Employment Adjustment and Part-time Work: Lessons from the United States and the United Kingdom*

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Abstract

We document that fluctuations in part-time employment play a major role in movements in hours per worker during cyclical swings in the labor market. Building on this result, we develop a stock-flow framework to describe the dynamics of part-time employment. The evolution of part-time employment is predominantly explained by cyclical changes in transitions between full-time and part-time employment. Those transitions occur overwhelmingly at the same employer, entail sizable changes in individuals' working hours and are associated with an increase in involuntary part-time work. Our findings provide a novel understanding of the cyclical dynamics of labor adjustment on the intensive margin.

JEL codes: E24; E32; J21.

Keywords: Employment; Hours; Part-time Work; Business Cycles

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1 Introduction

The separation of adjustment in total hours worked in adjustments in the number of employed workers (the extensive margin) and hours per worker among those employed (the intensive margin) is a central distinction in modern business cycle analysis (Rogerson and Shimer [2011], Ohanian and Raffo [2012]).[1] By combining data on labor market stocks and flows, recent research has significantly advanced our understanding of the behavior of the extensive margin (Shimer [2012], Elsby et al. [2013, 2015]). In this paper, we extend this line of research to study the behavior of the intensive margin. We show that in the United States and the United Kingdom the intensive margin lends itself to a stock-flow representation, which can be used to relate cyclical fluctuations in hours per worker to flows of workers across a small set of labor market states. The picture that emerges from our analysis is a rich and novel characterization of the dynamics of the intensive margin.

We start our analysis by documenting a new fact. The cyclical behavior of hours per worker is closely tracked by changes in the number of part-time workers among those employed, a quantity that we call *the part-time employment share*. In both countries, the part-time employment share accounts for a substantial share of employment and is very strongly countercyclical. Using simple statistical decompositions, we show that it accounts for the lion's share of the drop in hours per worker at the onset of recessions and its slow recovery during recessionary episodes. As a result of these observations, the cyclical variation on the intensive margin can be aptly described through the dynamics of the part-time employment share.

We develop an empirical framework based on a Markov-chain model in order to describe the dynamics of the part-time employment share. We draw on a vast body of research that uses this modeling framework to study unemployment through the behavior of worker transitions between employment and non-employment states.[2] In our model, in addition to unemployment and non-participation, workers can be in full-time or part-time employment in a private-sector paid position.[3] This specification allows to separate out fluctuations in the part-time employment share driven by changes *within employment* and changes *between employment and non-employment* states. Indeed, the literature shows that the composition of the pool of employed workers changes with the business cycle, and that adjustments in and out of employment play a key role in those dynamics (see e.g. Solon et al. [1994], or recently Mueller [2017]). In light of this, a major contender to explain fluctuations in hours per worker is the cyclicality of worker flows between employment and non-employment. Our results lead to a clear rejection of this explanation, as movements in transitions between full-time and part-time work without an intervening spell of non-employment account for most of the variation in part-time employment.

At this point, our analysis indicates that a deeper understanding of the dynamics of the intensive margin requires a close examination of transitions between full-time and part-time work. We start by considering the role of turnover across employers. A common view in the literature is that jobs have

[1] Ohanian and Raffo [2012] construct new data covering several OECD countries over a long period of time. They document that both movements in employment and hours per worker are quantitatively important to explain variation in total hours worked. 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 in the United States and in the largest European economies.

[2] See, e.g., sections 1.1.2 and 1.1.3. in the handbook chapter by Rogerson and Shimer [2011] for a summary of the literature since the work by Blanchard and Diamond [1990], and Elsby et al. [2015] for recent methodological advances in the statistical decompositions used in this literature.

[3] For completion, we also allow for a fifth labor market state, which lumps together all jobs provided outside private-sector paid employment. This allows us to distinguish potential differences in adjustment on the intensive margin between paid employment in the private sector and other forms of employment, like the public sector and self-employment.

fixed working hours, so that workers need to move jobs in order to change their hours (see Blundell et al. [2008] and references therein). Under this hypothesis, the countercyclicality of the part-time employment share mirrors the procyclicality of job-to-job mobility. A tighter labor market may allow workers employed on a part-time basis to increase their hours by moving to a new employer. An alternative hypothesis emphasizes the role of within-employer changes. When the labor market is slack, employers may adjust to shocks by moving part of their current workers from full-time to part-time employment. Our analysis strongly supports the latter hypothesis, as most of those transitions occur at the same employer. Next, we characterize the distribution of hours changes involved in transitions between full-time and part-time work. The average of these hours changes is close to one and a half working days, and the distributions exhibit mass points at exact multiples of a full working day.[4] Last, we assess the role played by involuntary part-time work in transitions between full-time and part-time employment, and find that it becomes a predominant driver of the dynamics observed during recessions.

To sum up, we establish the following facts for the two countries:

Fact 1: The cyclical variation in hours per worker is driven to a large extent by fluctuations in the share of part-time employed workers. This holds for the major recessions of the past four decades in the U.S. and for the Great Recession in the U.K.

Fact 2: The bulk of the variation in the part-time employment share is accounted for by cyclical fluctuations in transition rates between full-time and part-time work.

Fact 3: The cyclical variation in transitions between full-time and part-time work is predominantly accounted for by transitions at the same employer.

Fact 4: Transitions between full-time and part-time work at the same employer entail sizable and lumpy adjustments in individuals' working hours.

Fact 5: The incidence of involuntary part-time employment among new part-time workers increases dramatically in recessions, and is mostly driven by full-time workers facing slack work conditions.

Our interpretation of Facts 1 to 5 is that they reflect the ability of firms to vary the intensity of labor utilization, and that this ability offers an alternative to firing and hiring workers during cyclical swings in the labor market. In economic downturns, reducing the hours of current employees allows employers to avoid layoffs and save on future hiring and training costs.[5] If job requirements are highly specialized and suitable workers are hard to find, hiring and firing costs can be substantial. Moreover, during bad times workers have lower outside options, so they are more likely to accept a reduction in labor income via a decrease in working hours. On the other hand, in good times hiring costs may be amplified by an intense competition for workers. The facts documented in Cooper et al. [2007] and

[4] These observations show that transitions between full-time and part-time work reflect *actual* changes in labor market state, and they also help understand the high explanatory power of our partition of the schedule of working hours into two categories only (full-time and part-time work).

[5] Besides these costs, there are rules as well as policies that entail very different costs from employing workers on a full-time vs. a part-time basis. In the U.S., when there is sufficient differentiation between full-time and part-time workers (so that the Fair Labor Standards Act's rule of consistent treatment across employees is circumvented), it is not unusual to pay benefits such as vacation pay, holidays, personal days, healthcare, and retirement benefits only for full-time employees. The Affordable Care Act of 2010 follows that logic: it introduces penalties for employers with 50 or more employees who do not provide health insurance to their full-time workers (Even and Macpherson [2015]). Similarly, the major in-work benefit program in the U.K., the Working Families Tax Credit, defines eligibility to tax credits on minimum thresholds of working hours (at 16 and 30 weekly hours) (Blundell et al. [2008]).

Trapeznikova [2017] buttress our interpretation. Using establishment micro-data respectively from the U.S. and Denmark, they document that changes in establishment-level hours and employment are both quantitatively important and find evidence of a degree of substitution between them.[6] Differently from these papers, we relate those patterns to the procyclicality of hours per worker – the countercyclicality of the part-time employment share – observed at the aggregate level. This relationship suggests that firm-level adjustments play a central role in the behavior of the intensive margin.

Our paper carries two main implications for macroeconomic research on labor markets. First, the finding that labor adjustment on the intensive margin exhibits a fair amount of lumpiness challenges a conventional assumption of standard dynamic labor-supply models, that hours worked are the outcome of a smooth, concave maximization problem. Second, the finding that firms play a prominent role in aggregate labor adjustment on the intensive margin cautions against abstracting from this margin in models of employment adjustment. We provide a discussion of these implications in the last section of the paper.

We strike a note of caution before closing this introduction. Our analysis draws lessons from forty years of data and several major economic downturns in the U.S and the U.K. The analysis of U.K. data indicates that the importance of part-time employment is a more recent phenomenon in this country. Of course, it is an open question whether our findings extend beyond these two countries. The U.S. and the U.K. differ from other advanced economies along a number of dimensions, one of which is the relative importance of the intensive margin. The latter explains about one third of fluctuations in U.S. and U.K. total hours, which is low by international standards (Ohanian and Raffo [2012]). While we do not claim that our results generalize to other countries, we think our empirical framework can be easily adapted to study the intensive margin in other settings.

The paper unfolds as follows. Section 2 presents the data and the main definitions used in our analysis. Section 3 elaborates on the close relationship between fluctuations in hours per worker and the evolution of part-time employment. In Section 4, we decompose the evolution of the part-time employment share in the variation of transition probabilities across labor market states. Section 5 characterizes in more detail transitions between full-time and part-time work and summarizes our empirical results in a hypothesis of variable labor utilization. Section 6 presents our conclusions.

2 Data and Definitions

This section presents our data sources, sample and measurements of the main concepts of our analysis.

Data Sources. Our analysis is based on micro-data from the Current Population Survey (CPS) for the U.S. and from the Labor Force Survey (LFS) for the U.K. These two surveys share a number of common features relevant for our analysis. First, they are conducted at a relatively high frequency (monthly for the U.S., quarterly for the U.K.) and span a long period of time (1976–2016 for the U.S., 1977–2016 for the U.K., with the quarterly survey starting in the second quarter of 1992). Second, both have a longitudinal component that we use to match respondents across two consecutive interviews (in the U.K. only in the quarterly survey). Doing so enables us to identify workers' transitions across labor market states and construct measurements of gross labor market flows. Third, the variables used to circumscribe the sample and measure labor market objects can be made consistent across surveys.

[6] Specifically, the standard deviations of hours and employment growth have a similar magnitude and the two margins of adjustment are negatively correlated at the establishment level.

This ensures comparability between the figures we report for the U.S. and the U.K. Additional details about the CPS and the LFS are reported in the online appendix.

Sample. We present results for two samples: working-age (between 16 and 64 years old) and prime-age individuals (25 to 54 years old).[7] Among the employed population, we focus on individuals who receive a wage or salary working in the private sector. For the U.S., this definition comprises workers in the non-farm business sector who are not unpaid family workers or non-incorporated self-employed. In the U.K. this definition comprises employees whose main job is provided by the private sector as defined by the U.K. National Accounts. In both countries, the population of private-sector paid workers represents a very large share of total employment: 77.2% in the U.S. and 62.6% in the U.K.

Definitions and Measurements. Both labor force surveys collect information on usual and actual hours worked per week. Usual hours measure an individual's usual work schedule, including any paid or unpaid overtime, provided it is considered part of the *usual* schedule.[8] Actual hours refer to hours at work during the survey's reference week. In the CPS, information on usual and actual hours is obtained by asking surveyed individuals the following questions: *'How many hours per week do you usually work at all job(s)?'* and *'Last week, how many hours did you actually work at all job(s)?'*. Since hours worked at the respondent's main job can be distinguished from hours worked at other jobs (if any) only in recent waves of the survey, we use hours worked at all jobs as our main measurement of hours.[9] We show in Subsection 5.3 that this is inconsequential for our results. The definitions and measurements of working hours available in the LFS are very similar, but usual hours are only measured for the main job.

We define as part-time workers individuals who work (strictly) less than 35 usual hours per week. This is the official definition used by the U.S. Bureau of Labor Statistics. Using a different threshold of hours worked to define part-time work affects its levels, but not the main patterns we document (transition probabilities, business-cycle fluctuations, etc.).

3 Hours per Worker and Part-time Employment

In this section we present evidence in support of Fact 1, by uncovering a close empirical relationship between the cyclical behavior of actual hours per worker and fluctuations in part-time employment.

3.1 Evidence for the United States

Preliminaries. Our analysis of the intensive margin begins with a simple identity. Hours per worker at time t (h_t) can be calculated as the following weighted average:

[7] Until 2010 the U.K. working-age definition included men between 16 and 64 years old and women between the ages of 16 and 59. In August 2010 the ONS moved to a uniform definition of working age that includes all individuals between the ages of 16 and 64 (see Clegg et al. [2010]). While this change does not affect our analysis of labor market stocks, it limits our measurement of labor market flows to working-age individuals as per the pre-2010 definition. Until the second quarter of 2011 the two-quarter micro-data files contain information only on those individuals, which forces us to restrict the sample accordingly in order to obtain a consistent time series of labor market flows.

[8] The term 'usual' is determined by each respondent's own understanding of the term. The CPS Interviewing Manual instructs interviewers to define the term as '50% of the time or more, or the most frequent schedule during the past 4 or 5 months' (U.S. Bureau of the Census [2013]), should the respondent asks for a definition of 'usual'.

[9] The CPS underwent a complete overhaul in January 1994 (see Cohany et al. [1994]). As a result, we must use a number of refinements to obtain U.S. time series that are consistent over the whole sample period. These refinements are highlighted in the text and presented in Appendix A. In the online appendix, we provide extensive details and show that our results are not driven by the adjustments addressing the 1994 redesign of the CPS.

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

where ω_t^F (ω_t^P) is the share of workers in full-time (part-time) employment and h_t^F (h_t^P) is average hours per worker in full-time (part-time) employment.[10] Since by definition $\omega_t^F + \omega_t^P = 1$, we only need to keep track of one of the two employment shares. For convenience we focus on the part-time employment share, ω_t^P. Equation (1) implies that fluctuations at the intensive margin can be separated into changes in hours among full-time and part-time workers and changes in the part-time employment share. A straightforward way to assess their contribution to the dynamics of the intensive margin is to construct counterfactual series of hours per worker that hold the h_t^i's (ω_t^P) fixed to their respective sample means, while letting ω_t^P (h_t^i's) move as in the data; and then inspect how closely they track the behavior of the observed series of hours per worker.

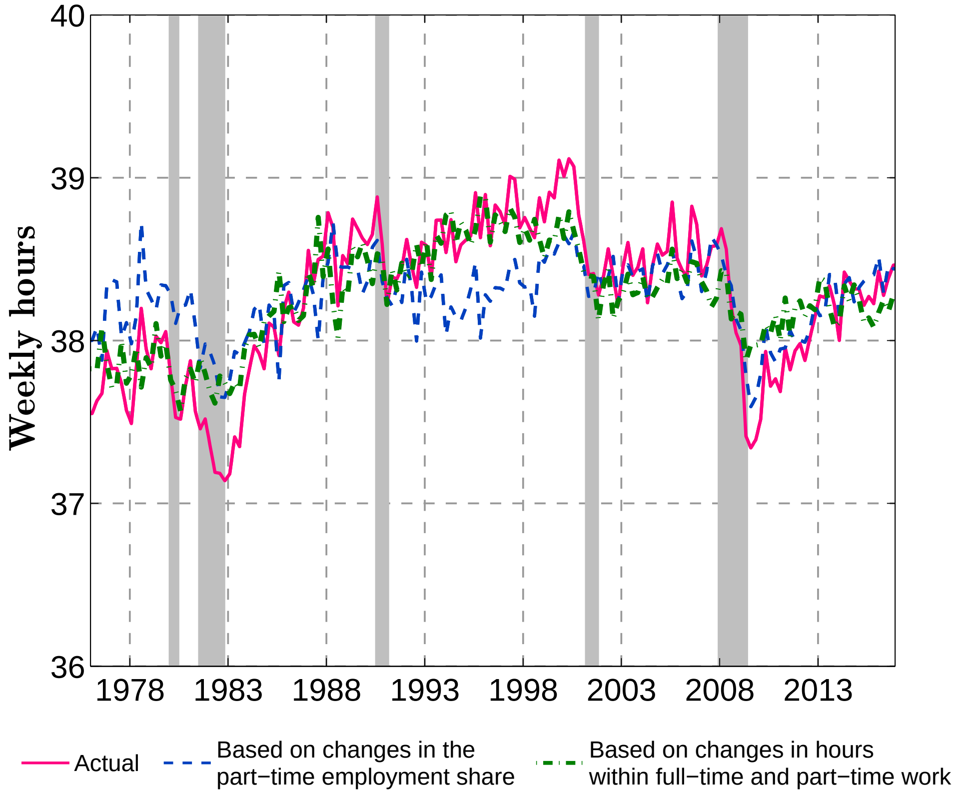


Figure 1: U.S. Hours per Worker, 1976–2016: All Working-age Individuals

Notes: Current Population Survey, quarterly average of monthly data, all working-age individuals in private-sector paid employment. The solid line shows the actual series of hours per worker. The dashed (resp. dashed-dotted) line shows the counterfactual series of hours per worker constructed from changes in the part-time employment share (resp. from changes in hours within part-time and full-time work). Gray-shaded areas indicate NBER recession periods.

Figure 1 plots the two counterfactual series (the dashed and dashed-dotted lines) along with the actual series of hours per worker (solid line). The gray-shaded areas indicate recessionary episodes identified by the National Bureau of Economic Research (NBER). Starting with the behavior of the solid line, the most salient pattern is the well-known procyclicality of hours per worker. Large drops in hours per worker around recessions are followed by rather slow recoveries (with the exception of

[10] The full-time/part-time employment status based on *usual* hours cannot be defined before 1994. Therefore, in order to calculate h_t^F and h_t^P, we use a different approach that defines the employment status using actual hours and, whenever possible, longitudinal matching; see Appendix A for details.

the Twin Recessions of the early 1980s). The solid line also exhibits a substantial amount of short-run variation that is more clearly visible during expansions. Its average value over the sample period is 38.3 weekly hours.

Moving to the behavior of dashed and dashed-dotted lines, we observe a clear co-movement between them and the solid line. On the 'eyeball metric', the dashed-dotted line appears quantitatively important to explain low-frequency changes in hours per worker across decades, such as the increase in hours between the mid-1980s and late 1990s. Compared to the dashed-dotted line, the dashed line appears slightly more volatile around a roughly constant mean value. Clearly, the two counterfactual series move procyclically and contribute to the fall in hours per worker during each recessionary episode, with the dashed line being closely synchronized with the solid line during the larger recessions (the Twin Recessions of the 1980s and the Great Recession).

Decomposing Changes in Hours per Worker. When quantifying the role of part-time employment to cyclical fluctuations at the intensive margin, we focus on the variation in hours per worker around recession periods, when the change in hours per worker is larger. We summarize the cumulative change in hours per worker during these cyclical swings by computing what we call delta coefficients, denoted $\Delta h_{s,t}$. The observed change in hours per worker, h_t, between some quarter s and any future quarter t , $\Delta h_{s,t}$, is given by

$$\Delta h_{s,t} \equiv h_t - h_s = \sum_{\tau=s}^{t-1} h_{\tau+1} - h_\tau. \tag{2}$$

Using the partition of employment into full-time and part-time work introduced in equation (1), we can write $\Delta h_{s,t}$ as follows:

$$\Delta h_{s,t} = \sum_{\tau=s}^{t-1} \left[\sum_{i=F,P} \left(\omega^i_{\tau+1} - \omega^i_\tau\right) \frac{h^i_\tau + h^i_{\tau+1}}{2} + \sum_{i=F,P} \left(h^i_{\tau+1} - h^i_\tau\right) \frac{\omega^i_\tau + \omega^i_{\tau+1}}{2} \right] \tag{3}$$

The first term inside the square brackets yields a series of chain-weighted changes in hours per worker driven by changes in the part-time employment share.[11] We use it to define the following coefficient:

$$\gamma_{s,t} \equiv \frac{1}{\Delta h_{s,t}} \times \sum_{\tau=s}^{t-1} \sum_{i=F,P} \left(\omega^i_{\tau+1} - \omega^i_\tau\right) \frac{h^i_\tau + h^i_{\tau+1}}{2}. \tag{4}$$

$\gamma_{s,t}$ (or gamma coefficient) exactly quantifies the contribution of the part-time employment share to changes in hours per worker between quarter s and quarter t.[12] In the next paragraphs, we compute gamma coefficients to measure the role of part-time employment for the dynamics of hours per worker during cyclical swings.

Analysis of U.S. Recessions. We take a closer look at recessions episodes in Figure 2a. Each plot in Figure 2a shows, in addition to the actual series of hours per worker, two counterfactual series holding either the h^i_t's or ω^P_t fixed to their value at the recession peak (denoted as quarter

[11] As in equation (1), we only need to keep track of one of the two categories of employment.

[12] An alternative calculation consists in measuring the share of the variance of $\Delta h_{s,t}$ explained by its covariance with $\sum_{\tau=s}^{t-1} \sum_{i=F,P} \left(\omega^i_{\tau+1} - \omega^i_\tau\right) \frac{h^i_\tau + h^i_{\tau+1}}{2}$ over a short-time horizon. Using a horizon of one quarter ($s = t - 1$), the corresponding variance contribution is 61% for hours among all working-age individuals and 46% for prime-age individuals. Both numbers are remarkably close to the peak-to-trough coefficients $\gamma_{s,t}$ reported in, respectively, Figures 2a and 2b. Thus, this approach yields similar conclusions. We choose to focus on the coefficients $\gamma_{s,t}$ because they enable us to provide a richer characterization of the dynamics of hours per worker.

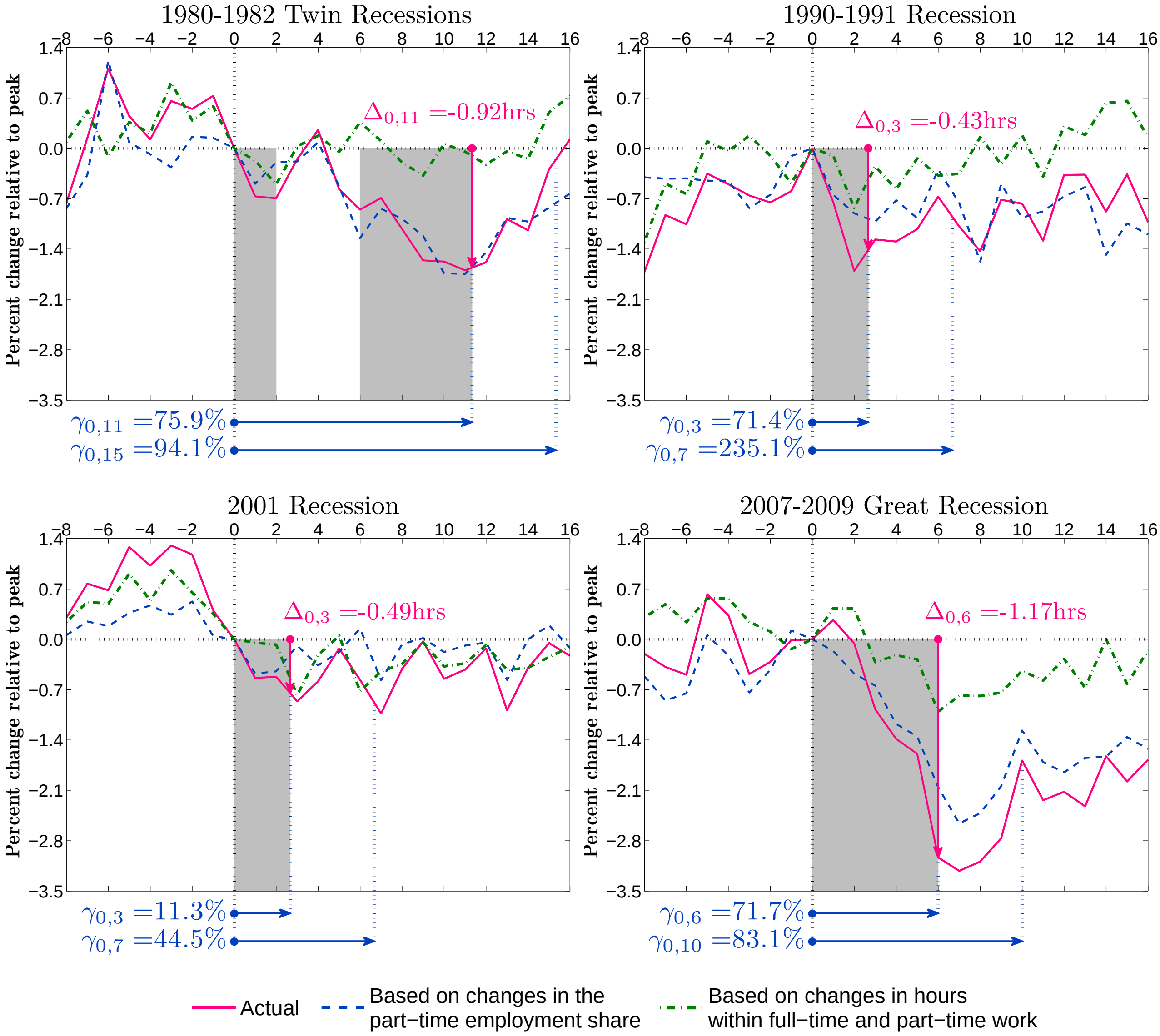


Figure 2a: Change in U.S. Hours per Worker during Recessions: All Working-age Individuals

Notes: Current Population Survey, quarterly average of monthly data, all working-age individuals in private-sector paid employment. The solid line shows the actual series of hours per worker. The dashed (resp. dashed-dotted) line shows the counterfactual series constructed from changes in the part-time employment share (resp. from changes in hours within part-time and full-time work). All series are in percent change relative to the peak of the business cycle episode (quarter 0). $\Delta_{s,t}$ reports the peak-to-trough change in the levels of hours per worker. $\gamma_{s,t}$ reports the contribution of the part-time employment share to the change in hours per worker over the period indicated by the horizontal arrow (see text for details). Gray-shaded areas indicate NBER recession periods.

0 on the horizontal axis). All series are expressed in percentage change relative to date 0 to ease comparisons across recessions. In each plot we also report a delta coefficient summarizing the peak-to-trough change in hours per worker in each recession (denoted by the vertical arrow), and two gamma coefficients calculated respectively at the peak-to-trough change and at the change from the peak to one year after the recession's trough (both are denoted by horizontal arrows).

Consider first the Great Recession, displayed in the bottom right graph of Figure 2a. Hours per worker fell by 3.03% from peak to trough, and the delta coefficient indicates the corresponding change in levels of -1.17 hours. Hours per worker continued to fall for one quarter after the recession and recovered slowly in the ensuing period, so much so that they remained 1.67% below their pre-crisis

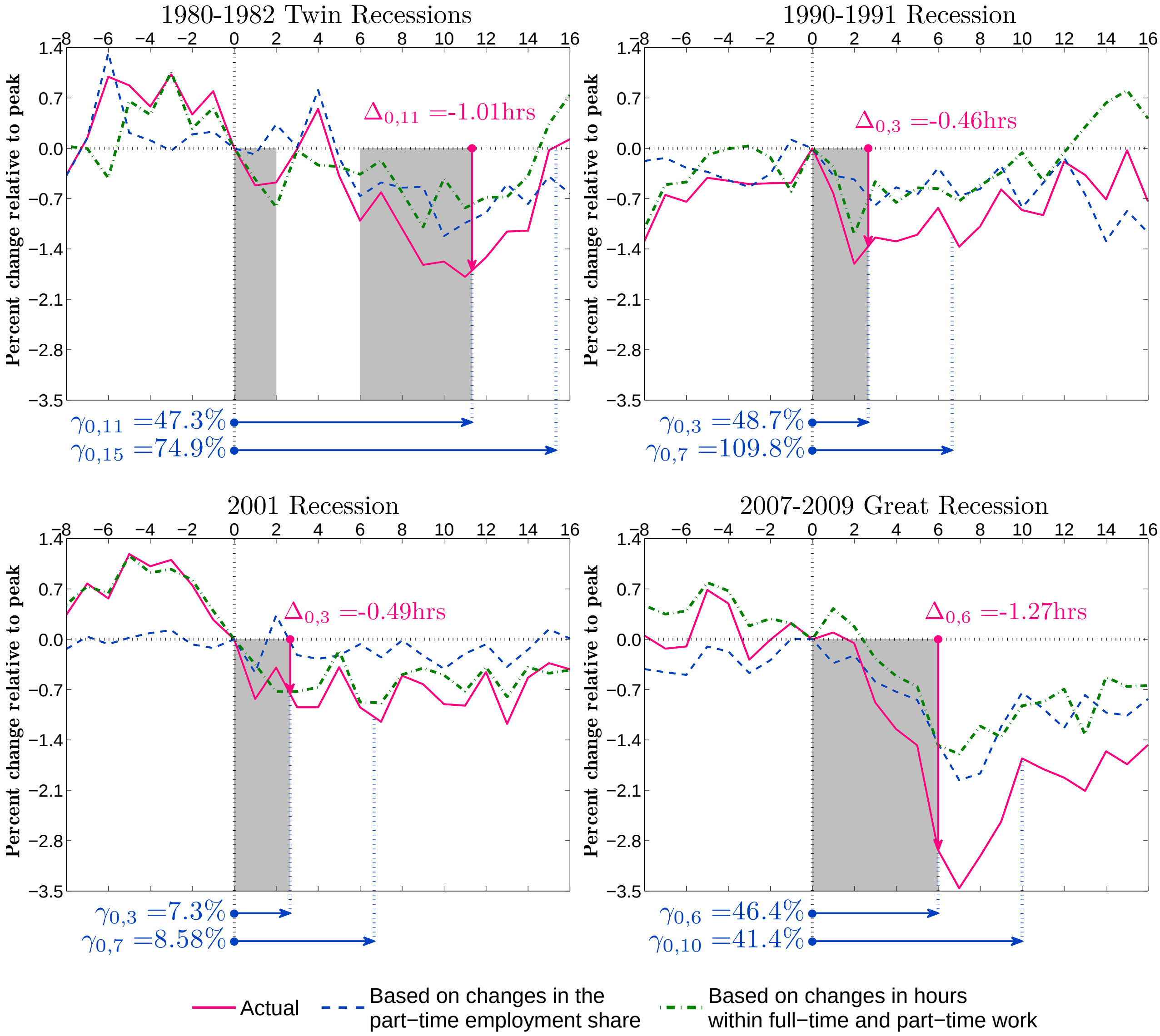


Figure 2b: Change in U.S. Hours per Worker during Recessions: Prime-age Individuals

Notes: Current Population Survey, quarterly average of monthly data, prime-age individuals in private-sector paid employment. The solid line shows the actual series of hours per worker. The dashed (resp. dashed-dotted) line shows the counterfactual series constructed from changes in the part-time employment share (resp. from changes in hours within part-time and full-time work). All series are in percent change relative to the peak of the business cycle episode (quarter 0). $\Delta_{s,t}$ reports the peak-to-trough change in the levels of hours per worker. $\gamma_{s,t}$ reports the contribution of the part-time employment share to the change in hours per worker over the period indicated by the horizontal arrow (see text for details). Gray-shaded areas indicate NBER recession periods.

level four years after the start of the recession. The dashed line tracks closely the solid line, indicating that the part-time employment share drives most of the decline beheld in the Great Recession, as well as the sluggish recovery during the recession's aftermath. The delta coefficients are respectively 71.7 and 83.1%.

We observe similar patterns during the 1980-1982 Twin Recessions (top left graph) and for the milder recession that took place in the early 1990s (top right graph), but not during the 2001 recession.[13] The $\gamma_{s,t}$'s confirm this visual inspection: the part-time employment share explains over 70%

[13] Hours per worker behave quite differently during the 2001 recession. They take their biggest hit during the two quarters prior to the start of the recession, and the role of the part-time employment share in these dynamics is dwarfed by changes in hours within part-time and full-time work. This difference may be related to the difficulty of teasing out

of the peak-to-trough drop in hours per worker in three out of the four recessions covered by our sample.[14] Moreover, the part-time employment share is largely responsible for the slow dynamics of hours per worker during the recovery period, especially after deeper recessions.

Next, we turn our attention to adjustment in hours per worker among prime-age individuals, reported in Figure 2b.[15] There is considerable interest in separating out this group from old and young workers because part-time employment is far more prevalent among the latter. We find that changes in the part-time employment share remain an important source of fluctuations at the intensive margin among prime-age workers: they account for almost 50% of the peak-to-trough change in hours per prime-age worker during recessions. In our view, this finding is remarkable, since labor force attachment is typically stronger among prime-age workers. We would therefore expect to find substantially more sluggishness in their full-time/part-time employment status, making most of the adjustment occur via changes in hours within each employment types. As just shown, this expectation is only partially borne out by the data. We will see that the other empirical patterns documented in our analysis are actually more, not less, pronounced when we focus on prime-age individuals.

3.2 Evidence for the United Kingdom

Figure 3 is the counterpart of Figure 1 for hours per worker in the U.K. The gray-shaded areas denote recession periods identified by the Economic Cycle Research Institute (ECRI).[16] As illustrated in the plot, the business-cycle history of the U.K. is similar to that of the U.S., the main difference being the absence of a recession in the early 2000s.

The U.K. labor market experienced a decrease in hours per worker from the late 1970s up to the early 2000s, after which they stabilized around 33 hours. This secular evolution is punctuated by clear cyclical swings during recession periods. Although the U.K. and U.S series are not directly comparable (due to differences in the frequency of measurement and the definition of hours used), the U.K. series seems to exhibit a lower short-run variation. In what concerns the role of part-time employment, the differences are starker. The behavior of the counterfactual series in Figure 3 is qualitatively similar (procyclical), indicating that both the part-time employment share and changes in hours within full-time and part-time work contribute to the cyclical dynamics of the intensive margin. However, up until the early 2000s, the evolution of the part-time employment share contributes mainly to the secular trend in hours per worker, while the evolution of hours within employment types drives most of the cyclical variation. From the early 2000s to 2010s, on the other hand, the behavior of part-time employment resembles more closely the dynamics of the intensive margin. This is visible in the closer

secular from cyclical events for the 2001 recession episode. Hours per worker in full-time employment started to decline at a steady, but rapid, pace during the summer of 2000. Part of this downward trend is picked up by the counterfactual series of hours within employment types, and this inflates the role played by the dashed-dotted line in explaining the solid line. On a different level, these observations question the accuracy of the NBER dates for the 2001 recession. Other authors have stressed that the first signs of slowdowns in the labor market were felt during the year 2000, which does not line up with the NBER start date (see e.g. Martel and Langdon [2001]).

[14] Recall that the $\gamma_{s,t}$'s provide an exact measurement of the contribution of ω_t^P to the cumulative change in hours between quarter s to quarter t. The counterfactual series plotted in Figure 2a provides a good approximation over a short time horizon of the change in hours relative to the value at the recession peak. Clearly, the sum of the dashed and dashed-dotted lines closely tracks the solid line in each graph of Figure 2a.

[15] The comparison of Figures 2a and 2b indicates that fluctuations in hours per worker are not substantially different among prime-age individuals. Relative to this group, young workers have more volatile weekly hours while older workers have much lower volatility in their weekly hours. As a result, the effects of trimming the population both below 25 and above 54 years old roughly cancels out. We further note that these observations are not inconsistent with Jaimovich and Siu [2009], who report that labor market volatility is hump-shaped in age. Their results concern total annual hours worked per individual, which aggregate weekly hours and annual weeks worked per individual. Among older workers, the latter source of variation (annual weeks of work) offsets the lower volatility of their weekly hours (Blundell et al. [2011]).

[16] We use the March 2017 update of the ECRI business cycles dates available at `https://www.businesscycle.com/`.

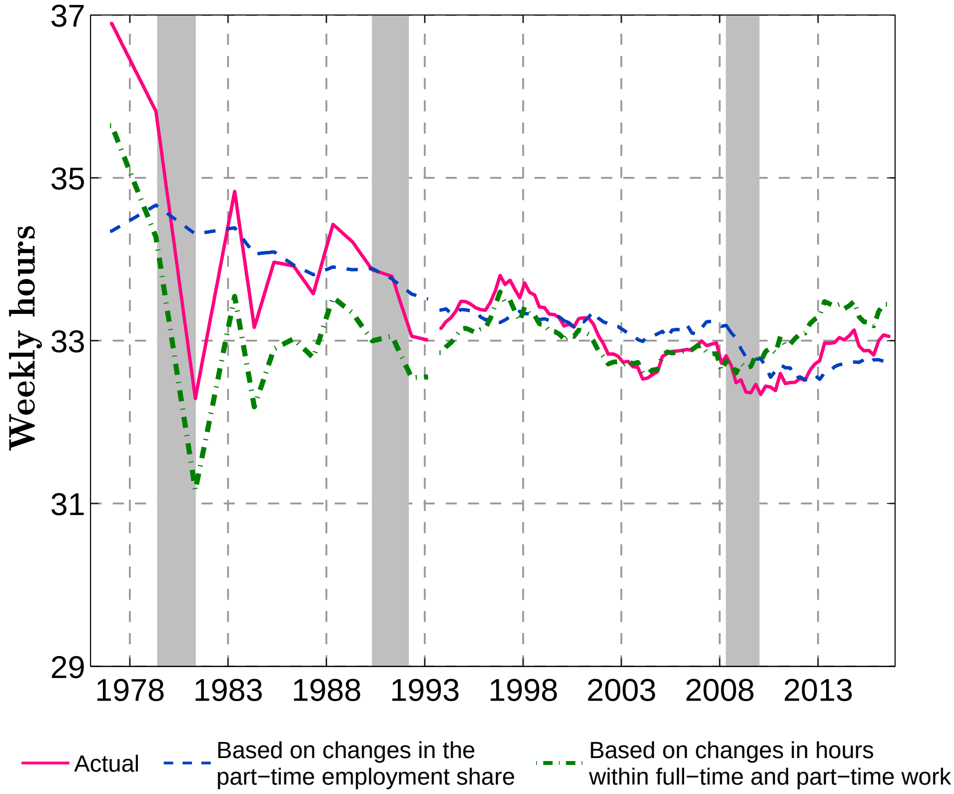


Figure 3: U.K. Hours per Worker, 1977-2016: All Working-age Individuals

Notes: Labor Force Survey, biennial data from 1977 to 1983, annual data from 1984 to 1993, quarterly data from 1993 to 2016, all working-age individuals in private-sector paid employment. The biennial/annual series are adjusted so that the average of each series over the 1993-2016 period (not shown) matches the average of the corresponding quarterly series. The solid line shows the actual series of hours per worker. The dashed (resp. dashed-dotted) line shows the counterfactual series of hours per worker constructed from changes in the part-time employment share (resp. from changes in hours within part-time and full-time work). Gray-shaded areas indicate ECRI recession periods.

Table 1: Change in U.K. Hours per Worker during Recessions

	Working age		Prime age	
1980s recession: $s = 1979$, $t =$	1981	1983	1981	1983
$\Delta h_{s,t}$	-4.48	-1.95	-4.56	-2.03
$\gamma_{s,t}$ (%)	1.19	-0.89	1.74	-0.37
1990s recession: $s = 1990$, $t =$	1992	1993	1992	1993
$\Delta h_{s,t}$	-1.16	-1.21	-0.89	-0.89
$\gamma_{s,t}$ (%)	27.1	32.1	-2.07	-3.03
Great Recession: $s = 2008$, $t =$	2010	2011	2010	2011
$\Delta h_{s,t}$	-0.40	-0.54	-0.32	-0.42
$\gamma_{s,t}$ (%)	107.9	73.4	111.2	69.4

Notes: Labor Force Survey, biennial data from 1977 to 1983 and annual data from 1984 to 2016, individuals in paid employment (data for the Great Recession are thus different from the data used in Figure 3 and 4). $\Delta h_{s,t}$ reports the change in the levels of hours per worker between quarter s and quarter t, and $\gamma_{s,t}$ reports the contribution of the part-time employment share to the change in hours per worker between quarter s and quarter t (see text for details).

co-movement of the dashed and solid lines, which is particularly noticeable during the Great Recession and its aftermath. We explore these differences in more detail in the next paragraphs.

Similar to our analysis of hours per worker around U.S. recessions, we decompose changes in hours per worker in the U.K. by means of $\Delta h_{s,t}$ and $\gamma_{s,t}$ coefficients (equations (2) and (4)). Table 1, which is based on biennial and annual data, reports the results of these calculations for each recession. The changes in hours per worker (measured by $\Delta h_{s,t}$) confirm what is already apparent in Figure 3: hours per worker drop sharply at the onset of recessions. Among working-age individuals the peak-to-trough changes are -4.48 hours in the 1980s recession, -1.16 hours in the 1990s recession and -0.40 hours in the Great Recession. The values obtained for prime-age workers are of similar magnitude but somewhat smaller, with the exception of the early 1980s recession. Interestingly, while the magnitude of the peak-to-trough drop in hours worked becomes increasingly smaller in more recent downturns, the contribution of the part-time employment share to these dynamics is increasingly greater. Indeed, this contribution (measured by $\gamma_{s,t}$) is negligible in the recessions of the 1980s and 1990s – perhaps with the exception of the 1990s in the working-age sample, where the contribution of part-time employment is 27.1%. This picture changes drastically in the Great Recession. Part-time employment becomes the predominant driver of the recessionary drop in hours per worker, when it explains 107.9% of the peak-to-trough change computed on annual data.

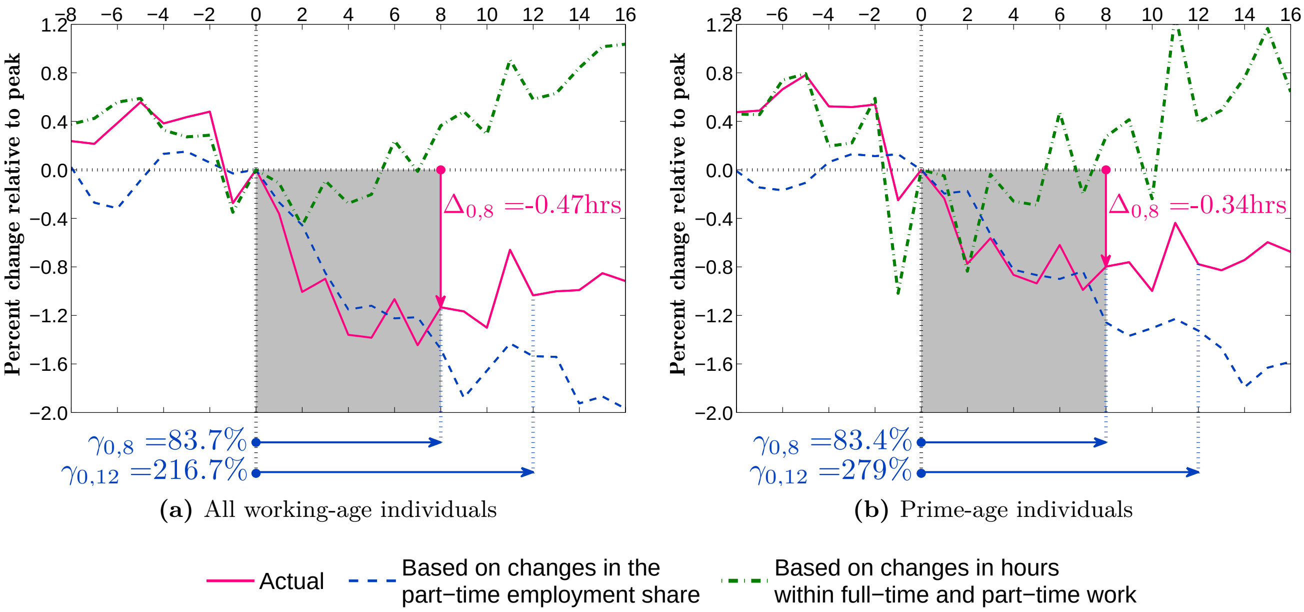


Figure 4: Change in U.K. Hours per Worker during the Great Recession

Notes: Labor Force Survey, quarterly data, working-age (4a) and prime-age (4b) individuals in private-sector paid employment. The solid line shows the actual series of hours per worker. The dashed (resp. dashed-dotted) line shows the counterfactual series constructed from changes in the part-time employment share (resp. from changes in hours within part-time and full-time work). All series are in percent change relative to the peak of the Great Recession (quarter 0). $\Delta_{s,t}$ reports the peak-to-trough change in the levels of hours per worker. $\gamma_{s,t}$ reports the contribution of the part-time employment share to the change in hours per workers over the period indicated by the horizontal arrow (see text for details). Gray-shaded areas indicate ECRI recession period of the Great Recession.

Figure 4, which is based on quarterly data, provides the U.K. counterpart to Figures 2a and 2b. As can be seen in the graphs, in both samples the series driven by the part-time employment share (dashed line) explains almost all of the drop in hours per worker on impact (83 to 84%) and drags its recovery during the recession's aftermath. By contrast, the series based on changes in hours in full-time and part-time employment (dash-dotted line) exhibits a small drop during the recession, but pushes the increase in actual hours during the recovery.

3.3 Taking Stock

In this section we showed that the part-time employment share offers a simple, yet powerful, description of the cyclical dynamics of the intensive margin. By focusing on the behavior of one single variable, we are able to explain the bulk of the recessionary drop in hours per worker in the major recessions in the U.S. and in the Great Recession in the U.K. From an accounting perspective, this finding is explained by the pronounced countercyclicality of the part-time employment share, which dwarfs the variation in hours per worker within full-time and part-time employment. The U.K. patterns suggest that the role of the part-time employment share in the dynamics of the intensive margin is a more recent phenomenon in that country.

In the online appendix, we report the time series of hours per worker respectively in full-time and part-time employment over the whole sample period for both countries. Those series bring to light the large difference in average hours worked between full-time and part-time employment. Despite the presence of trends in the time series, full-time work entails a schedule of weekly hours that is close to twice that of part-time work throughout the sample period. In the appendix, we also provide details on the distribution of hours worked within each employment category. Though the distributions show some heterogeneity, there is a fair amount of clustering around certain mass points (e.g., 40 hours in full-time employment, 20 hours in part-time employment). These large and persistent differences between full-time an part-time work are not only helpful to understand Fact 1, but more importantly, they suggest that full-time and part-time work likely constitute distinct labor market states.[17] In the next section, we build explicitly on this notion to develop a measurement framework describing the dynamics of the part-time employment share.

4 The Dynamics of Part-time Employment

Having established Fact 1, we direct our attention to the behavior of the part-time employment share. Figure 5 tracks the evolution of this share over the past four decades in the U.S. and U.K. labor markets. The solid and dashed lines in Figures 5a and 5b denote the part-time employment share among working-age and prime-age individuals, respectively.

There are several remarkable facts in Figure 5. The first concerns the incidence of part-time employment. Part-time work represents a large fraction of employment in both labor markets. In the U.S. it covers around 18% of the working-age sample, and 12% of prime-age workers. In both samples the incidence of part-time work fluctuates around stable mean values. In contrast, in the U.K. there is a very salient upward trend in part-time work in the larger sample: the share of part-time work among working-age individuals increased by almost 10 percentage points over a period of four decades (from 18 to close to 27%). In contrast, among the prime aged the incidence of part-time employment has been far more stable around a mean value of 21%.

[17] In line with these observations, the *levels* of part-time employment differ systematically across individuals of different age, gender and education and across industries and occupations. For completion, we characterize these differences in the online appendix. Both in the U.S. and the U.K., part-time work is concentrated among women and younger individuals, and is more prevalent in retail trade and in sales and services occupations. We show in Appendix C that these features do not seem to explain the cyclicality of part-time employment, as compositional changes play a small role in the dynamics observed during recessions.

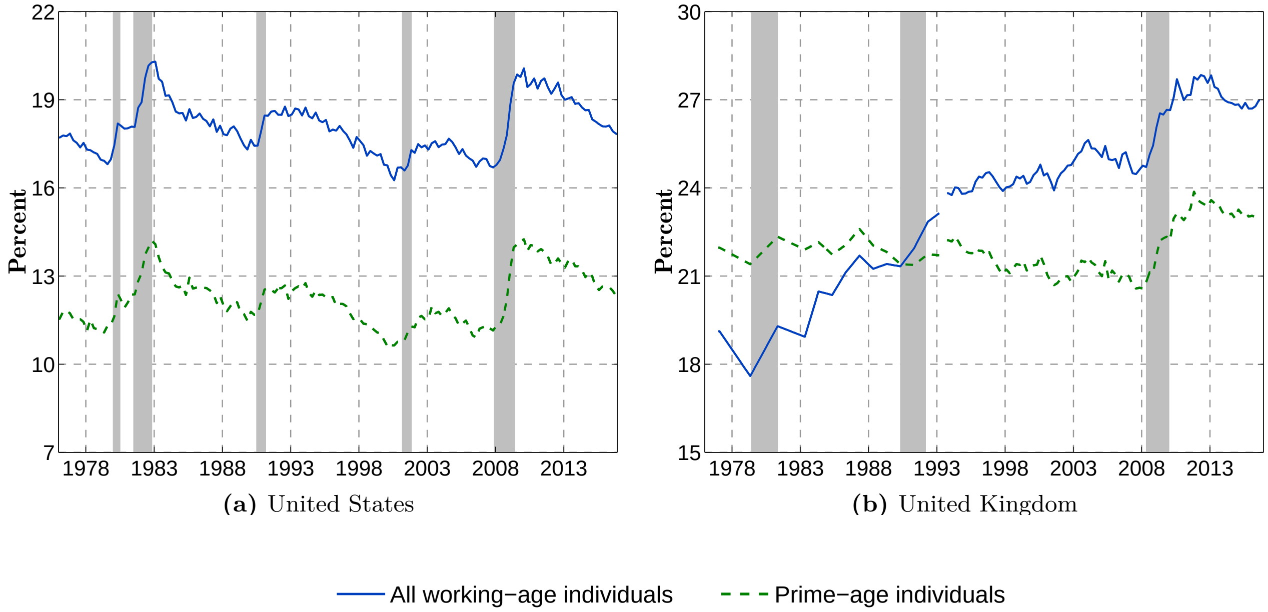


Figure 5: Part-time Employment Share, U.S. 1976-2016 and U.K. 1977-2016

Notes: Fig. 5a: Current Population Survey, quarterly average of monthly data. Fig. 5b: Labor Force Survey, biennial data from 1977 to 1983, annual data from 1984 to 1993, quarterly data from 1993 to 2016. Sample: individuals in private-sector paid employment. The lines show the share (in percent) of workers in part-time employment. Gray-shaded areas indicate NBER and ECRI recession periods.

The second remarkable fact visible in Figure 5 is the strong countercyclicality of part-time work. In both plots the solid and dashed lines shoot up in recessionary periods – indicating a quick shift in the composition of employment towards part-time work – and post-recession periods are characterized by a slow decrease in part-time employment. The cyclical patterns are more pronounced in the U.S., where it affects equally working-age and prime-age individuals. In the U.K. it is more difficult to tease out cyclical variations due to the presence of a strong trend. Nonetheless, in both U.K. samples we observe a stable pattern across business cycles, whereby part-time work decreases (or stabilizes) in the recessions' ramp up, and then jumps upwards as the recession sets in.

Last, in line with patterns described in the previous section, the behavior of part-time employment during the Great Recession in the U.K. is clearly different from previous downturns. Not only is the magnitude of the peak-to-trough change greater (in levels), but it is equally present among prime-age and working-age individuals. These two features render the cyclical response of part-time employment during the Great Recession in the U.K. very similar to the patterns observed for the U.S. over the past four decades.[18] For this reason, in the remainder of the paper we describe the dynamics of part-time employment over the whole sample period, for the U.S., and focus on a shorter time span covering the Great Recession for the U.K. Fortunately for us, the advent of a quarterly version of the LFS in 1992 means that the structure of the data is similar in both countries during the overlapping period.

[18] It is unclear whether trends in part-time work affect the cyclicality of the part-time employment share. While part-time employment is on the rise among working-age individuals, it has been stable among the prime-aged. Yet, the cyclical response in the Great Recession is equally large in both samples. One possibility is that the U.K. labor market is now functioning more closely to the U.S. Our findings seem consistent with other papers that analyze recent changes in the U.K labor market. Gregg et al. [2014] document a stronger resilience of employment during the Great Recession and emphasize the greater flexibility of nominal and real wage adjustment.

4.1 Measurement Framework

To describe the dynamics of the part-time employment share, we develop a model that explicitly links the behavior of worker stocks to the evolution of their underlying flows. Our stock-flow framework classifies employed workers in one of three states: in a private-sector paid position on a full-time basis (F) or on a part-time basis (P), or in any other form of employment (X). The latter state is useful because it allows to isolate the potentially confounding factors arising from the patterns of turnover specific to other forms of employment, like government jobs and self-employment. When not employed, individuals can be either in unemployment (U) or in non-participation (N). The vector of worker stocks in each state in period t is defined in the following way:

$$\boldsymbol{\ell}_t = \begin{bmatrix} F & P & X & U & N \end{bmatrix}_t^{\prime}. \tag{5}$$

We characterize the evolution of vector $\boldsymbol{\ell}_t$ by means of a discrete-time, first-order Markov chain. Formally,

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

where the elements of $\boldsymbol{M}_t$ are transition probabilities p^{ij} between labor market states i and j satisfying $\sum_j p^{ij} = 1$, for any i. As explained in Appendix A, we adjust the time series to account for systematic seasonal variation, margin-error (Poterba and Summers [1986], Elsby et al. [2015]) and time-aggregation bias (Shimer [2012]). We work with quarterly transition probabilities for both countries throughout the analysis.[19]

4.2 Flows in and out of Full-time and Part-time Employment

Armed with our estimates of transition probabilities, we use them to characterize the flows of workers moving in and out of the stocks of full-time and part-time employment. Table 2 report sample averages over the sample period for both working-age and prime-age individuals.

We start by remarking the similarities between the average flows in the two countries. First, part-time work appears as a transitory form of employment. In every quarter in the U.S. (U.K.), roughly 43% (17%) of part-time workers move to a different labor market state in the following period. The corresponding numbers for full-time employment are much smaller (10.8 % for the U.S. and 6% for the U.K.). In addition, whatever the labor market state of destination, full-time workers face a lower outflow risk compared to part-time workers. Second, the most likely transition for a part-time worker is towards a full-time position (20.9% in the U.S., 7.48% in the U.K.), followed by transitions to non-participation (12.7% in the U.S., 4.59% in the U.K.). Third, the most likely destination for a full-time worker is towards part-time employment (4.35% in the U.S., 2.23% in the U.K.). Fourth and last, the patterns we just highlighted also hold among prime-age workers.

Table 2 also reveals a number of differences in part-time employment flows across the U.S. and the U.K. The most striking feature is the extent of labor churning. In both full-time and part-time employment, workers in the U.S. are significantly more mobile compared to workers in the U.K. This echoes findings from cross-country studies of labor mobility (see e.g. Jolivet et al. [2006] and Elsby et al. [2013]). Second, although non-participation is closely related to part-time employment in

[19] For the U.S. we match individuals' 1st to 4th (or 5th to 8th) interviews to calculate their quarterly transition probabilities to move across labor market states. We obtain monthly time series of quarterly transition probabilities, which we then aggregate to a quarterly frequency by taking the average of the monthly values. Appendix A provides details on how we handle the 1994 redesign of the CPS in the calculation of these time series.

Table 2: U.S. and U.K. Average Transition Probabilities

	United States		**United Kingdom**	
	Working age	Prime age	Working age	Prime age
	(i) Full-time employment			
p^{FP}	4.35	3.26	2.23	1.79
p^{FX}	1.02	0.95	1.27	1.17
p^{FU}	3.51	2.97	1.70	1.24
p^{FN}	1.90	1.20	0.80	0.44
$\sum_{i\neq F} p^{Fi}$	10.8	8.39	6.00	4.65
	(ii) Part-time employment			
p^{PF}	20.9	23.2	7.48	6.80
p^{PX}	2.26	2.71	2.01	2.09
p^{PU}	6.70	5.49	2.82	1.89
p^{PN}	12.7	8.26	4.59	2.45
$\sum_{i\neq P} p^{Pi}$	42.5	39.7	16.9	13.2
	(iii) Other and non-employment			
p^{XF}	2.74	2.75	1.66	1.62
p^{XP}	1.55	1.19	0.71	0.59
p^{UF}	29.7	33.5	12.3	12.4
p^{UP}	18.7	12.7	9.55	7.73
p^{NF}	2.70	3.20	0.58	0.42
p^{NP}	5.46	3.77	2.77	1.65

Notes: United States: Current Population Survey, 1976-2016. United Kingdom: Labor Force Survey, 1993-2016. The table reports the average of quarterly transition probabilities (in percent). The probabilities are based on series of stocks and flows corrected for seasonal variation, margin error and time-aggregation bias.

both countries – underscoring the view that part-time work is often associated with lower labor force attachment –, that relationship is stronger in the U.K. The ratio of outflow transition probabilities from non-participation into private sector paid employment (viz. p^{NP}/p^{NF}) is 4.8 vs. 2.0, respectively in the U.K. and the U.S. A third difference concerns the importance of turnover between private-sector paid employment and other forms of employment (X), which is far greater in the U.K. This difference is explained by the higher incidence of the public sector and self-employment in the U.K.

Two Hypotheses. Having established the similarity across the two countries in terms of the relative magnitude of flows in and out of full-time and part-time employment, we now consider two hypotheses to rationalize the countercyclicality of the part-time employment share. Our first hypothesis, which we label "within-employment reallocation", is that the cyclical dynamics of part-time employment is due to movements of workers occurring within private-sector paid employment. Given the large relative size of transition probabilities between full-time and part-time work (i.e. $p^{FP}$and p^{PF}) they are likely to play a major role in driving the dynamics of the part-time employment share. According to this hypothesis, the recessionary increase in part-time employment is the result of an increase in $p^{FP}$and a drop in p^{PF}.

An alternative hypothesis emphasizes the role of worker reallocation through non-employment and the greater relative cyclicality of full-time employment flows. We label this hypothesis "non-employment reallocation". Consistent with previous literature (see e.g. Smith [2011] and Elsby et al. [2015]), we find that the dynamics of employment are similar in both countries. Specifically, in recessions the transition probabilities from non-employment to private-sector paid employment (full-time or part-time) fall, and the transition probabilities from private-sector paid employment to unemployment increase. The key difference is that these patterns are much more pronounced for transition probabilities in and out of full-time work, compared to their part-time work counterparts. Thus, this hypothesis attributes the recessionary increase in part-time employment to an increase in ${}^{p^{FU}}\!/_{p^{PU}}$ and a decrease in ${}^{p^{UF}}\!/_{p^{UP}}$ and ${}^{p^{NF}}\!/_{p^{NP}}$.

4.3 Decomposing the Variation in Part-time Employment

In order to assess the quantitative importance of the two hypotheses, we decompose the variation in the part-time employment share in the fractions accounted for by changes in each transition probability.[20] Specifically, we extend the dynamic variance decomposition developed by Elsby et al. [2015] to our Markov-chain model.[21] The output of this exercise are a set of β^{ij} coefficients that quantify the contribution of any flow hazard λ^{ij} to the variation in the part-time employment share, ω_t^P:

$$\beta^{ij} = \frac{\mathbb{C}\text{ov}\left(\Delta\omega_{t-1,t}^P, \Delta\widetilde{\omega}_{t-1,t}^P\right)}{\mathbb{V}\text{ar}(\Delta\omega_{t-1,t}^P)}. \tag{7}$$

$\Delta\widetilde{\omega}_{t-1,t}^P$ denotes the first-difference of the counterfactual part-time employment share whose evolution is *only* based on the past and contemporaneous values of a particular flow hazard λ^{ij}. The variation in the part-time employment share can be approximately decomposed into the variance contributions of each flow hazard (see Appendix B). That is:

$$\sum_{i \neq j} \beta^{ij} \approx 1. \tag{8}$$

Panel A. of Table 3 displays the results of the variance decomposition.[22] Subpanel (i) shows the variance contributions of flow hazards across full-time and part-time employment, as well as their joint variance contribution. Put together, fluctuations in these two transition hazards account for around 70% of the observed variation in the part-time employment share. These results provide a clear answer to the question posed in the previous subsection: the dynamics of the part-time employment share are overwhelmingly explained by within-employment reallocation. A closer look shows that the variance contribution of p^{FP} and $p^{PF}$are different across countries and samples within each country. In the U.S. β^{FP} is always greater than β^{PF}, and it is higher among prime-age vis-à-vis working-age individuals (54.9 vs 44.7%). In the U.K, β^{PF} is higher than β^{FP} in the working-age sample (40.7 vs 26.4%), while the opposite is observed for the prime aged (31.6 vs 40.6%).

[20] In what follows, we refer to flow hazards or hazard rates denoted by λ, as the dynamic decomposition is based on this object (see Appendix B). λ^{ij} is associated to p^{ij} through the following equation: $p^{ij} = 1 - e^{-\lambda^{ij}}$.

[21] Their out-of-steady-state decomposition method is particularly suited for our application as the dynamics the U.K. labor market are not fast enough to rely on a steady-state approximation. In other words, since the fraction of adjustment towards steady state is not covered over the relevant frequency of observation, we need to keep track of the effects of lagged changes in flow hazards on current stocks.

[22] The bottom row displays the sum of the variation in the part-time employment share accounted for by the variance decomposition. In both countries and samples, the sum of the variance contributions is always very close to 100%, meaning that we can confidently interpret the β^{ij} coefficients as the relative contribution of each flow hazard.

Table 3: Dynamics of the U.S. and U.K. Part-time Employment Shares

	United States		United Kingdom	
	Working age	Prime age	Working age	Prime age
	A. Variance analysis			
	(i) Full- and part-time employment			
β^{FP}	44.7	54.9	26.4	40.6
β^{PF}	25.1	18.3	40.7	31.6
$\beta^{FP} + \beta^{PF}$	69.8	73.2	67.1	72.3
	(ii) Other and non-employment			
β^{X}	4.14	2.79	12.4	13.6
β^{U}	15.1	8.38	10.8	11.9
β^{N}	10.1	15.8	7.60	7.25
Total	99.2	100.2	97.9	105.9
	B. Peak-to-trough change in the Great Recession			
	(i) Full- and part-time employment			
γ^{FP}	59.7	69.9	63.1	56.3
γ^{PF}	27.6	10.1	95.8	37.0
$\gamma^{FP} + \gamma^{PF}$	87.3	80.0	158.9	93.3
	(ii) Other and non-employment			
γ^{X}	-3.90	-3.83	19.9	24.0
γ^{U}	23.0	30.3	-8.9	-7.2
γ^{N}	-6.41	-6.44	-69.9	-10.1

Notes: United States: Current Population Survey, 1976-2016. United Kingdom: Labor Force Survey 1993-2016. Panel A. reports the variance contributions of transition between employment states (FP, PF), their sum, and the variance contributions of other states (X, U, N) to quarterly changes in the part-time employment share. The last row in each column shows the sum $\beta^{FP} + \beta^{PF} + \beta^{X} + \beta^{U} + \beta^{N}$. Panel B. reports the contribution of transitions between employment states (FP, PF), their sum, and the contribution of other states (X, U, N) to the predicted changes in the part-time employment share during each country's Great Recession peak-to-trough. The sum $\gamma^{FP} + \gamma^{PF} + \gamma^{X} + \gamma^{U} + \gamma^{N}$ in each column may not add up to 100 due to rounding. All entries are reported in percent.

The remaining variation in the part-time employment share is accounted for by changes in flow hazards between private-sector paid employment and the other three labor market states (other employment, unemployment and non-participation). In subpanel (ii), their contributions are summarized in a single number by aggregating the variance contributions of all transitions between each state and private-sector paid employment. For instance, the contribution of unemployment, U, is given by $\beta^{U} = \sum_{i=P,F} \beta^{iU} + \sum_{j=P,F} \beta^{Uj}$. The composition of the remaining sources of variation is somewhat different in the two labor markets. Perhaps the most noticeable difference concerns the relative importance of the interaction between private-sector paid employment and other forms of employment, X, which is much larger in the U.K.

We have described results that capture variation over the whole sample period for both countries. This is convenient to summarize information over several recessions in the U.S. in a few set of coefficients. However, since the U.K. sample covers only one recession during a period of twenty years, it is useful to zoom in on the Great Recession to understand the sources of adjustment in both countries during that episode. Panel B. of Table 3 reports coefficients quantifying the contribution of different transition hazards to the peak-to-trough change in the part-time employment share during the Great Recession.[23] Specifically, we calculate the peak-to-trough change in this share implied by each flow hazard or state, and divide it by the total predicted change. The U.S. figures in subpanel (i) indicate that the relative importance of within-reallocation is even higher during the Great Recession, particularly due to the dynamics of p^{FP}. In the U.K., the results are similar insofar as within-employment reallocation is also more dominant during the recession, but it is mainly the dynamics of p^{PF}that accounts for this pattern. With exception of non-employment – whose interaction with private-sector paid employment predicts a decrease in part-time employment –, the variations implied by the other states are distinct across the two countries.

A Look at p^{FP} and p^{PF}. To conclude this section, Figure 6 displays the time series that account for most of the fluctuations in part-time employment in both samples and countries, namely p^{FP} and p^{PF}. The plots in the top panel show the evolution of the transition probability p^{FP}. In addition to a clear upward trend, there is a very steep increase in all four series of p^{FP}at the onset of recessions. It is also noticeable that all series recover slowly from the impact of recessions and, in fact, never recover fully to their pre-crisis levels. The U.S. series of transitions from part-time to full-time work, p^{PF}, also trend upwards, a pattern that is absent in the U.K. Despite these differences in their long-run behavior, in both countries the p^{PF} series are more volatile relative to their reverse transitions and fall abruptly at the onset of recessions. In the next section we advance an economic interpretation of the patterns present in Figure 6.

5 Why is Part-time Employment Cyclical?

So far our investigation has narrowed the empirical description of the dynamics of the part-time employment share to fluctuations in transition probabilities across full-time and part-time work. We put forward a hypothesis of *variable labor utilization* to rationalize the source of these fluctuations. We draw on the wealth of auxiliary information available in the U.S. and U.K. labor force surveys to confront this hypothesis with the data.

5.1 Variable Labor Utilization

We conjecture that labor reorganization within the firm operates as an adjustment channel to various shocks. These shocks can affect either the firm's demand or the labor supply decisions of the firm's employees. The main idea is that in the presence of adjustment costs along the extensive margin (viz. hiring or firing costs), the intensive margin of labor inputs (hours per worker) offers an alternative adjustment channel to smooth out the effects of shocks. This hypothesis can speak to what we observe in both cyclical upturns and downturns. When the economy is growing and competition for labor increases, firms may have an incentive to adjust the hours of their employees upwards in order to retain them. This prediction is consistent with a well-known notion of cyclical labor upgrading (see Okun et al. [1973], and Moscarini and Postel-Vinay [2012] for recent empirical evidence). Similarly, in a recession negative shocks to firms' profitability may prompt a reduction in labor costs, which can be

[23]We report the γ^{ij} coefficients for the other U.S. recessions in the online appendix. The picture of labor market dynamics they provide is qualitatively, and often quantitatively, similar to the coefficients for the Great Recession.

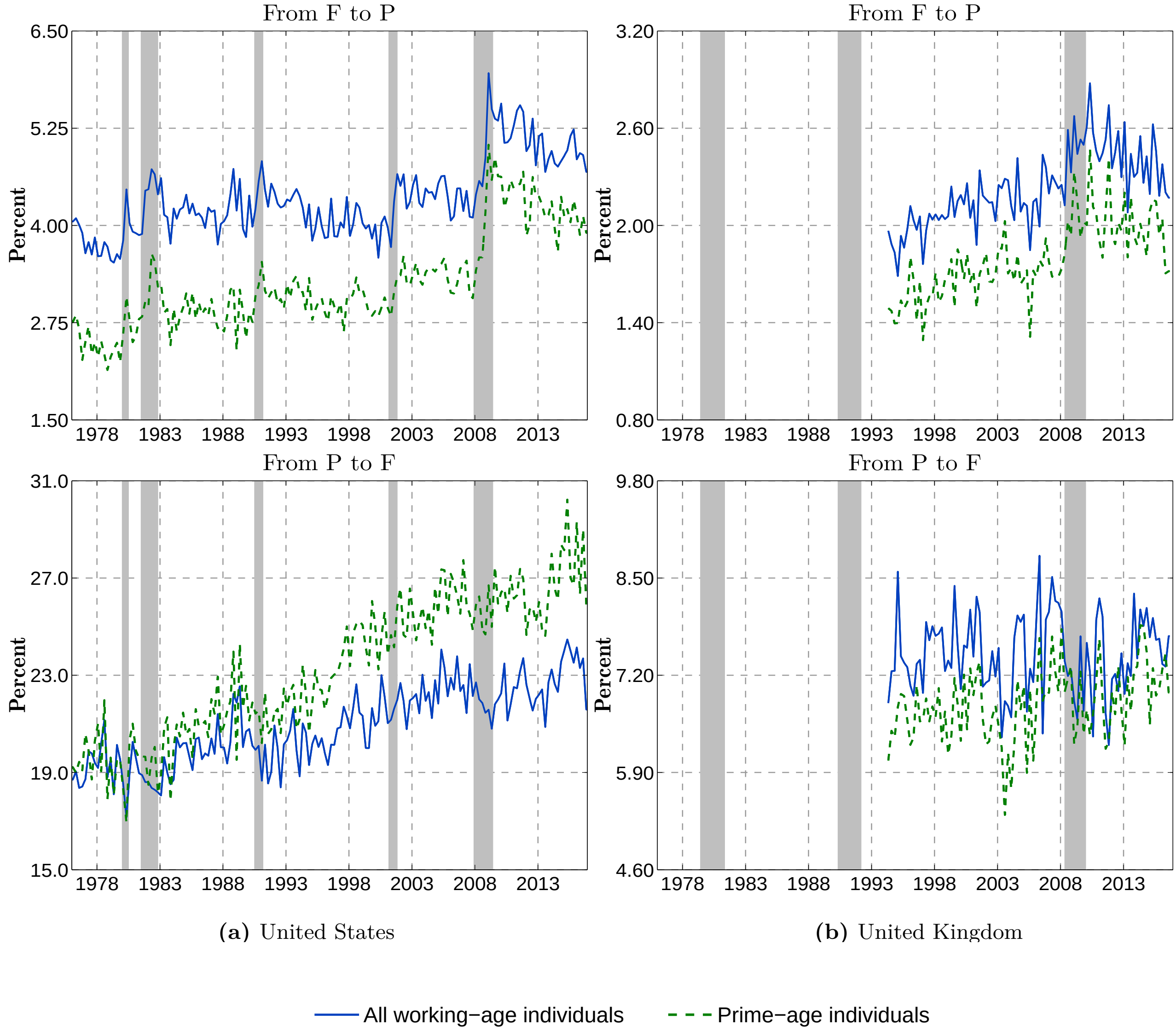


Figure 6: U.S. and U.K. Transition Probabilities between Full-time and Part-time Employment

Notes: Fig. 6a: Current Population Survey, quarterly average of monthly data, 1976-2016. Fig. 6b: Labor Force Survey, quarterly data, 1993-2016. Sample: individuals in private-sector paid employment. The line show the quarterly probabilities (in percent) of transition between full-time and part-time employment. The series are constructed from seasonally-adjusted data corrected from margin error and time aggregation bias as described in Appendix A. Gray-shaded areas indicate NBER and ECRI recession periods.

made by putting some of their full-time employees on part-time hours. The labor hoarding hypothesis (Okun [1962]) predicts similar patterns, but in its standard formulation requires that firms pay labor services in excess of those being provided by their employees.

In the following subsection we present evidence that is consistent with the labor adjustment story just described. First, we show that changes in the schedule of working hours along the full-time and part-time margin (and vice versa) occur mostly within, not across, firms. Second, we document that workers who move between full-time and part-time employment at the same employer experience large changes in working hours. Last, we report evidence showing that the incidence of involuntary part-time work in transitions towards part-time employment rises steeply during recessions, and that slack work/business conditions play a major role in those dynamics.

5.2 Assessment of the Hypothesis

Transitions between Full-time and Part-time Work at the Same Employer. We first quantify the importance of reallocation within vs. across employers for workers who move between full-time and part-time employment. We identify job-to-job transitions as follows. In the CPS, we match individuals from their 1st to 4th (or 5th to 8th) interview and count an employer change if either the individual changes employer in month 2, 3 or 4, or if the individual is not employed in month 2 or 3.[24] In the LFS, we use information on the length of time of continuous employment with the same employer, which is recorded in months.

Table 4: U.S. and U.K. Transitions at the same Employer

	United States		**United Kingdom**	
	Working age	Prime age	Working age	Prime age
	(i) Share of transitions at the same employer			
F to P	85.0	86.8	87.0	89.6
P to F	82.5	85.7	77.5	85.3
	(ii) Contribution to the variation of p^{FP} and p^{PF}			
F to P	84.7	84.3	92.6	97.8
P to F	76.8	87.0	71.0	78.2

Notes: United States: Current Population Survey, 1994-2016. United Kingdom: Labor Force Survey 1993-2016. Sample: individuals in private-sector paid employment. Panel (i) reports the share of transition between employment states (FP, PF) occurring at the same employer. Panel (ii) reports the contribution of transitions at the same employer to the variations (the variance of the first difference) of the transition probabilities p^{FP} and p^{PF}. All entries are reported in percent.

Panel (i) of Table 4 shows the share of transitions between full-time (F) and part-time (P) work that occur at the same employer. Whatever the transition we consider, this share is almost always above 80%. To provide a point of reference, for workers who remain in the same employment category (F or P) in two consecutive periods, the corresponding shares (not reported) are about 10 percentage-points higher. These figures are not surprising in light of what we know about job-to-job mobility, namely that it affects only a small percentage of the workforce in every quarter. However, the fact that the extent of employer-to-employer mobility is not too far off for workers who move between full-time and part-time work is a new and surprising fact. It suggests that adjustments on the intensive margin occur predominantly within the firm, and possibly even within the same job. This evidence seems to contradict a common finding that jobs have fixed working hours, so that in order to adjust their labor supply workers need to change employer (e.g. Blundell et al. [2008]).[25]

[24] Since 1994, the CPS asks respondents who are employed for two consecutive months whether they are employed with the same employer as in the previous month. Notice that our treatment of non-employment spells in months 2 and 3 ignores the possibility that a worker can be recalled by her previous employer. Therefore, our numbers provide a *lower* bound for the importance of within-firm reallocation.

[25] Perhaps the obvious explanation for the seemingly contradictory evidence is that our paper looks at the data in a different way. First, we should note that the most recent and cited evidence on this issue is based on the U.K. labor market (Blundell et al. [2008] and Benito and Saleheen [2013]). A recent working paper by Kurmann and McEntarfer [2017] that looks at similar aspects of U.S. data as we do (but only for the state of Washington) finds patterns that are very consistent with ours. Specifically, they find evidence of substantial changes in hours worked among job-stayers. Second, the cited U.K. papers use different data (the British Household Panel Survey), samples (Blundell et al. [2008] focus on employed lone mothers with children and Benito and Saleheen [2013] on employed individuals who experienced

Given the high levels of transitions at the same employer, we should expect within-firm reallocation to explain most of the cyclical variation in p^{FP} and p^{PF}. This prediction is confirmed by examining panel (ii) of Table 4. In the U.S., the variance contributions of mobility at the same employer are around 85% both for F to P and P to F transitions. The corresponding numbers of the U.K. are not so stable. It seems that within-firm reallocation is more relevant to explain fluctuations in F to P transitions than transitions in the reverse direction. This said, even in the latter case, reallocation at the same employer explains about three quarters of the variation in the probability to move from part-time to full-time employment.

Changes in Hours at the Worker Level. To continue our examination of the variable labor utilization hypothesis, we look at the patterns of hours changes at the worker level. Panel (i) of Table 5 complements our analysis of transitions between full-time and part-time work within and across employers. First, it shows that workers who remain employed with the same employer (stayers) experience hours changes that are sizable. On average, they range between 11 and 13 weekly hours in the U.S. and the U.K. In contrast, a large fraction (not shown in the table) of job-stayers who remain in the same employment category do not experience any change in hours worked. In the U.S., the fraction of stayers in full-time or part-time employment who report exactly zero change in their weekly schedule is respectively 66.1 and 44.3%. The U.K. figures come very close, respectively at 43.7 and 54.6%. These facts suggest that fluctuations in the part-time employment share are not driven by transitions involving a small, economically negligible, change in hours worked.

Second, workers who in addition to a change of employment category also change employer (movers) experience larger changes in hours (by about 5 to 6 hours more in the U.S., and 7 to 9 hours more in the U.K).[26] In this respect, our results qualify rather than contradict the idea that workers need to move jobs in order to change their hours: there is some flexibility in the hours of job-stayers, but not as much as that experienced by job-movers. In fact, our interpretation of those differences is that job changes are more indicative of voluntary adjustments in labor supply, whereas changes in hours for job-stayers reflect adjustments prompted by the employer.

Third, in panel (ii) of Table 5 we provide evidence that changes in hours at the worker level exhibit some lumpiness.[27] For both F to P and P to F transitions a substantial fraction of changes in individual working hours correspond to multiples of a half working day (5 hours) or a full working day (8 hours). The U.S. patterns of lumpy adjustments are clearly stronger – the five mass points shown in the table account for more than half of all hours changes–, but the U.K. results are still striking. We interpret this evidence as indicative that adjustments in hours worked are subject to certain restrictions, arising either from the employer side (e.g. coordination of employees' schedules) or from the worker side (e.g. travel-to-work costs). Whatever their source, these discrete adjustments do not seem to be the outcome of a smooth optimization problem.

Involuntary Transitions towards Part-time Employment. The third dimension of the investigation conducted in this section concerns the role of involuntary part-time work. In the U.S.,

a financial shock), frequency of hours changes (they focus on annual changes in weekly usual hours) and sample period (end before the Great Recession). It is quite possible that these differences lead to distinct results.

[26] It is interesting to note that the average change in hours for transitions at the same employer is considerably lower than the difference in average working hours across the two employment states, whereas the figures come very close for transitions accompanied by a change of employer (17-18 weekly hours in the U.S., 18-20 in the U.K.).

[27] Panel (ii) of Table 5 focuses on stayers because they explain the bulk of transitions between full-time and part-time employment. Of course, the patterns of lumpiness that we document are not specific to stayers (they are also present among job-movers, though they are slightly less pronounced).

Table 5: U.S. and U.K. Hours Changes at the Worker Level

			United States		United Kingdom	
			Working age	Prime age	Working age	Prime age
			(i) Average absolute changes in hours			
F to P	stayers		13.1	12.6	11.7	10.5
	movers		18.3	17.7	20.5	17.5
P to F	stayers		12.5	11.9	11.7	11.1
	movers		18.1	16.9	18.8	18.3
			(ii) Distribution of absolute changes in hours (stayers)			
F to P	1/2 days	1	10.1	10.1	10.3	10.8
		2	18.8	19.1	7.39	7.47
		3	8.01	7.00	3.77	3.76
	full days	1	11.9	13.4	7.96	7.26
		2	3.77	3.77	2.99	3.09
	other		47.5	46.6	67.6	67.7
P to F	1/2 days	1	11.3	11.3	10.6	11.7
		2	20.9	20.8	7.98	8.28
		3	8.84	7.78	4.08	3.96
	full days	1	11.0	12.7	7.55	7.39
		2	3.42	3.51	2.56	2.37
	other		44.6	43.9	67.2	66.3

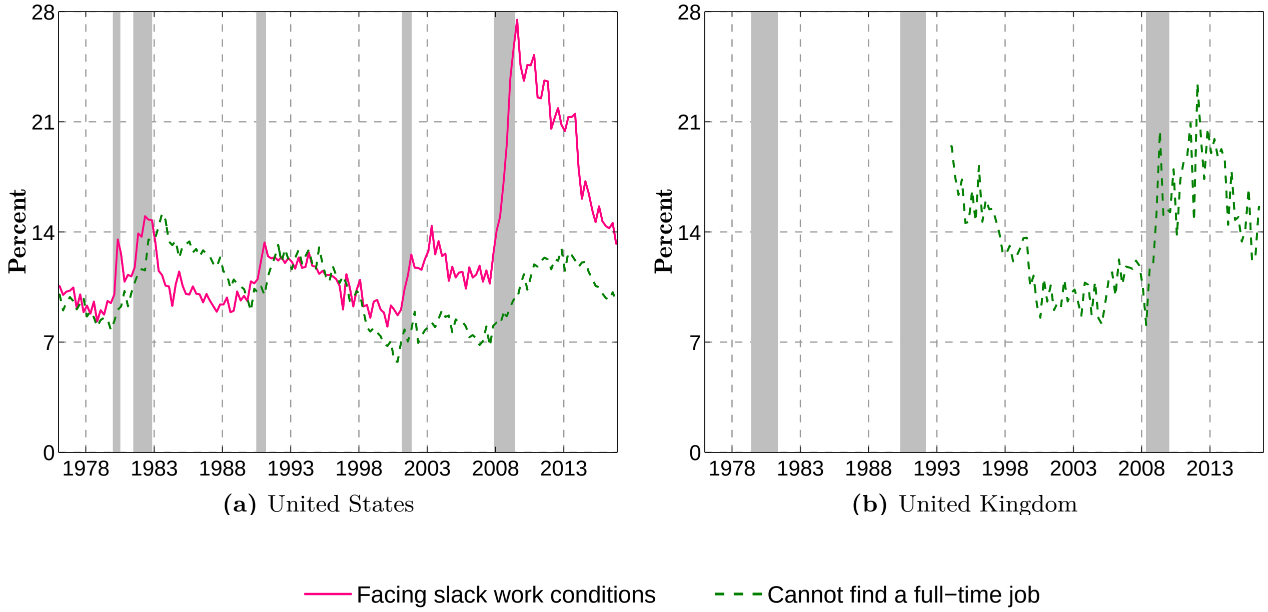
Notes: United States: Current Population Survey, 1994-2016. United Kingdom: Labor Force Survey, 1993-2016. Sample: individuals in private-sector paid employment. Panel (i) reports the change in hours (in absolute values) among job-stayers and job-movers who change employment states (FP, PF). Panel (ii) reports the distribution of hours changes among job-stayers who change employment states (FP, PF). A 1/2 working day amounts to 5 hours, and a full working day amounts to 8 hours. All entries in panel (ii) are reported in percent.

involuntary part-time workers are those individuals who either cannot find a full-time job or work part-time because of slack work/unfavorable business conditions in their current job. In the U.K., individuals who report accepting a job with a lower schedule of working hours because they could not find a full-time job are classified as involuntary part-time workers.[28]

The dashed lines in Figure 7 plot the share of new entrants to part-time work who do so because they cannot find a full-time job. There is a very clear countercyclical pattern in both plots. We also note that the levels and magnitude of the cyclical response of the U.K. series are higher, which is likely to reflect a discrepancy in data collection between the CPS and the LFS rather than actual differences in the composition of involuntary part-time work.[29] The solid line in Figure 7a reports the share of new entrants to part-time employment who face slack work conditions in their current job. The level of this series is similar to the dashed line during the first two decades, but starting in the aftermath of the 2001 recession, the solid line increases markedly and the response during the Great Recession is

[28]Like many items collected in labor force surveys, the measurement of involuntary part-time work is exposed to some degree of subjectivity. We show in the online appendix that the stated reasons for working part-time involuntarily exhibit a fair amount of consistency with the actual labor market trajectories of individuals. Notice, in addition, that our analysis focuses on the cyclical variation, rather than the level, of involuntary part-time work.

[29]Recall that LFS respondents are not given the option to report “slack work/business conditions” as the reason for working part time involuntarily; the only response item available to them is “cannot find a full-time job”.



(a) United States **(b)** United Kingdom

Figure 7: U.S. and U.K. Involuntary Transitions towards Part-time Employment

Notes: Fig. 7a: Current Population Survey, quarterly average of monthly data, 1976-2016. Fig. 7b: Labor Force Survey, quarterly data, 1993-2016. Sample: all working-age individuals. The lines show the share (in percent) of involuntary transitions towards part-time employment, i.e. because the worker either faces slack work conditions (solid) or cannot find a full-time job (dashed). The series are constructed from seasonally-adjusted data corrected from margin error and time aggregation bias as described in Appendix A. Gray-shaded areas indicate NBER and ECRI recession periods.

by all accounts extraordinary. In light of the very strong resemblance between the U.S. and the U.K. in every other dimension of part-time employment we have documented so far, it seems reasonable to conjecture that similar patterns of slack work are at play in the U.K.

Table 6: U.S. Involuntary Transitions towards Part-time Employment

		Average	Peak-to-trough change during recessions (%)			
			1980Q1 to 1982Q4	1990Q3 to 1991Q1	2001Q1 to 2001Q4	2007Q4 to 2009Q2
			(i) Contribution to flows from F to P			
slack work	working age	16.9	56.7	28.7	43.9	110.6
	prime age	19.1	52.8	23.2	43.8	91.1
			(ii) Contribution to the inflows of P			
F, slack work	working age	9.25	57.7	30.6	48.0	120.2
	prime age	12.3	51.7	24.9	43.2	94.6
U, N, ~~full-time job~~	working age	5.43	97.1	-1.00	32.6	38.2
	prime age	5.03	98.3	5.60	50.2	13.9

Notes: Current Population Survey, 1976-2016. Panel (i) reports the share of flows from F to P accounted for by full-time workers facing slack work conditions. The two upper (resp. lower) rows of panel (ii) reports the share of the inflows of P accounted for by full-time workers (F) facing slack work conditions (resp. non-employed workers (U, N) who cannot find a full-time job). The column titled 'average' reports averages over the sample period. The other columns report changes relative to the value at the peak during U.S. recessions. All entries are reported in percent.

We take advantage of the richer information provided by the CPS in Table 6. In panel (i), we look at the share of transitions from full-time to part-time work that are accounted for by workers who report facing slack work conditions. They average at 16.9 and 19.1% over the sample period. Clearly, during recessions this share increases markedly, especially during the Great Recession, when it more than doubled for our main sample. Panel (ii) of Table 6 shows how this affects the composition of the inflows to part-time employment. On average full-time workers facing slack work conditions account for about 10% of the inflows to part-time employment, while non-employed workers (U, N) explain 5% of the inflows. During recessions, the composition of the inflows to part-time work shifts towards these two categories, but much more so towards full-time workers facing slack work conditions. This outcome indicates that the large contribution of transitions from F to P to the dynamics of part-time employment is mainly explained by slack work conditions.

5.3 An Examination of Alternative Hypotheses

Our detailed analysis of worker flows supports the hypothesis of variable labor utilization as a possible explanation for the cyclicality of part-time employment. To strengthen our main message, we briefly assess a number of competing hypotheses. Further details are provided in Appendix C.

Hypothesis 1: Compositions Effects. A possible explanation for the countercyclical pattern of part-time employment is that it results from changes in the demographic, industry and occupation structure of employment. Indeed, part-time employment is unevenly distributed across different segments of the labor market that differ in terms of their employment response to the business cycle (see Footnote 17 and the summary statistics provided in the online appendix). Consider for instance service-based industries, which use part-time employment contracts more intensively. Part-time employment may increase in recessions simply because of the countercyclicality of the share of employment accounted for by service-based industries.

To assess the role of this explanation, we construct counterfactual part-time employment shares controlling for changes in the composition of employment in terms of demographic characteristics, industries and occupations. We then compare their behavior to the actual change in the part-time employment share between the Great Recession's peak to trough dates. The results displayed in Table C1 of the appendix show that controlling for changes in the demographic (age, education and sex) and job characteristics (industry and occupation) of employed workers only marginally change the recessionary increase in part-time employment. Overall, these findings point to the conclusion that changes in the part-time employment share are not driven by composition effects.

Hypothesis 2: Multiple Jobholding. Our sample includes individuals who, during the reference week of the survey, have more than one job (the so-called multiple jobholders). Since multiple jobholders often combine a full-time job and a part-time job (Lalé [2015]), their behavior may impart a bias on the evolution of the part-time employment share. For example, suppose that these workers hold their second job as a buffer against the risk of losing the primary job. Then, part of the increase in the part-time employment share during the recession may result from the higher probability of multiple jobholders to remain in the sample with a part-time job. Moreover, since our accounting framework will record this case a transition from full-time to part-time employment, the inclusion of multiple jobholders is potentially problematic for our analysis of worker flows.

To purge our findings from the effects of multiple jobholding, we repeat the analysis using a sample which excludes any individual who holds more than one job in two consecutive quarters. For reasons of data availability, we can implement this sample restriction only after 1994. The results, displayed in Table C2 of the appendix, are quantitatively very close to the baseline ones – the U.S. results are slightly more sensitive, but the differences remains negligible. This partly follows from the fact that multiple jobholders account for a small share of employment. In conclusion, our findings are strongly robust to the presence of multiple jobholders.

Hypothesis 3: Definition of Part-time Employment. The definition of part-time employment considered in our analysis is commonly used in the U.S. and U.K. labor markets.[30] Insofar as there are no technological factors determining the separation between full-time and part-time at exactly 35 hours, or that existing institutions based on that threshold pose only a limited constraint on agents' decisions, our results should hold for alternative definitions of part-time employment. On the other hand, we cannot completely rule out that part of what we label reallocation between part-time and full-time employment is the fabrication of small movements around the 35 hours threshold, and that would disappear, or be severely dampened, if an alternative threshold were used instead.

In order to gauge the sensitivity of our findings to the definition of part-time employment, we recompute our main results based on a threshold of 30 usual hours (again, after 1994 due to data availability). The results are displayed in Table C3. The main effect of lowering the threshold that determines full-time employment is to dampen the baseline results. The peak-to-trough change in the part-time employment share is lower in both countries, and so is the contribution of part-time employment to the dynamics of hours per worker. The two countries differ most in the patterns of reallocation between full-time and part-time employment. In the U.S. the variance contribution of transitions from full-time to part-time employment decreases, whereas in the U.K. the main difference comes from transitions in the reverse direction. In addition, in the U.S. the variance contributions of transitions at the same employer become lower. In sum, the results are weakened in the U.S. where a threshold of 30 hours is uncommon (compared to the usual cutoffs at 34 or 39 hours) and they are almost unchanged in the U.K. where the 30-hours cutoff is frequently used.[31]

6 Conclusions

We started this paper by establishing an empirical connection between cyclical fluctuations at the intensive margin (hours per worker) and movements in the share of part-time employment. Building on this new finding, we then developed a stock-flow framework that relates these movements to the dynamics of worker transitions across labor market states. Lastly, we pieced together several facts regarding the behavior of labor market stocks and flows, and showed that fluctuations in hours per worker are consistently explained by the hypothesis of variable labor utilization at the firm level.

Our analysis is potentially relevant to several strands of research in macro and labor economics. First, the amount of lumpiness in hours changes that we uncovered does not square well with the assumption that hours worked are the outcome of a smooth, concave maximization problem. This point is worth emphasizing, as there is a trend in the literature towards modeling the extensive and intensive margins jointly in heterogeneous-agent incomplete market economies (see Chang et al. [2014]

[30] In the U.S., whether an employee is considered full-time or not is determined by the employer, viz. the Fair Labor Standards Act (FLSA) does not define full-time or part-time employment (see `http://www.dol.gov/general/topic/workhours/full-time`; last accessed on June 22, 2017). In practice, the threshold of 34 (sometimes 39) weekly hours plays an important role in dictating practices regarding part-time work. Similarly, in the U.K. there is no legal definition of part-time employment, although full-time status is usually granted to those who work at least 35 hours per week (see `https://www.gov.uk/part-time-worker-rights`; last accessed on June 22, 2017).

[31] Several surveys in the U.K. use a definition of part-time employment based on a threshold of 30 usual hours.

for a recent application). Few studies, however, consider the discrete nature of adjustments in hours per worker. To our knowledge, the main exception is Chang et al. [2011] who adopt a specification much in line with our results.[32] We think our analysis can provide guidance for the representation of the intensive margin postulated in this class of models. In particular, it provides a simple empirical test to the dynamics of hours per worker predicted in these models. As we have shown, to be consistent with the data, the distribution of changes in hours per worker at the cross-section should be concentrated rather than uniformly distributed among employed agents.

Second, in light of our hypothesis of variable labor utilization, an account of firms' adjustment costs seems integral to the understanding of the cyclicality of the extensive and intensive margins. An increase in firing costs, for instance, is likely to raise the relative contribution of the intensive margin to business-cycle fluctuations in labor inputs. Few studies have considered this implication. In fact, the only work we are aware of is Llosa et al. [2012], which does provide cross-country evidence supporting this implication.[33] In our view, the new vintage of macro-search models featuring a notion of firm size (e.g., Elsby and Michaels [2013], Acemoglu and Hawkins [2014], Kaas and Kircher [2015]) offers a rich structure to investigate this issue further. First, the notion of firm size allows to think about adjustments in hours per worker at the firm level. Second, and more importantly, frictions à la Mortensen and Pissarides [1999] contain predictions about fluctuations in search frictions and wages, which affect the costs of labor adjustments along the extensive and intensive margins. Incorporating an intensive margin in this class of models to evaluate their cyclical performance is a very exciting avenue for further research.

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[32] Chang et al. [2011] demonstrate that conventional estimation strategies to recover preference parameters can be seriously flawed if hours are the outcome of a discrete choice problem.

[33] Llosa et al. [2012] make another important point: countries with a greater relative role for the extensive margin exhibit more fluctuations in total hours worked (and, moreover, their employment fluctuations are more correlated with output). They analyze these patterns through the lens of a quantitative model with costly firing decisions.

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Appendix

A Data

Our treatment of U.S. data is as follows:

- Actual hours worked in full-time and part-time employment (Section 3) are computed using a full-time/part-time status based on actual hours combined, when possible, with longitudinal matching. Specifically, we retrieve information on hours worked on up to four consecutive months using the longitudinal structure of the CPS. For each individual, we then compare the number of periods spent working less than 35 hours to the total number of observed working periods. An individual with either 1/1, 2/2, 2/3 or 3/4 spells of employment under 35 actual hours is considered a part-time worker. This approach fits the notion of 'usual' work schedule defined in the CPS Interviewing Manual [2013] and allows us to obtain consistent time series stretching back to January 1976. After January 1994 (when information on usual hours becomes available), we find that our time series behave very similarly to the series where the full-time/part-time employment status is based on usual hours (see the online appendix).

- Our approach that uses actual hours to define a full-time/part-time status is not applicable to the measurement of worker flows. Fortunately for our purposes, prior to 1994 the CPS contains information about individuals' usual work schedule: if a respondent reports less than 35 actual hours of work, she is asked in addition whether she usually works less than 35 hours per week. This enables to construct time series of stocks and flows prior to 1994, which we then align to post-1994 data using multiplicative adjustment factors (Polivka and Miller [1998], Shimer [2012], Elsby et al. [2009]). In order to work with quarterly transition probabilities, we match the 1st to the 4th (or 5th to 8th) interview of CPS respondents (see Footnote 19). The margin-error correction (see below) adjusts the flows calculated in this way to reconcile them with the levels of observed changes in stocks. In the online appendix, we conduct internal and external validation exercises showing that the behavior of our time series is not driven by the 1994 CPS redesign.

Our treatment of U.K. data is as follows:

- Actual hours worked are computed using biennial extracts between 1977 and 1983 and annual extracts from 1984 onwards. The LFS records usual and actual hours since 1977. Usual and actual hours refer to hours worked in the main job including paid and unpaid overtime, except between 1977 and 1983, when hours of unpaid overtime were not recorded by the survey. We also calculate quarterly hours series that start in 1993Q4, when the LFS is administered every quarter and the variable identifying private-sector employment becomes available. Our series line up well with other U.K. hours series documented in the literature (see the online appendix).

- Transition probabilities (Sections 4 and 5) combine data from the quarterly cross sections and two-quarter longitudinal extracts. Our series begin in the last quarter of 1993, when the information needed to implement our sample definition becomes available.

For both U.S. and U.K. data, we also:

- Remove systematic seasonal variation using the U.S. Census bureau's X-13ARIMA-SEATS program. We estimate the seasonal components of our time series by applying the SEATS program.

When estimation fails, we revert to the capabilities of the X12-ARIMA program to obtain an alternative estimate of seasonal components.

- Adjust the transition probabilities to account for margin error, i.e. we minimize the distance between the actual changes in stocks (computed from cross-sectional data) and the changes in stocks implied by the transition probabilities (computed from longitudinally-linked data). We use the adjustment procedure proposed by Elsby et al. [2015].
- Correct the transition probabilities for time-aggregation bias. That bias occurs when the discrete-time probabilities miss some of the transitions that occur at a higher frequency. We adapt Shimer [2012]'s continuous-time correction method to our setup to address this issue.

B Measurement Framework

This section presents the background of the decomposition of fluctuations in part-time employment conducted in Subsection 4.3. Starting from equation:

$$\boldsymbol{\ell}_t = \boldsymbol{M}_t \boldsymbol{\ell}_{t-1} \tag{9}$$

and recalling that, by definition, at every period t labor stocks sum up to the relevant population total ($W_t = F_t + P_t + X_t + U_t + N_t$), we can express the system of equations (9) by a reduced-Markov chain

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

where $\tilde{\boldsymbol{\ell}}_t = \boldsymbol{\ell}_t / W_t$, $\boldsymbol{q}_t = \begin{bmatrix} p^{NF} & p^{NP} & p^{NX} & p^{NU} \end{bmatrix}'_t$ and $\tilde{\boldsymbol{M}}_t$ is rearranged accordingly.

Solving for system (10)'s steady state (we use an upper-bar throughout the analysis to indicate a steady state) we obtain:

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

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

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

where $\boldsymbol{A}_t = \boldsymbol{I} - \tilde{\boldsymbol{M}}_t$ and $\boldsymbol{B}_t = \boldsymbol{A}_t \tilde{\boldsymbol{M}}_{t-1} \boldsymbol{A}_{t-1}^{-1}$. In this equation and in the remainder of the appendix, Δ denotes the first-difference operator (i.e. $\Delta x_t = x_t - x_{t-1}$). Working backwards from system (12), one can express this system in its distributed lag form:

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

This representation highlights that changes in labor stocks, $\tilde{\boldsymbol{\ell}}_t$, are governed by changes in the underlying flow hazards λ_t^{ij}, which affect both the transition probabilities p_t^{ij} (the elements of matrices $\boldsymbol{A}_t$

and $\boldsymbol{B}_t$), and the steady state the system is converging to at every period, $\bar{\tilde{\boldsymbol{\ell}}}_t$.

To quantify the relative contribution of changes in any particular flow hazard to the variation of part-time employment, we follow three consecutive steps:

1. Compute counterfactual series of changes in labor stocks driven by current and past changes in each flow hazard.
2. Use the structure of equation (13) to express the variance of changes in each stock as the sum of the covariances between the series and its approximation by changes in each flow hazard.
3. Calculate the variance contribution of each flow hazard to changes in the part-time employment share using a first-order linear approximation to the part-time employment share.

We now describe each of these steps in more detail. In step 1, we start from the first-order approximation of changes in steady-state stocks:

$$\Delta\bar{\tilde{\boldsymbol{\ell}}}_t \approx \sum_{i\neq j} \frac{\partial\bar{\tilde{\boldsymbol{\ell}}}_t}{\partial\lambda_t^{ij}}\Delta\lambda_t^{ij}. \tag{14}$$

Given estimates of p_t^{ij} (λ_t^{ij}), to obtain $\Delta\bar{\tilde{\boldsymbol{\ell}}}_t$ we need only compute the partial derivatives $\frac{\partial\bar{\tilde{\boldsymbol{\ell}}}_t}{\partial\lambda_t^{ij}}$. 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 λ_t^{ij}. The continuous-time counterpart of the discrete-time Markov chain (equation (9)) is:

$$\dot{\tilde{\boldsymbol{\ell}}}_t = \tilde{\boldsymbol{H}}_t\tilde{\boldsymbol{\ell}}_t + \boldsymbol{g}_t, \tag{15}$$

where the elements of matrices $\tilde{\boldsymbol{H}}_t$ and $\boldsymbol{g}_t$ are flow hazards λ_t^{ij}, and its steady state is given by:

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

We apply matrix calculus to this equation to compute the partial derivatives of steady-state stocks with respect to each flow hazard. Next, feeding the estimates of time series of hazard rates λ_t^{ij} into equation (14), we substitute in the respective series of first-order approximations to changes in steady-state stocks ($\Delta\bar{\tilde{\boldsymbol{\ell}}}_t$) into equation (13).[34] So doing, we obtain time series of counterfactual changes in labor stocks driven by current and past changes in each flow hazard.

Step 2 follows from the linearity of equation (14), which implies the following decomposition of the variance of changes in labor stocks:

$$\mathbb{V}\mathrm{ar}(\Delta\tilde{\boldsymbol{\ell}}_t) \approx \sum_{i\neq j} \mathbb{C}\mathrm{ov}\left(\Delta\tilde{\boldsymbol{\ell}}_t, \sum_{k=0}^{t-2} \boldsymbol{E}_{k,t-k}\frac{\partial\bar{\tilde{\boldsymbol{\ell}}}_{t-k}}{\partial\lambda_{t-k}^{ij}}\Delta\lambda_{t-k}^{ij}\right). \tag{17}$$

$\sum_{k=0}^{t-2} \boldsymbol{E}_{k,t-k}\frac{\partial\bar{\tilde{\boldsymbol{\ell}}}_{t-k}}{\partial h_{t-k}^{ij}}\Delta\lambda_{t-k}^{ij}$ denotes the time series of counterfactual changes in labor stocks driven by current and past changes in each flow hazard ($\Delta\lambda_t^{ij}$). Suppose we want to quantify the contribution of flow hazard λ_t^{FP} to the variation in the stock of full-time employed workers denoted by $\tilde{F}_t$. It follows

[34] Since we have already obtained time series of transition probabilities (p_t^{ij}), as well as series of flow hazards λ_t^{ij}, we can construct time series of matrices $\boldsymbol{A}_t$ and $\boldsymbol{B}_t$.

from equation (17) that:

$$\mathbb{V}\text{ar}(\Delta\tilde{F}_t) \approx \sum_{i\neq j} \mathbb{C}\text{ov}\left(\Delta\tilde{F}_t, \left[\sum_{k=0}^{t-2} \boldsymbol{E}_{k,t-k} \frac{\partial\bar{\bar{\boldsymbol{\ell}}}_{t-k}}{\partial\lambda_{t-k}^{ij}} \Delta\lambda_{t-k}^{ij}\right]_{1,1}\right). \tag{18}$$

Dividing both sides of equation (18) by $\mathbb{V}\text{ar}(\Delta\tilde{F}_t)$ yields:

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

where $\beta_{\tilde{F}}^{ij}$ is the share of the variation in $\Delta\tilde{F}_t$ accounted for by variation in $\Delta\lambda_t^{ij}$. For instance, the variance contribution of changes in λ^{FP} to the variation in changes in $\tilde{F}_t$ is measured by:

$$\beta_{\tilde{F}}^{FP} = \frac{\mathbb{C}\text{ov}\left(\Delta\tilde{F}_t, \left[\sum_{k=0}^{t-2} \boldsymbol{E}_{k,t-k} \frac{\partial\bar{\bar{\boldsymbol{\ell}}}_{t-k}}{\partial\lambda_{t-k}^{FP}} \Delta\lambda_{t-k}^{FP}\right]_{1,1}\right)}{\mathbb{V}\text{ar}(\Delta\tilde{F}_t)}. \tag{20}$$

Step 3 addresses the fact that our interest lies in changes in the *ratio* between labor stocks, rather than changes in the labor stocks themselves. Since the part-time employment share is given by: $\omega_t^P = \frac{P_t}{P_t+F_t}$, we can express its changes in terms of changes in $\tilde{P}_t$ and $\tilde{F}_t$. We do so using a first-order linear approximation:

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

At this step, we can calculate the coefficients β^{ij} that quantify the contribution of each transition hazard λ^{ij} to the variation of the part-time employment share. We also have all the necessary ingredients to compute the γ^{ij}'s, which measure the sources of peak-to-trough changes in the part-time employment share during recessions.

C Robustness

In this section, we report results that are summarized in Subsection 5.3 of the paper. We display results for all working-age individuals to save on space. The results based on the sample of prime-aged workers lead to the same conclusions and are available upon request.

- In Table C1 we assess the impact of compositional changes on the peak-to-trough changes in the part-time employment share during the Great Recession. The first column reports the actual peak-to-trough change. The other columns shows counterfactual changes that would have been observed had the composition of employment not shifted during the recession. For instance, in the U.S. the reference point is the observed peak-to-trough increase in the part-time employment share of 2.92 percentage points (pp). As can be seen in columns (2)–(4), controlling for changes in the demographic characteristics of employed workers entails very similar peak-to-trough changes. In fact, changes in the age and education level of the employed population since the beginning of the Great Recession have dampened the measured increase in the part-time employment share, whereas changes with respect to gender have had the opposite effect. In any case, both effects are quantitatively negligible. The assessment is similar if we include controls for changes in the industry (columns (5) to (8)) or occupation (columns (9) to (12)) structure of employment.

- In Table C2 we study the sensitivity of our results to the presence of multiple jobholders in our sample. The column titled "Baseline" contains a subset of the results that best illustrate Facts 1 to 5 presented throughout the paper. The column titled "Alternative" reports the same statistics calculated on the sample which excludes any individual who holds more than one job in two consecutive quarters (so as to alleviate measurement issues with respect to flows, in addition to labor stocks). Comparing the two columns across rows for each country indicates that the exclusion of multiple jobholders does not affect the results in a significant way.

- In Table C3 we study the effects of using an alternative definition of part-time employment: we classify as part-time workers individuals who usually work less than 30 weekly hours. The table follows the same structure as Table C2. The comparison of the two columns across rows for the U.S. shows that the results are perhaps not as stark, particularly in what concerns Facts 1, and to a smaller extent for Facts 2 and 3. As we have suggested in the text, those differences may be related to the fact that a threshold of 30 hours is uncommon (compared to the usual cutoffs at 34 or 39 hours) for the U.S. The "Monday–Friday 9am–5pm" full-time norm in this country implies that a worker who moves to a schedule of 4 days of 8 hours (32 hours) remains full-time employed under the alternative definition considered here, but not under the baseline one. Table C3 shows that the U.K. results are also weakened, but the differences are quantitatively negligible. In this country, it is not unusual to define part-time employment using a threshold of 30 hours worked per week.

Table C1: Examination of Alternative Hypotheses 1: Composition Effects

	Actual	Demographics			Industry				Occupation			
					Only	Controls			Only	Controls		
		Age	Sex	Edu.		Age	Sex	Edu.		Age	Sex	Edu.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
U.S.	2.92	3.43	2.77	3.07	2.39	2.92	2.43	2.49	2.43	2.93	2.48	2.48
U.K.	1.87	2.32	2.22	2.71	2.63	2.48	2.04	1.66	1.42	2.09	1.70	1.41

Notes: United States: Current Population Survey, pooled data from 2007Q4 to 2009Q2. United Kingdom: Labor Force Survey, pooled data from 2008Q2 to 2010Q1. Column (1) reports the actual peak-to-trough changes in the part-time employment share. Columns (2)–(4) report counterfactual changes controlling for a quartic in age (2), sex (3) and educational attainment (4). Column (5) reports counterfactual changes controlling for employment industries, and in columns (6)–(8) we add controls for changes in age (6), sex (7) and educational attainment (8). Column (9) reports counterfactual changes controlling for occupations of employment, and in columns (6)–(8) we add controls for changes in age (10), sex (11) and educational attainment (12). U.S. education categories are "Less than high-school", "High-school graduates", "Some college", "College or higher education". U.S. industries and occupations are the two-digit categories of the 2000 Census classification schemes. U.K. education categories are: "Primary education (below GCSE)", "Secondary Education (A-level, GCSE or equivalent)", "Higher Education or more". U.K. Industries are the 17 sections of the Standard Industry Classification of 1992. U.K. occupations are the two-digit occupation groups of the Standard Occupational Classification of 2000. All entries are percentage point peak-to-trough differences.

Table C2: Examination of Alternative Hypotheses 2: Multiple Jobholding

	United States		**United Kingdom**	
	Baseline	Alternative	Baseline	Alternative
Fact 1				
$\Delta h_{s,t}$: $\gamma_{s,t}$ – Peak to trough	-1.17 : 71.7	-1.16 : 68.0	-0.47 : 83.7	-0.48 : 82.3
$\Delta h_{s,t}$: $\gamma_{s,t}$ – Peak to one year after trough	-0.65 : 83.1	-0.63 : 83.7	-0.22 : 216.7	-0.18 : 242.9
Fact 2				
β^{FP} : β^{PF} : $\beta^{PF} + \beta^{FP}$	44.7 : 25.1 : 69.8	43.6 : 25.2 : 68.7	26.4 : 40.7 : 67.1	28.4 : 39.3 : 67.7
Fact 3				
Variance contribution of transitions at the same employer: p^{FP} : p^{PF}	84.7 : 76.8	86.0 : 75.0	92.6 : 71.0	93.0 : 74.2
Fact 4				
Average abs. change in weekly hours worked: F to P : P to F	13.1 : 12.5	12.6 : 12.4	11.7 : 11.7	11.3 : 11.3
Fact 5				
Share of involuntary transitions to part-time average : peak-to-trough change	23.1 : 18.0	24.1 : 18.8	13.7 : 7.18	13.6 : 7.04

Notes: United States: Current Population Survey, 1994-2016. United Kingdom: Labor Force Survey, 1993-2016. Sample: All working-age individuals. The columns titled 'Baseline' reproduce the results shown in the paper. The columns titled 'Alternative' report results based on a sample that excludes multiple jobholders. For Fact 1, the table shows the change in hours per worker in levels ($\Delta h_{s,t}$) and the contribution of the part-time employment share ($\gamma_{s,t}$) to this dynamics during the Great Recession and its aftermath. For Facts 2, 3 and 4, the table shows the figures corresponding respectively to Tables 3, 4 and 5 in the text. For Fact 5, the table shows the share of involuntary transitions to part-time employment on average, and their peak-to-trough change during the Great Recession. All entries in the table are reported in percent, except hours changes ($\Delta h_{s,t}$ in Fact 1, and Fact 4) which are measured in hours.

Table C3: Examination of Alternative Hypotheses 3: Definition of Part-time Employment

	United States		**United Kingdom**	
	Baseline	Alternative	Baseline	Alternative
Fact 1				
$\Delta h_{s,t}$: $\gamma_{s,t}$ – Peak to trough	-1.17 : 71.7	-1.17 : 48.3	-0.47 : 83.7	-0.47 : 80.5
$\Delta h_{s,t}$: $\gamma_{s,t}$ – Peak to one year after trough	-0.65 : 83.1	-0.65 : 45.6	-0.22 : 216.7	-0.22 : 175.1
Fact 2				
β^{FP} : β^{PF} : $\beta^{PF} + \beta^{FP}$	44.7 : 25.1 : 69.8	38.1 : 23.5 : 61.6	26.4 : 40.7 : 67.1	27.8 : 36.4 : 64.2
Fact 3				
Variance contribution of transitions at the same employer: p^{FP} : p^{PF}	84.7 : 76.8	76.6 : 71.4	92.6 : 71.0	92.3 : 72.7
Fact 4				
Average abs. change in weekly hours worked: F to P : P to F	13.1 : 12.5	14.6 : 14.5	11.7 : 11.7	12.6 : 12.7
Fact 5				
Share of involuntary transitions to part-time average : peak-to-trough change	23.1 : 18.0	21.4 : 15.1	13.7 : 7.18	16.3 : 8.46

Notes: United States: Current Population Survey, 1994-2016. United Kingdom: Labor Force Survey, 1993-2016. Sample: All working-age individuals. The columns titled 'Baseline' reproduce the results shown in the paper. The columns titled 'Alternative' report results based on a 30-hours threshold to define part-time employment. For Fact 1, the table shows the change in hours per worker in levels ($\Delta h_{s,t}$) and the contribution of the part-time employment share ($\gamma_{s,t}$) to this dynamics during the Great Recession and its aftermath. For Facts 2, 3 and 4, the table shows the figures corresponding respectively to Tables 3, 4 and 5 in the text. For Fact 5, the table shows the share of involuntary transitions to part-time employment on average, and their peak-to-trough change during the Great Recession. All entries in the table are reported in percent, except hours changes ($\Delta h_{s,t}$ in Fact 1, and Fact 4) which are measured in hours.