,t-k} \Delta \bar{\tilde{\boldsymbol{s}}}_{t-k}} + \overbrace{\prod_{k=0}^{t-2} \boldsymbol{B}_{t-k} \Delta \tilde{\boldsymbol{s}}_2}^{\text{effect of initial condition}}. \tag{13}$$

This representation highlights that changes in labor stocks $\tilde{\boldsymbol{s}}_t$ are governed by changes in the underlying flow hazards h^{ij}, which affect both the transition probabilities p^{ij} (the elements of matrices $\boldsymbol{A}_t$ and $\boldsymbol{B}_t$), and the steady-state the system is converging to at every period $\bar{\tilde{\boldsymbol{s}}}_t$.

The connection between flow hazards h_t^{ij} and steady-stade stocks can be seen more clearly by looking at the expression of the continuous-time counterpart of the discrete-time Markov chain (Equation (6)):

$$\dot{\tilde{\boldsymbol{s}}}_t = \tilde{\boldsymbol{H}}_t \tilde{\boldsymbol{s}}_t + \boldsymbol{g}_t, \tag{14}$$

where the elements of matrices $\tilde{\boldsymbol{H}}_t$ and $\boldsymbol{g}_t$ are flow hazards h_t^{ij}. This can be seen more clearly by writing the system explicitly:

$$\begin{bmatrix} \dot{\tilde{P}} \\ \dot{\tilde{F}} \\ \dot{\tilde{U}} \\ \dot{N} \end{bmatrix}_t = \begin{bmatrix} -h^{XP} - \sum_{j=-P} h^{Pj} & h^{FP} - h^{XP} & h^{UP} - h^{XP} & h^{NP} - h^{XP} \\ h^{PF} - h^{XF} & -h^{XF} - \sum_{j=-F} h^{Fj} & h^{UF} - h^{XF} & h^{NF} - h^{XF} \\ h^{PU} - h^{XU} & h^{FU} - h^{XU} & -h^{XU} - \sum_{j=-U} h^{Uj} & h^{NU} - h^{XU} \\ h^{PN} - h^{XN} & h^{FN} - h^{XN} & h^{UN} - h^{XN} & -h^{XN} - \sum_{j=-N} h^{Nj} \end{bmatrix}_t$$

$$\times \begin{bmatrix} \tilde{P} \\ \tilde{F} \\ \tilde{U} \\ \tilde{N} \end{bmatrix}_t + \begin{bmatrix} h^{XP} \\ h^{XF} \\ h^{XU} \\ h^{XN} \end{bmatrix}_t .$$

We use this method to quantify the relative contribution of changes in any particular flow hazard h^{ij} to the variation of changes in any labor stock s. The distributed lag representation of the evolution of labor stocks allows us to take into account, not only the effect of current changes in each flow hazard, but also their past changes. To implement it we follow three steps. First, we use the structure provided by Equation (13) to compute counterfactual series of changes in labor stocks driven only by current and past changes in each flow hazard. Second, using a first-order linear approximation to changes in steady-state stocks driven by changes in flow hazards, the variance of changes in each stock can be expressed as the sum of the covariances between that series of stock changes and its approximation by changes in each flow hazard. Then, the relative contribution of each flow hazard to the variation in each stock is straightforward to compute. Using a first-order linear approximation to the part-time employment share, we compute the variance contribution of each flow hazard to changes in the part-time employment share. We now describe each of these steps in more detail.

Inspection of equation (13) shows that, to obtain counterfactual series of changes in stocks, we need only estimate series of counterfactual changes in steady-state stocks due to changes in each flow hazard. Applying the correction described in Subsection A.1, we have already obtained time series of time-aggregation-corrected transition probabilities (p^{ij}), as well as series of flow hazards h^{ij}. This is sufficient to estimate time series of matrices $\boldsymbol{A}_t$ and $\boldsymbol{B}_t$, which are only a function of transition probabilities.

Taking a first-order approximation to changes in steady-state stocks yields the following expression:

$$\Delta\bar{\tilde{\boldsymbol{s}}}_t \approx \sum_{i \neq j} \frac{\partial \bar{\tilde{\boldsymbol{s}}}_t}{\partial h_t^{ij}} \Delta h_t^{ij}. \tag{15}$$

Given estimates of p^{ij} and (h^{ij}, to obtain $\Delta\bar{\tilde{\boldsymbol{s}}}_t$ we need only compute the partial derivatives $\frac{\partial \bar{\tilde{\boldsymbol{s}}}_t}{\partial h_t^{ij}}$. Analytical expressions for those derivatives can be readily derived by differentiating the continuous-time expression of the system's steady-state with respect to each flow hazard h^{ij}. We first solve (14) to get the continuous-time expression of the system's steady-state:

$$\bar{\tilde{\boldsymbol{s}}}_t = -\tilde{\boldsymbol{H}}_t^{-1} \boldsymbol{g}_t, \tag{16}$$

and then use matrix calculus to compute its partial derivatives with respect to each flow hazard.

A full expression the steady-state of the continuous-time representation of this system reads:

$$
\begin{bmatrix} \bar{\tilde{P}} \\ \bar{\tilde{F}} \\ \bar{\tilde{U}} \\ \bar{\tilde{N}} \end{bmatrix}_t = - \begin{bmatrix} -h^{XP} - \sum_{j=-P} h^{Pj} & h^{FP} - h^{XP} & h^{UP} - h^{XP} & h^{NP} - h^{XP} \\ h^{PF} - h^{XF} & -h^{XF} - \sum_{j=-F} h^{Fj} & h^{UF} - h^{XF} & h^{NF} - h^{XF} \\ h^{PU} - h^{XU} & h^{FU} - h^{XU} & -h^{XU} - \sum_{j=-U} h^{Uj} & h^{NU} - h^{XU} \\ h^{PN} - h^{XN} & h^{FN} - h^{XN} & h^{UN} - h^{XN} & -h^{XN} - \sum_{j=-N} h^{Nj} \end{bmatrix}_t^{-1}
\times \begin{bmatrix} h^{XP} \\ h^{XF} \\ h^{XU} \\ h^{XN} \end{bmatrix}_t .
$$

Feeding the estimates of time series of hazard rates h^{ij} into Equation (15), we substitute in the respective series of first-order approximations to changes in steady-state stocks ($\Delta\bar{\tilde{\boldsymbol{s}}}_t$) into Equation (13), and obtain series of counterfactual changes in labor stocks driven by current and past changes in each flow hazard.

Step two follows from noting that the linearity of Equation (15) implies the following decomposition of the variance of changes in labor stocks:

$$
\mathrm{Var}(\Delta\tilde{\boldsymbol{s}}_t) \approx \sum_{i \neq j} \mathrm{Cov}\left(\Delta\tilde{\boldsymbol{s}}_t, \sum_{k=0}^{t-2} \boldsymbol{E}_{k,t-k} \frac{\partial \bar{\tilde{\boldsymbol{s}}}_{t-k}}{\partial h_{t-k}^{ij}} \Delta h_{t-k}^{ij}\right), \tag{17}
$$

where $\sum_{k=0}^{t-2} \boldsymbol{E}_{k,t-k} \frac{\partial \bar{\tilde{\boldsymbol{s}}}_{t-k}}{\partial h_{t-k}^{ij}} \Delta h_{t-k}^{ij}$ denotes the time series of counterfactual changes in labor stocks driven by current and past changes in each flow hazard (Δh_t^{ij}).

Suppose we want to quantify the contribution of flow hazard h^{FP} to the variation in the stock of part-time workers in % of the working-age population $\tilde{P}_t$. It follows from Equation (17) that:

$$
\mathrm{Var}(\Delta\tilde{P}_t) \approx \sum_{i \neq j} \mathrm{Cov}\left(\Delta\tilde{P}_t, \left[\sum_{k=0}^{t-2} \boldsymbol{E}_{k,t-k} \frac{\partial \bar{\tilde{\boldsymbol{s}}}_{t-k}}{\partial h_{t-k}^{ij}} \Delta h_{t-k}^{ij}\right]_{1,1}\right). \tag{18}
$$

Diving both sides of Equation 18 by $\mathrm{Var}(\Delta\tilde{P}_t)$ yields:

$$
\sum_{i \neq j} \beta_{\tilde{P}}^{ij} \approx 1, \tag{19}
$$

where $\beta_{\tilde{P}}^{ij}$ is the share of the variation in $\Delta\tilde{P}_t$ accounted for by variation in Δh_t^{ij}.

The variance contribution of changes in h^{FP} to the variation in changes in $\tilde{P}_t$ is simply:

$$
\beta_{\tilde{P}}^{FP} = \frac{\mathrm{Cov}\left(\Delta\tilde{P}_t, \left[\sum_{k=0}^{t-2} \boldsymbol{E}_{k,t-k} \frac{\partial \bar{\tilde{\boldsymbol{s}}}_{t-k}}{\partial h_{t-k}^{FP}} \Delta h_{t-k}^{FP}\right]_{1,1}\right)}{\mathrm{Var}(\Delta\tilde{P}_t)} \tag{20}
$$

However, our goal is to quantify the contribution of each transition hazard h^{ij} to the variation in the part-time employment share ($\rho_t = \frac{P_t}{P_t+F_t}$), so there is one more step to complete. Using a first-order linear approximation to the part-time employment share, we express its changes in terms of changes in $\tilde{P}_t$ and $\tilde{F}_t$. That is:

$$\Delta\rho_t \approx \frac{\Delta\tilde{P}_t(1-\rho_{t-1}) - \Delta\tilde{F}_t\rho_{t-1}}{\tilde{P}_{t-1}+\tilde{F}_{t-1}}. \tag{21}$$

B Supplementary Information

B.1 Data Details

Hours Worked: Terminology in the US and UK Labor Force Surveys

The US and UK labor force surveys employ different notions of working hours. Here we provide a brief description of the terminology used in both surveys.

The CPS has two different hours concepts: usual and actual hours. Usual hours measure an individual's normal work schedule. This includes any paid or unpaid overtime, provided they are considered as part of the normal work schedule. In addition for those who report that their hours at work usually vary, the CPS runs certain cross-checks using auxiliary questions which allow to classify these individuals as either "usually part-time" or "usually full-time" workers. Actual hours refer to hours at work during the survey's reference week. Actual hours are measured using the following question: "LAST WEEK, how many hours did you ACTUALLY work". The fact that actual hours typically exhibit higher-frequency variation relative to usual hours is apparent in these definitions. Due to sickness, days off, etc. actual hours are also on average lower than usual hours.

The LFS uses a similar distinction between usual and actual hours of work. In addition, the LFS distinguishes basic from total hours, where basic hours exclude any paid or unpaid overtime hours. Similar to the US, actual hours exclude hours not at work due to sickness, holidays, leave etc. Like in the US data, actual hours in the UK exhibit high-frequency variation and their levels are below those of usual hours.

Adjustments to US Series of Hours Worked

Table 1 in the text (Section 3) reports averages of the US series of hours worked since 1994. Before applying the adjustments described in the table footnote, we need to correct the values at three dates: 1996m01, 1998m09 and 1999m09. The reason is that hours worked are measured over a reference week and therefore they are subject to substantial variations when regular activities during that week are disrupted. This occurred in January 1996 (1996m01) when a major Winter storm hit parts of the United States. As for September 1998 and 1999 (1998m09, 1999m09), the Labor Day holiday fell on Monday of the reference week, which cut weekly hours by about one-fifth at these dates. There is no ideal method to adjust hours for these disruptions. Thus, we simply replace the value computed from the raw data by the average of the two previous and two consecutive values.

Adjustments to UK Series of Gross Flows

There are two problems that needs to be adressed to construct series of worker flows in the UK. The first problem is one of data availability and comes from the change in the LFS's periodicity, from seasonal to calendar quarters. The two-quarters data extract corresponding to the last seasonal quarter of 1996 is not available from the UK Data Service. To overcome this limitation we compute worker flows series in this quarter using the corresponding five-quarter extract. The second problem mainly affects the period between 1995q2 - 1997q2 and the variable that allows one to identify private-firm jobs. In particular, the number of sample respondents to this question drops severely during this period. To obtain a consistent time series of labor flows, we apply a margin-error adjustment (which uses as targets the seasonally unadjusted series of labor stocks) and fit a high-order polynomial to the resulting series during this period.

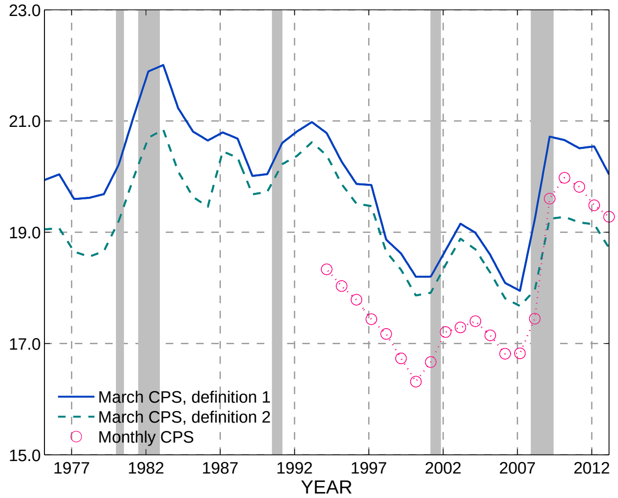


Figure B1: Part-time Employment Shares: Comparison to March CPS data
Sample: workers in the nonfarm business sector. Gray-shaded areas indicate recessionary periods.

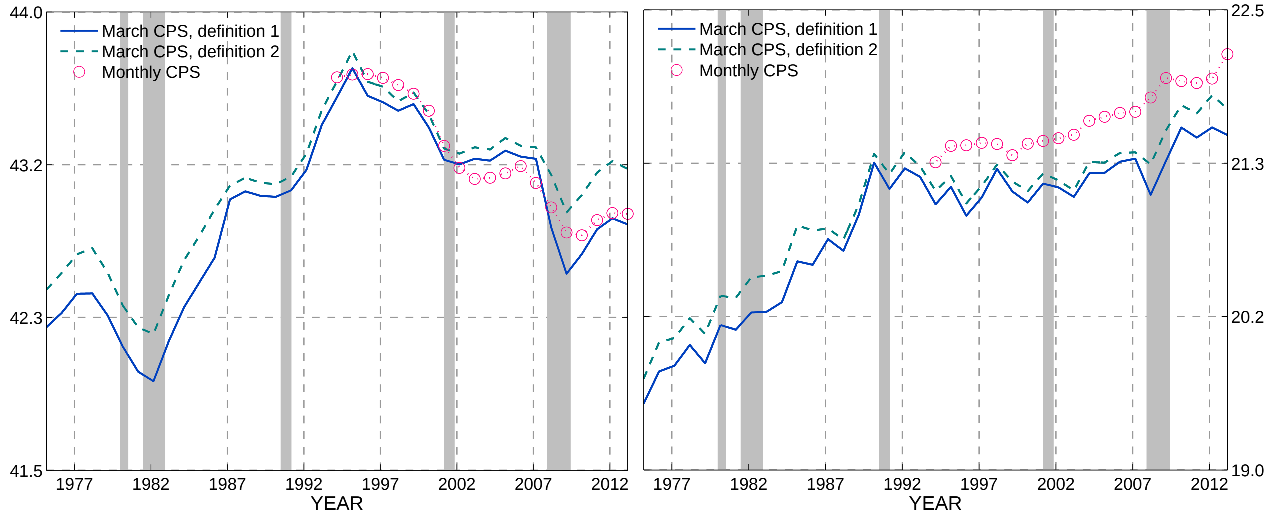
B.2 Comparison to March CPS data

As explained in Section 2, the 1994 re-design of the CPS limits our investigation of part-time work in the US to that period onwards. That is, earlier monthly files of the CPS contain information about actual hours worked only.[41] Using this variable to identify part-time workers would lead us to systematically underestimate the level of part-time employment, and potentially mismeasure their cyclical behavior. Another reason for not going further back in time is that other changes introduced upon the re-design make some of our sample restrictions not applicable before January 1994. For instance, it is not possible to identify multiple jobholders with the earlier files of the CPS.

The March supplements of the CPS provide us with an alternative source of information on part-time employment. Since 1976, the March CPS has been collecting information on normal work schedules, such as part-time vs full-time status, usual weekly hours, number of weeks worked on a part-time basis, etc. Using these data for the years 1976 to 2014, we can produce an annual time series of the part-time employment share from 1975 to 2013 (the March CPS contains information about employment in the previous calendar year). This is useful to check the accuracy of the same time series obtained using the monthly files of the CPS, as well as provide a historical perspective on part-time employment.

Figure B1 reports the part-time employment share in the US nonfarm business sector for the years 1975 to 2013. We use two measurements of part-time work in the March CPS. Definition 1 (solid line) identifies part-time workers as those respondents who define themselves as part-time workers in the previous year. Definition 2 (dashed line) classifies respondents as part-time workers if they report to have worked more than half of the total number of weeks worked in the previous year at a part-time job. Finally, the time series from the monthly CPS (dots) is the yearly average of the part-time employment share displayed in Figure 2 of the paper. In spite of a slight difference in levels for the years 1994 to 2008, it is apparent that the series from the monthly CPS tracks the series from the March CPS well. Two patterns stand out on Figure B1. First, the high levels of part-time employment attained during the Great Recession are not without precedent. Indeed, part-time work was well above 20% during the twin recessions of the 1980s. Second, the recessionary increase in part-time employment was more short-lived during previous downturns. On the other hand, several years after the Great Recession, we

[41] To be precise, the pre-1994 version of the CPS includes the following question: "Do you usually work 35 hours or more a week at this job?". Unfortunately, this does not enable us to obtain a consistent measurement of part-time work before and after the re-design of the survey. Two categories are not well identified before January 1994: (i) workers whose hours of work usually vary and (ii) workers whose normal work schedule includes many overtime or extra hours. As a result, we find part-time employment to be substantially lower in the pre-1994 period, both when compared to the post-1994 series and compared to series based on the contemporaneous March survey.



(a) Full-time Jobs

(b) Part-time Jobs

Figure B2: Average Usual Hours Worked: Comparison to March CPS data
Sample: workers in the nonfarm business sector. Gray-shaded areas indicate recessionary periods.

observe that the part-time employment share gravitates around the peak value reached by the end of the recession. This finding holds both for the monthly files and the March CPS data time series

In Figure B2, we extend the comparison with the March CPS data by looking at average *usual* hours worked in part-time and full-time jobs. This measurement is informative because our definitions of part-time work in the March CPS do not depend directly on usual hours worked. Yet, as illustrated in Figure B2, they result in average usual hours in full-time and part-time jobs that line up closely with those based on the monthly CPS. This obviates concerns regarding the choice of the threshold in usual hours used to define part-time work (see Subsection 2.4). In particular, we note that usual hours in full-time jobs are remarkably similar across definitions and across surveys (left plot). As for usual hours in part-time jobs (right plot), the slight difference seems to be caused by the greater number of respondents with usual hours between 1 and 10 in the March CPS. This plot also reveals an otherwise not documented fact regarding the evolution of the US labor market, namely the secular increase in average hours of work in part-time jobs. We find a similar pattern in the UK data.

B.3 Case Study: The 2001 Recession

In this subsection, we provide a brief case study of the 2001 recession in the US. In so doing, our goal is to assess whether the patterns we uncover are specific to the Great Recession. Our overall assessment is that the 2001 recession confirms most of our conclusions, but offers a picture of employment adjustment which is not as stark as in the Great Recession.

Figure B3 repeats the measurement exercise we perform in the Introduction: the solid line shows the observed series of hours per worker, while the dashed and dotted lines report the two counterfactual series of hours per worker. The picture conveyed by Figure B3 appears disctinct from that in Figure 1, and this for the following reason. Beginning in 2000m05, hours per worker in full-time jobs started to decline at a steady, but rapid, pace. Part of this downward trend is picked up by the counterfactual series based on changes in hours (dotted line), which inflates the role played by this series in explaining the recessionary fall in hours per worker. Thus, to clarify the mechanisms at work we fix the fraction of part-time and full-time jobs (resp. hours worked in full-time and part-time jobs) to their levels in 2000m05, not 2001m02 (that is, the last period before the recession).[42]

[42]Our choice echoes the discussion that emerged in the aftermath of the 2001 recession regarding its exact starting

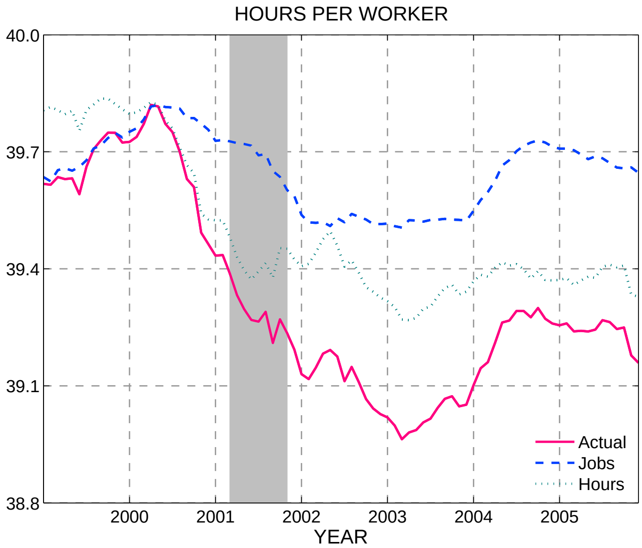


Figure B3: Actual and Counterfactual Hours per Worker in the US 2001 Recession
The solid line is the actual time series of weekly hours per worker. The dashed (dotted) line is the counterfactual series measuring the effects of changes in part-time and full-time jobs (in hours worked in part-time and full-time jobs). It is obtained by fixing hours in each job type to their pre-recession levels (the fraction of part-time and full-time jobs) and allowing only the fraction of part-time and full-time jobs (hours in each job type) to change. The gray-shaded area indicates the 2001 recession period.

Focusing on the recessionary period as indicated by the gray-shaded area, Figure B3 shows that changes in hours per worker in full-time and part-time jobs played a non-negligible role during the first months of the recession. As of the summer of 2001, the continued decline in hours per worker was increasingly driven by changes in the part-time employment share. In the summer of 2002, meanwhile, we observe another decline in hours per worker stemming from the dotted line, not the dashed line. Overall, hours per worker in full-time jobs seem to have played a larger role in this recessionary episode, although the three-year downward trend yields a less clear-cut picture compared to the Great Recession. On the other hand, during the 2004 expansion the increase in hours per worker was clearly driven by the reduction in part-time jobs, not by changes in hours per worker in either job category.

B.4 Additional Descriptive Statistics on Usual Hours Worked

A brief glance at the distribution of usual hours worked is informative as to the distinction between part-time and full-time jobs. Table B1 characterizes the distribution of usual hours in the US and the UK, emphasizing the ranges of hours in which hours tend to be distributed uniformly vs the hours at which we observe a mass of individuals. The table indicates a vast degree of heterogeneity in part-time jobs. In the US we observe a mass of workers at 20, 25 and 30 weekly hours. The picture is less clear-cut for the UK: there are mass points at 20 and 30 weekly hours, as well as large proportions of workers under 10 hours or between 11 and 19 hours. By comparison, full-time jobs is a more homogeneous category. In the US, full-time workers can be almost exclusively ascribed to a single hour category, namely 40 weekly hours. In the UK, we observe more dispersion across hours bins. Nevertheless, workers with hours in the range between 35 and 44 account for 77.5% of full-time employment, similar to the 40 hours category in the US.

The information contained in Table B1 is also relevant for gauging the effect of the cutoff value in hours used to define part-time jobs. In the US, we notice that the range from 35 to 39 hours accounts for less than 7% of full-time employment. Aligning the statistical definition of part-time work to its

date. In fact, the first signs of slowdowns in the labor market were felt during the year 2000 (see e.g. Martel and Langdon [2001]).

Table B1: Usual Hours Worked in Part-time and Full-time Jobs

Part-time Jobs					
	United States			**United Kingdom**	
	Percent	Cum.		Percent	Cum.
< 10	6.8	6.8	< 10	14.1	14.1
10	4.1	10.9	10	4.6	18.7
11–19	16.8	27.7	11–19	32.6	51.3
20	21.9	49.6	20	12.9	64.2
21–24	7.7	57.3	21–24	13.1	77.3
25	11.0	68.3	25	6.4	83.7
26–29	3.4	71.6	26–29	6.1	89.8
30	18.5	90.1	30	10.2	100
31–34	9.9	100.0	–	–	–
Full-time Jobs					
	United States			**United Kingdom**	
–	–	–	31–34	2.5	2.5
35–39	6.8	6.8	35–39	11.1	13.6
40	69.1	75.9	40	39.9	53.5
41–44	1.5	77.3	41–44	26.6	80
45	5.5	82.9	45	9.4	89.5
46–49	1.6	84.5	46–49	2.9	92.4
50	8.0	92.5	50	3.3	95.7
51–59	2.4	94.9	51–59	1.7	97.4
> 59	5.1	100.0	> 59	2.6	100

Notes: Sample: private-firm salaried workers. Period: Years 2004-2006.

legal definition (see Subsection 2.4) would thus only mildly increase measured part-time employment shares. Similarly in the UK, adding workers in the range 31 to 34 hours to the part-time employment category would reduce the number of full-time jobs by only 2.5 percentage points. Our measurement of part-time work thus appears consistent with the underlying distribution of usual hours in both countries.

B.5 Involuntary Part-time Employment

This subsection characterizes the incidence of involuntary part-time work over the business cycle. In so doing, our objective is to provide further evidence in support of the findings in Section 6.

Definition

We use the definitions of involuntary part-time work directly provided by the BLS and the ONS. In the US, involuntary part-time workers are those individuals who report working part-time for economic reasons. The BLS defines part-time work for economic reasons as *part-time work that stems from slack work or unfavorable business conditions, inability to find full-time work, or seasonal declines in demand.* In the UK, the LFS asks respondents who report working on a part-time basis if they accepted a job with a lower schedule of working hours *because they could not find a full-time job.* This information is used to identify involuntary part-time workers among those who just moved to a part-time job.

We note that although these two definitions of involuntary part-time work are not identical, the differences between them are not a major impediment to our analysis. Our goal is not to compare the levels of involuntary part-time work across countries. Rather, we are interested in the variation of the incidence of part-time work over the business cycle. Thus, the relevant question for our purpose is whether the cyclical behavior of involuntary part-time work is similar in both countries – and, if yes, whether it is consistent with the hypothesis of variable labor utilization put forward in Section 6.

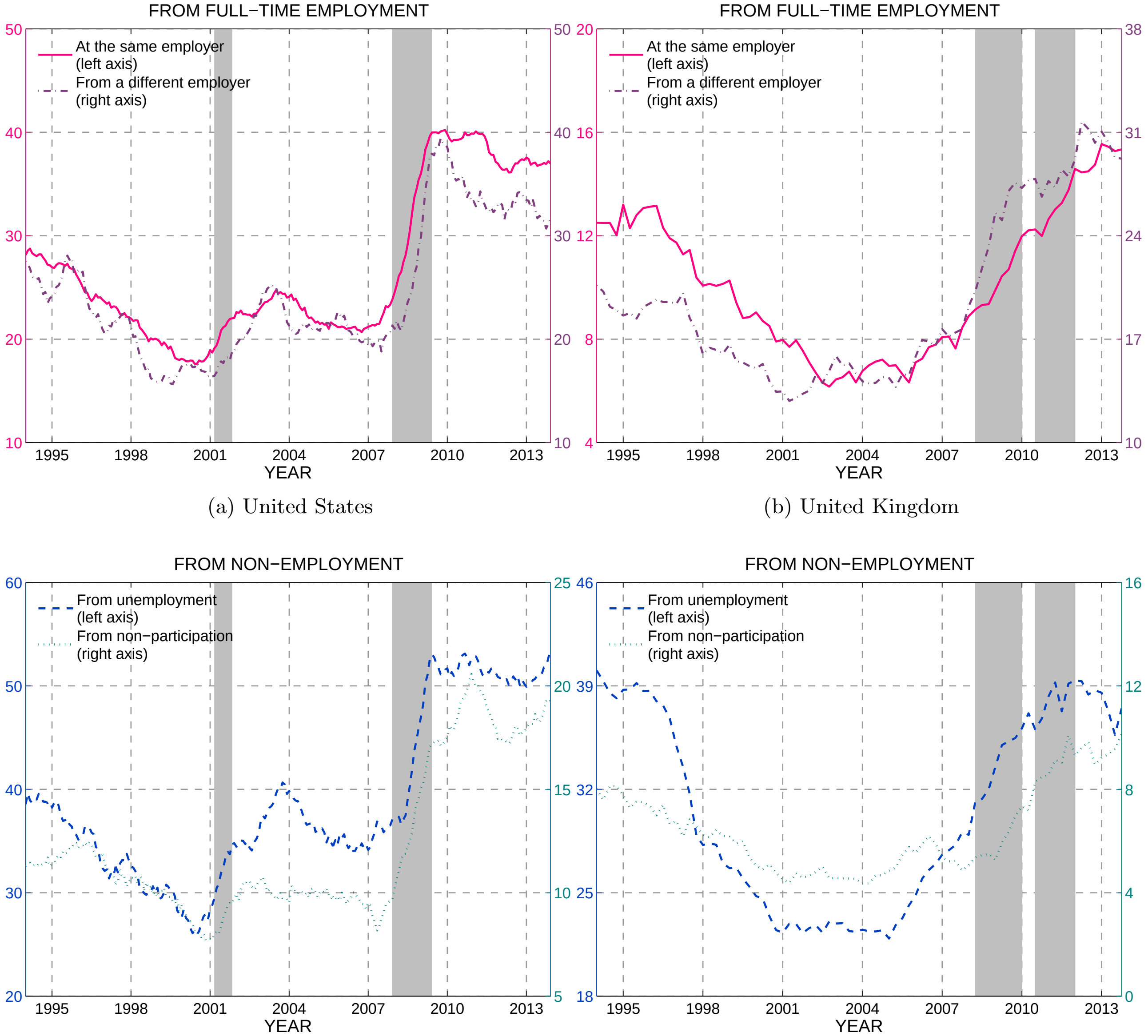
Results

In Figure B4, we provide a visual answer to these questions. The different plots show the share of involuntary part-time work, defined as the proportion of involuntary part-time workers among new entrants into part-time employment. We emphasize that we restrict attention to workers who just moved into part-time work (that is, in the current month in the US, or the current quarter in the UK), and we distinguish them according to the labor market state of origin. To improve legibility, Figure B4 reports only four time series: (i) from full-time employment (upper plots), either at the same employer or upon changing employer and (ii) from non-employment (lower plots), either from unemployment or from nonparticipation.[43]

Both in the US and the UK, the fraction of new part-time workers who take on a part-time position for economic reasons is countercyclical. Most significant to our analysis is the evolution of involuntary part-time work among those who retain their current employer. There we notice a marked increase during downturns. This supports the view that firms adjust the hours of their employees downwards, and that the latter cannot but accept a reduced schedule of working hours. The lower plots reveal another interesting pattern, namely that the recessionary increase in the time series is also present for workers who move from nonparticipation into part-time employment. This is noteworthy because one may expect individuals in nonparticipation to delay entry in the labor market during downturns if they cannot find a job that meets their requirements in terms of working hours. Nevertheless, we cannot rule out the possibility that this countercyclical pattern results from time-aggregation, i.e. that

[43] To be precise, the upper plots show the series for: workers who move from a full-time to a part-time position at the same employer (solid line) and workers who move from either a full-time or part-time position to a part-time position at a different employer (dashed-dotted line). As for the latter, we decided to pool together full-time and part-time workers who change employers in order to increase the size of the inflow.

it masks a transition from nonparticipation to unemployment followed by a transition to a part-time job.



(a) United States

(b) United Kingdom

(c) United States

(d) United Kingdom

Figure B4: Incidence of Involuntary Part-time Work in Transitions towards Part-time Jobs
Sample: private-firm salaried workers. Centered moving averages of seasonally adjusted series. Gray-shaded areas indicate recessionary periods.

To summarize the information conveyed in Figure B4, Table B2 reports the average of each time series in non-recession periods, the average during the Great Recession and the percentage change relative to the pre-recession period.[44] Table B2 reveals cross-country differences in the extent of involuntary part-time work for reasons we cannot fathom. Turning to Columns (2) and (3), Table B2 quantifies the countercyclical pattern identified visually in Figure B4. During the Great Recession in the US (resp. the UK), the share of transitions from a full-time position to an involuntary part-time position at the same employer increased by 43% (resp. 61%). Transitions from non-employment towards involuntary part-time work also rose substantially: by 38% in the US and 46% in the UK. In sum, the behavior during the Great Recession appears consistent with the idea of a firm-level, demand-driven

[44] We maintain the approach adopted in Section 6 and define the pre-recession episode as the preceding five-year period.

shift towards part-time work.

Table B2: Incidence of Involuntary Part-time Work: Average and Changes over the Recession

	Non-recession period	Great Recession	
		Average	Change (%)
A. United States			
From employment at the same employer	26.58	31.97	43.18
From employment at a different employer	24.51	26.99	25.62
From unemployment	38.78	43.08	17.72
From nonparticipation	12.32	13.38	37.50
B. United Kingdom			
From employment at the same employer	9.73	11.62	60.53
From employment at a different employer	17.91	26.29	67.04
From unemployment	29.19	35.82	45.12
From nonparticipation	6.18	7.39	45.68

Notes: Sample: private-firm salaried workers. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4. The raw series of gross flows have been seasonally adjusted.

B.6 Additional Descriptive Statistics on Part-time Work

In this subsection we report additional descriptive statistics on part-time employment that complement the information displayed in Table 3 in the main text. Tables B3 and B4 display, respectively for the US and the UK, industry and occupation categories' shares of total and part-time employment (Columns (1) and (2)), as well as their part-time employment shares (Column (3)). For practical purposes, these statistics are only reported for those occupations and industries that are more representative in terms of total employment (the top five categories).

Focusing on Column (3) of both tables, the heterogeneity in part-time intensities among the most representative industries and occupations stands out. Among these few, highly representative industries the part-time employment share ranges from 7.0 to 32.7% in the US, and from 8.0 to 41.3 in the UK. These figures are even more striking among occupations. The part-time employment shares of the top-five occupations in terms of employment go from 4.4 to 43.9%, in the US, and from 5.9 to 72.5%, in the UK. Inspection of Column (2) of both tables shows that some of these industries and occupations represent an important share of part-time employment. But the figures in those columns also highlight that this form of employment is widespread, covering an nonnegligible share of employment in very distinct industries and occupations in both countries. For example, the construction sector and managerial occupations exhibit low part-time intensities, whereas the part-time shares of retail trade and sales positions are quite high.

Table B3: Part-time Employment: Descriptive Statistics – United States

	% of population total (1)	% of population part-time (2)	Part-time employment share (3)
All	–	–	16.7
a. Gender			
Men	56.0	33.5	10.0
Women	44.0	66.5	25.2
b. Age			
16 to 24 years	18.1	45.4	41.9
25 to 34 years	24.4	16.6	11.3
35 to 44 years	24.9	15.3	10.2
45 to 54 years	21.7	12.8	9.8
55 to 64 years	10.9	9.8	15.1
c. Education			
Low	13.9	23.2	27.8
Middle	32.5	27.0	13.8
High	24.5	31.2	21.2
Very high	29.1	18.6	10.6
d. Occupations (top 5)			
Executive, administrative, and managerial occupations	8.8	2.3	4.4
Sales representatives, commodities	8.6	18.4	35.5
Food preparation and service occupations	6.7	17.7	43.9
Construction trades, except supervisors	4.7	1.6	5.7
Motor vehicle operators	4.2	2.3	9.2
e. Industries (top 5)			
Retail Trade	23.0	45.1	32.7
Professional and Related Services	17.3	21.3	20.5
Manufacturing, Durable Goods	10.2	1.9	3.0
Construction	8.4	3.5	7.0
Finance, Insurance, and Real Estate	8.2	4.9	9.9

Notes: Sample: private-firm salaried workers. Period: Years 2004-2006. Panels a., b. and c. of the table reproduce Table 3 in the text. Panel d. (resp. e.) show the corresponding statistics in the five occupations (resp. industries) with the largest share of total employment. **Education categories**: Low is "Less than high-school", Middle is "High-school graduates", High is "Some college", Very high is "College or higher education". **Occupations and Industries**: Two-digit categories of the corresponding 2000 Census classification schemes.

Table B4: Part-time Employment: Descriptive Statistics – United Kingdom

	% of population total	% of population part-time	Part-time employment share
	(1)	(2)	(3)
All	–	–	24.7
a. Gender			
Men	58.0	23.1	9.9
Women	42.0	76.9	45.1
b. Age			
16 to 24 years	19.9	31.0	38.6
25 to 34 years	24.1	17.0	17.4
35 to 44 years	24.9	22.2	22.0
45 to 54 years	17.3	14.2	20.2
55 to 64 years	12.0	14.1	29.0
c. Education			
Low	24.2	28.3	28.9
Middle	52.1	57.7	27.4
High	23.7	14.0	14.6
d. Occupations (top 5)			
Sales assistants and retail cashier	9.2	25.6	68.8
Functional managers	5.9	1.4	5.9
Elementary personal service occupations	4.0	11.8	72.5
Administrative occupations: finance	3.7	5.0	33.4
Transport Drivers and operatives	3.6	1.4	9.4
e. Industries (top 5)			
Wholesale, retail and motor trade	22.1	37.0	41.3
Manufacturing	20.4	6.7	8.0
Real estate and renting	14.0	10.6	18.7
Transport, storage and communication	8.3	4.4	13.1
Construction	7.8	2.5	8.0

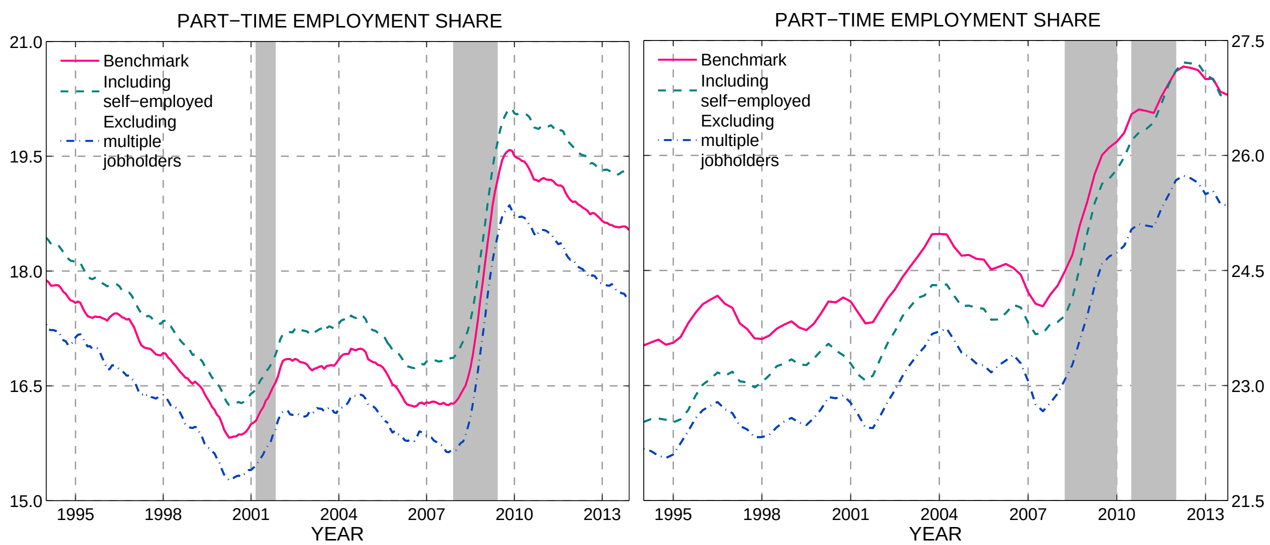
Notes: Sample: private-firm salaried workers. Period: Years 2004-2006. Panels a., b. and c. of the table reproduce Table 3 in the text. Panel d. (resp. e.) show the corresponding statistics in the five occupations (resp. industries) with the largest share of total employment. **Education categories.**: Low is "Primary education (below GCSE)", Middle and high is "Secondary Education (A-level, GCSE or equivalent)" and Very high is "Higher Education or more". **Occupations and Industries**: Two-digit occupation groups of the Standard Occupational Classification (SOC) 2000. Industries are the 17 sections of the Standard Industry Classification (SIC) 92.

C Robustness Checks

C.1 Multiple jobholders and the Self-employed

In the main text we describe the dynamics of the part-time employment share in the sample of private-firm salaried workers, where these workers may be single or multiple jobholders. Another relevant category of individuals excluded from our main sample is the self-employed. To complement and assess the robustness of the main results, we present here the time-series beavior of the part-time employment share measured in different subsamples, and also report the estimated beta coefficients for each of these subsamples.

The two graphs in Figure C1 plot the part-time employment share measured in the benchmark sample (solid line), in the sample that includes the self-employed (dashed line) and in the sample that excludes multiple jobholders (dash-dotted line), respectively in the US and the UK. The main conclusion we draw from these figures is that relaxing the restrictions of our main sample disposition only marginally affects the levels of part-time employment and leaves its cyclical properties virtually unchanged. In the US, the part-time employment share is larger when the self-employed are included in the sample, and lower if multiple jobholders are removed from it. The latter pattern is what one would expect given that multiple jobholders tend to work part-time in their multiple jobs. In the UK, the part-time employment share is lower both when dual jobholders are excluded from the sample and also when the self-employed are included in it. As already mentioned, self-employment is more commom in the UK relative to the US. Therefore, it likely to be a less marginal form of employment, which is one reason why self-employed workers in the UK may be more likely to work full-time.



(a) United States

(b) United Kingdom

Figure C1: Part-time Employment Share – Different Samples

The displayed series are centered moving-averages of seasonally adjusted series.

We now turn to the quantitative description of the dynamics of the part-time employment share in each of the two alternative samples. For results based on labor stocks, multiple jobholders are unlikely to affect the main results, as they represent a very small share of employment. In the US, where moonlighting is more frequent, multiple jobholders account for 5.5% of employment on average over the sample period. This figure is smaller for the UK, just over 4%. Multiple jobholding is potentially more problematic when analyzing flows, as these workers may be subject to higher and distinct mobility patterns vis-a-vis single jobholders. Table C1 reports variance contributions of the flow hazards in our model, estimated on a sample that excludes multiple jobholders.[45] The table reveals some slight

[45]More specifically, we remove from our sample individuals who reported to hold more than one job either in period t

(informative) differences compared to the figures reported in Table 6, but the substantive results are the same. In particular, in both countries p^{FP} and p^{PF} account for more than half of the variation in the part-time employment share. However, those shares are smaller by 8.5 and 10.1 pp respectively for the US and the UK. By comparison, the relative contributions of all other labor market states increase, particularly those of nonparticipation (7.3 pp 4.6, resp. for the US and the UK).

Table C1: Part-time Employment Share Variance Contributions - Single Jobholders

	United States	**United Kingdom**
β_ρ^{PF}	35.3	27.9
β_ρ^{FP}	32	22.9
$\beta_\rho^{PF} + \beta_\rho^{FP}$	67.2	50.8
β_ρ^{PU}	2.8	2.61
β_ρ^{FU}	1.78	9.02
β_ρ^{UP}	3.72	-2.04
β_ρ^{UF}	1.83	9.21
$\sum_{i=P,F} \beta_\rho^{iU} + \sum_{j=P,F} \beta_\rho^{Uj}$	10.1	18.8
β_ρ^{PN}	5.24	11.4
β_ρ^{FN}	-1.69	0.15
β_ρ^{NP}	15.8	2.15
β_ρ^{NF}	2.43	2.78
$\sum_{i=P,F} \beta_\rho^{iN} + \sum_{j=P,F} \beta_\rho^{Nj}$	21.8	16.5
β_ρ^{PX}	0.48	0.13
β_ρ^{FX}	1.11	6.36
β_ρ^{XP}	2.4	2.46
β_ρ^{XF}	5.13	0.52
$\sum_{i=P,F} \beta_\rho^{iX} + \sum_{j=P,F} \beta_\rho^{Xj}$	9.13	9.46
$\sum_{i=U,N,X} \sum_{j=P,F} \beta_\rho^{ij}$	31.4	15.1
$\sum_{i=P,F} \sum_{j=U,N,X} \beta_\rho^{ij}$	9.72	29.7
$\sum_{i,i\neq j} \beta_\rho^{ij}$	108.3	95.5
Obs.	238	78

Notes: Sample: private-firm salaried workers, no multiple jobholders. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4. The raw series of transition probabilities have been seasonally adjusted and corrected for time aggregation and margin error.

Table C2 reports the results in the sample that also includes self-employed individuals. The resulting lower contribution of reallocation via other forms of employment (X) translates itself into an increase in the variance contribution of p^{FP}, both in the US and the UK. The other relevant changes differ across countries. In the UK, the contribution of reallocation via unemployment increases, while that of nonparticipation decreases. The converse occurs in the US. Overall, the results in Table C2 suggest that the cyclical patterns of part-time employment are similar across salaried and self-employed workers,

or period $t-1$.

particularly in what concerns the prominence of reallocation between part-time and full-time positions.

Table C2: Part-time Employment Share Variance Contributions - Private-firm workers

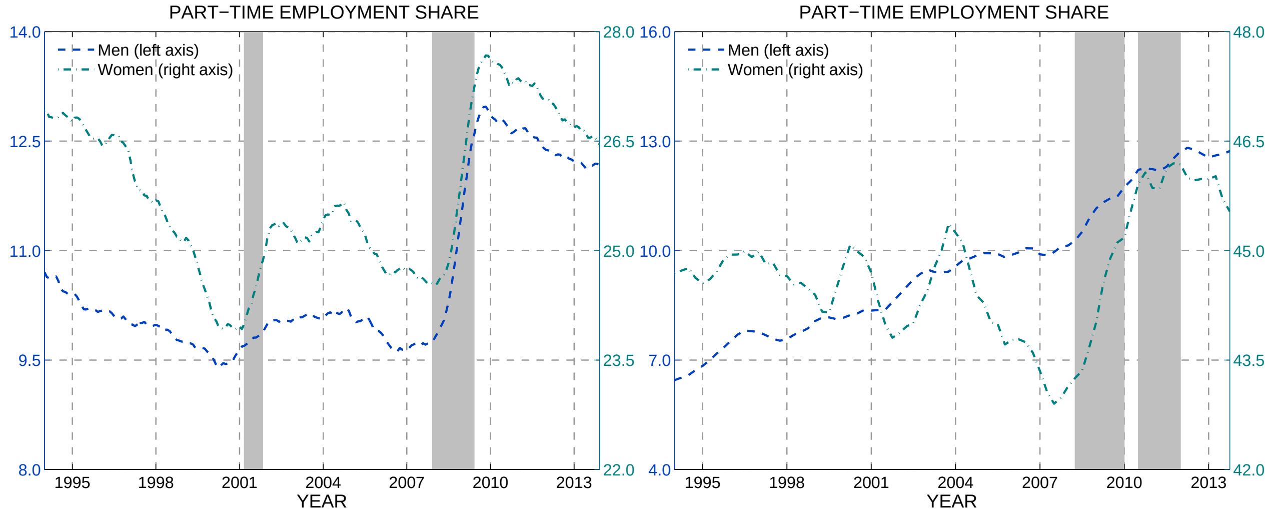
	United States	**United Kingdom**
β_ρ^{PF}	32.4	34.7
β_ρ^{FP}	44.7	31.9
$\beta_\rho^{PF} + \beta_\rho^{FP}$	77.1	66.6
β_ρ^{PU}	-1.18	-2.69
β_ρ^{FU}	1.98	10.2
β_ρ^{UP}	1.87	0.15
β_ρ^{UF}	2.78	11.4
$\sum_{i=P,F} \beta_\rho^{iU} + \sum_{j=P,F} \beta_\rho^{Uj}$	5.45	19.1
β_ρ^{PN}	2.23	8.34
β_ρ^{FN}	0.48	0.29
β_ρ^{NP}	12.2	-0.95
β_ρ^{NF}	1.73	1.8
$\sum_{i=P,F} \beta_\rho^{iN} + \sum_{j=P,F} \beta_\rho^{Nj}$	16.6	9.49
β_ρ^{PX}	0.043	0.79
β_ρ^{FX}	0.48	3.15
β_ρ^{XP}	1.75	0.35
β_ρ^{XF}	2.02	-0.51
$\sum_{i=P,F} \beta_\rho^{iX} + \sum_{j=P,F} \beta_\rho^{Xj}$	4.3	3.78
$\sum_{i=U,N,X} \sum_{j=P,F} \beta_\rho^{ij}$	22.3	12.2
$\sum_{i=P,F} \sum_{j=U,N,X} \beta_\rho^{ij}$	4.03	20.1
$\sum_{i,i\neq j} \beta_\rho^{ij}$	103.5	98.9
Obs.	238	78

Notes: Sample: private-firm workers, includes self-employed workers. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4. The raw series of transition probabilities have been seasonally adjusted and corrected for time aggregation and margin error.

C.2 Gender

In this subsection we look at the dynamic patterns of part-time employment across genders. Figure C2 displays the part-time share in the sample of female and male private-firm salaried workers. It reveals marked differences across the two countries. In the US, the incidence of part-time employment is quite similar across genders, and its cyclical behavior is common among men and women. On the other hand, in the UK part-time work is much more prevalent among women and is also more cyclical among them. Part-time employment among men is only marginally cyclical and it exhibits an upward trend over the whole period.

The variance decomposition of the part-time employment among female private firm-salaried workers



(a) United States

(b) United Kingdom

Figure C2: Part-time Employment Shares – Gender

The displayed series are centered moving-averages of seasonally adjusted series.

is reported in Table C3. Unsurprisingly, the results are similar to those using the baseline sample, as women hold the majority of part-time jobs. This is more stiking in the US compared to the UK. In this country, β^{PF} is quite a lot smaller among women vs the full sample, while the contribution of reallocation via Other employment is larger with respect to the full sample.

The patterns of the dynamics of part-time employment among men reported in Table C4 reveal some clear-cut contrasts vis-a-vis those of women (who, due to their greater importance in part-time work, essentially drive the aggregate behavior). In the US the differences are not quantitatively large, but there is a noticeable higher importance of other employment- and unemployment-reallocation to the variation in the part-time employment share among men. In the UK the differences are more salient. While the overall importance of reallocation between part-time and full-time jobs is quantitatively similar among both genders, its composition is markedly distinct. Unlike among female workers, the importance of the variation in the flow hazard from part-time to full-time is quite large among men (46.9 vs 18.6, resp. for men and women), whereas that of the reverse transition rate is much smaller (15.9 vs 32.7 resp., for men and women). Similarly, the variance contribution of reallocation via other employment is higher among women, while that of unemployment is higher among men. Last, the importance of private-firm salried jobs inflows is about 16 pp larger among women.

C.3 Different subperiods

The last robustness exercise involves estimating beta coefficients in two subsamples, obtained by dividing the original sample in two equally long samples. The results are displayed in Table C5. The analysis of this table suggests three remarks. First, the importance of reallocation between part-time and full-time positions is higher during the period which comprises the Great Recession. Second, in the US the two subperiods portray a rather similar picture of the dynamics of part-time employment. The main difference is the greater importance of nonparticipation-reallocation in the first subperiod and of unemployment reallocation in the period comprising the Great Recession. Third, the UK exhibits a distinct dynamics during the two subperiods. During the Great Recession period the dynamics of part-time work is strongly driven by fluctuations in the transition from part-time to full-time employment, with a lower relative contribution of both unemployment and nonparticipation. One final note. The last two remarks are consistent with the distinct labor market histories experienced in the two countries between 1994 and the early 2000s. The UK escaped the 2001 recession, experienced a period

Table C3: Part-time Employment Share Variance Contributions - Female private-firm salaried workers

	United States	**United Kingdom**
β_ρ^{PF}	36.1	18.6
β_ρ^{FP}	41.3	32.7
$\beta_\rho^{PF} + \beta_\rho^{FP}$	77.4	51.3
β_ρ^{PU}	-2.68	2.55
β_ρ^{FU}	0.94	2.17
β_ρ^{UP}	4.4	3.3
β_ρ^{UF}	2.86	6.43
$\sum_{i=P,F} \beta_\rho^{iU} + \sum_{j=P,F} \beta_\rho^{Uj}$	5.52	14.4
β_ρ^{PN}	2.48	5.26
β_ρ^{FN}	0.77	1.78
β_ρ^{NP}	9.77	2.15
β_ρ^{NF}	3.26	4.1
$\sum_{i=P,F} \beta_\rho^{iN} + \sum_{j=P,F} \beta_\rho^{Nj}$	16.3	13.3
β_ρ^{PX}	-0.71	3.36
β_ρ^{FX}	0.26	5.98
β_ρ^{XP}	2.86	7.48
β_ρ^{XF}	3.96	2.69
$\sum_{i=P,F} \beta_\rho^{iX} + \sum_{j=P,F} \beta_\rho^{Xj}$	6.37	19.5
$\sum_{i=U,N,X} \sum_{j=P,F} \beta_\rho^{ij}$	27.1	26.2
$\sum_{i=P,F} \sum_{j=U,N,X} \beta_\rho^{ij}$	1.07	21.1
$\sum_{i,i\neq j} \beta_\rho^{ij}$	105.6	98.6
Obs.	238	78

Notes: Sample: private-firm salaried workers, excludes males. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4. The raw series of transition probabilities have been seasonally adjusted and corrected for time aggregation and margin error.

of declining unemployment rates, which was accompanied by an expansion of part-time work. On the other hand, the US suffered a mild recession followed by a quick expansion. Similar to the second half of the sample, the labor market experienced a countercyclical response of part-time employment and unemployment.

Table C4: Part-time Employment Share Variance Contributions - Male private-firm salaried workers

	United States	**United Kingdom**
β_ρ^{PF}	33.4	46.9
β_ρ^{FP}	33.8	15.9
$\beta_\rho^{PF} + \beta_\rho^{FP}$	67.2	62.8
β_ρ^{PU}	5.69	2.99
β_ρ^{FU}	0.12	4.93
β_ρ^{UP}	6.19	8.56
β_ρ^{UF}	3.18	4.35
$\sum_{i=P,F} \beta_\rho^{iU} + \sum_{j=P,F} \beta_\rho^{Uj}$	15.2	20.8
β_ρ^{PN}	3.5	6.13
β_ρ^{FN}	-0.82	-0.76
β_ρ^{NP}	7.73	2.06
β_ρ^{NF}	2.95	-0.074
$\sum_{i=P,F} \beta_\rho^{iN} + \sum_{j=P,F} \beta_\rho^{Nj}$	13.4	7.36
β_ρ^{PX}	1.55	-1.09
β_ρ^{FX}	0.62	2.93
β_ρ^{XP}	3.82	-1.51
β_ρ^{XF}	11.4	3.93
$\sum_{i=P,F} \beta_\rho^{iX} + \sum_{j=P,F} \beta_\rho^{Xj}$	17.4	4.26
$\sum_{i=U,N,X} \sum_{j=P,F} \beta_\rho^{ij}$	35.3	17.3
$\sum_{i=P,F} \sum_{j=U,N,X} \beta_\rho^{ij}$	10.7	15.1
$\sum_{i,i\neq j} \beta_\rho^{ij}$	113.1	95.2
Obs.	238	78

Notes: Sample: private-firm salaried workers, excludes females. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4. The raw series of transition probabilities have been seasonally adjusted and corrected for time aggregation and margin error.

Table C5: Part-time Employment Share Variance Contributions - Private-firm salaried workers

	United States		**United Kingdom**	
	1994m02-2004m01	2004m01-2013m12	1994q2-2004q1	2004q1-2013q4
β_ρ^{PF}	35.6	36.1	21.1	42.2
β_ρ^{FP}	37.3	43.5	26.6	26.9
$\beta_\rho^{PF} + \beta_\rho^{FP}$	72.9	79.5	47.7	69.1
β_ρ^{PU}	1.5	-2.23	-1.15	1.48
β_ρ^{FU}	-0.82	5.15	5.88	8.43
β_ρ^{UP}	2.43	4.75	5.67	-12.1
β_ρ^{UF}	2.32	3.57	10.4	11.6
$\sum_{i=P,F} \beta_\rho^{iU} + \sum_{j=P,F} \beta_\rho^{Uj}$	5.44	11.2	20.8	9.48
β_ρ^{PN}	5.07	-0.86	8.83	6.43
β_ρ^{FN}	0.43	0.71	1.71	0.00
β_ρ^{NP}	12.6	6.8	6.99	2.16
β_ρ^{NF}	0.69	3.08	1.16	3.01
$\sum_{i=P,F} \beta_\rho^{iN} + \sum_{j=P,F} \beta_\rho^{Nj}$	18.8	9.74	18.7	11.6
β_ρ^{PX}	-0.034	-0.95	2.13	0.27
β_ρ^{FX}	0.28	1.12	5.91	6.4
β_ρ^{XP}	2.52	1	-1.3	6.04
β_ρ^{XF}	4.14	2.3	7.24	0.054
$\sum_{i=P,F} \beta_\rho^{iX} + \sum_{j=P,F} \beta_\rho^{Xj}$	6.9	3.47	14	12.8
$\sum_{i=U,N,X} \sum_{j=P,F} \beta_\rho^{ij}$	24.7	21.5	30.1	10.8
$\sum_{i=P,F} \sum_{j=U,N,X} \beta_\rho^{ij}$	6.43	2.94	23.3	23
$\sum_{i,i\neq j} \beta_\rho^{ij}$	104.1	104	101.2	102.9
Obs.	119	119	39	39

Notes: Sample: private-firm salaried workers. **US**: Monthly data 1994m01 – 2013m12. **UK**: Quarterly data 1994q1 – 2013q4. The raw series of transition probabilities have been seasonally adjusted and corrected for time aggregation and margin error.