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; J23.

Keywords: Employment; Hours; Part-time Work; Business Cycles; Demand and Supply of Labor

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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 (U.S.) and the United Kingdom (U.K.) 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 makes up a large fraction 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 us 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.

To obtain a deeper understanding of the dynamics of the intensive margin, we examine more closely 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 fixed working hours, so that workers need

[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.

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 five 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 and thereby give firms an incentive to increase the working hours of current employees. The facts documented in Cooper et al. [2007] and Trapeznikova [2017] buttress our interpretation. Using establishment micro-data respectively from

[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]).

the U.S. and Denmark, they document that changes in establishment-level hours per worker and employment are both quantitatively important and find evidence of a degree of substitution between them.[6] Our worker-level analysis relates those patterns to the procyclicality of hours per worker – the countercyclicality of the part-time employment share – observed at the aggregate level.

Our paper builds on, and contributes to, several strands of literature. First, we expand previous empirical work on the cyclical dynamics of hours per worker. By using longitudinal worker-level micro-data from two countries across several recessions, we provide new facts on the sources of cyclical labor adjustment on the intensive margin.[7] Second, our findings offer fresh perspectives on two important questions in the labor-supply literature, namely the extent to which jobs have fixed working hours and the relation between micro and macro labor-supply elasticities. More broadly, the evidence produced in this 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 outcome of dynamic labor-supply models, that hours per worker adjust smoothly at business-cycle frequencies. Second, the finding that firms play a prominent role in aggregate labor adjustment on the intensive margin cautions against ignoring this margin in models of employment adjustment. We discuss the connections between our paper and the literature in the last section.

We strike a note of caution before closing this introduction. Our analysis draws lessons from fifty 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 rest of 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 Definitions and Measurements

This section presents the main concepts underpinning our empirical analysis and the data sources used to measure them. Supplementary details are provided in Appendix A.

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

[7] As we have already mentioned, Cooper et al. [2007] and Ohanian and Raffo [2012] focus on the decomposition of hours per worker using either establishment-level or aggregate data. Although not directly related to the dynamics of the intensive margin, earlier and concurrent papers have described the aggregate behavior of part-time employment using a flows approach (see OECD [1990], Canon et al. [2014], Warren [2015] and Borowczyk-Martins and Lalé [2016]). Some of their findings are closely related to our own (e.g. Canon et al. [2014] and Warren [2015] document that flows between employment and non-employment play a marginal role in the dynamics of employment stocks in U.S. data), but they focus chiefly on involuntary part-time work and do not relate the dynamics of part-time employment to fluctuations in hours per worker. Moreover, they analyze a shorter time period for only one country (the U.S.) and do not offer a precise variance decomposition of the variation in part-time employment, like we do. Finally, a recent working paper by Kurmann and McEntarfer [2017] uses firm-level data from the state of Washington of the U.S. and shows evidence of substantial changes in hours worked among job-stayers during the Great Recession.

2.1 Definitions

An important distinction in labor force surveys, and one that plays an important role in our analysis, is that between 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. 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 '*How many hours did you work LAST WEEK at all job(s)?*'. The qualifier '*at all job(s)*' is replaced by '*at your (main) job*' if the survey explicitly distinguishes between single and multiple jobholders. When this occurs, the latter are usually asked additional questions to measure the hours worked outside their main job.

Following a long tradition in the literature, we measure the intensive margin of labor inputs based on actual hours. We use usual hours to define workers' employment status. In particular, we classify 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 (BLS).[9]

2.2 Sample

We present results for two samples: working-age (between 16 and 64 years old) and prime-age individuals (25 to 54 years old). 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.

2.3 Measurements

To conduct our analysis we create two data sets for each country. The first contains time series of hours per worker among full-time and part-time employed workers and is the key ingredient to Section 3, in which we establish Fact 1. The second data set puts together series of stocks and flows of individuals in different labor market states, and is used to establish Facts 2 to 5 in Sections 4 and 5.

U.S. Data. Our source of U.S. data is the Current Population Survey (CPS). Each month, the CPS surveys about 60,000 households and collects demographic and employment information on the civilian non-institutional population aged 16 and older. The CPS is an address-based survey; the occupants of a housing unit are interviewed for 4 consecutive months, rotated out of the survey for 8 months, and then included in the survey again for an additional 4 months. These features allow CPS users to link up to three-quarters of respondents across consecutive months.

The CPS is organized around a main questionnaire, carried out every month, whose responses are collected in the basic monthly files. In addition, some questionnaires are administered less frequently and/or only to a subsample of respondents and collected in different files. Before 1994, information on usual hours worked is available only in the May supplements from 1969 to 1978 and in the Earner

[8] In most surveys, including those used in our analysis, the term 'usual' is determined by each respondent's own understanding of the term. For instance, the CPS Interviewing Manual instructs interviewers to define it 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 [2015]).

[9] Some statistical agencies use a definition of part-time employment based on a threshold of 30 usual hours. Our main findings are robust to using this alternative definition of part-time employment (see Subsection 5.3).

Study questions after January 1979.[10] The May extracts are – as the name suggests – annual data, which record the hours of all wage and salary workers. The Earner Study questions are administered every month to about one-fourth of the sample called the Outgoing Rotation Groups (ORG). In both instances, usual hours refer to the main job held by the respondent.[11] For those with missing information on their usual hours (about 5% of all eligible CPS respondents), the BLS uses demographic edits followed by a "hot-deck method" to obtain imputted values.[12] As part of the 1994 redesign of the survey (Cohany et al. [1994]), the question about usual hours was moved forward from the Earner Study questions to the main questionnaire and administered to the full CPS sample thereafter. Also, the option of answering "hours vary" instead of reporting an exact number of usual hours worked was added to the survey.[13] These changes led to a drop in the number of observations with imputted values, while around 7% of workers after 1994 report that their usual work hours are "variable". Finally, in the redesigned CPS hours worked at all jobs can be distinguished from hours worked at the main job.

We use the various data sources above to construct two sets of alternative series of hours per worker. The first one, labeled 'yearly data', is based on the May extracts from 1969 to 1978 and on the ORG files from 1979 to 2017.[14] We aggregate the latter to a yearly frequency as per the format of the 1969–1978 data. The yearly series serves the purpose of comparing the behavior of the intensive margin across the highest possible number of recessions. We find, in addition, that aggregation is an effective method to remove some of the discrepancies coming from the lack of consistent data collection on usual hours described in the previous paragraph. The second set of time series, labeled 'quarterly data', provides a richer description of short-run fluctuations. In creating these time series, we avoid the usual hours variable altogether and use data on actual hours at all jobs instead, for which there is a consistent measurement from 1976 until 2017 in the basic monthly files.[15] Via longitudinal matching, we use workers' actual hours in consecutive months to define their employment status (i.e. full-time/part-time) in a way that fits the notion of 'usual' work schedule (see Footnote 8). Appendix A provides a complete description of this procedure.

To construct our data set with series of stocks and flows, we rely on the basic monthly files starting in 1976. Since our approach of defining a full-time/part-time status based on actual hours across several interviews is not applicable to the measurement of worker flows, we pursue an alternative route. Specifically, prior to 1994 the CPS records one piece of information on 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 provides a proxy variable to identify individuals

[10]We thank an anonymous referee for bringing to our attention the existence of CPS data on usual hours prior to 1994. The May supplements data began with the major CPS revision made in 1967, but only data starting in 1969 seem to be publicly available (see `http://www.nber.org/data/cps_may.html`).

[11]There is some element of uncertainty for individuals with multiple jobs. Citing debriefings with CPS interviewers, Polivka and Rothgeb write, '*some respondents do not seem to hear the phrase 'at all jobs*'' (Polivka and Rothgeb, 1993, p.16). This said, we find that removing multiple jobholders has no discernible impact on the hours series based on the 1973-1978 May supplements (which allow one to identify workers with multiple jobs).

[12]Details about edits and imputation methods are available in Chapter 9-1 of U.S. Bureau of the Census [2006].

[13]Documentation provided by Unicon Research Corporation and IPUMS-CPS [2017] suggests another source of discrepancy in data about usual hours between the pre-1994 and post-1994 CPS. According to both research entities, in the Earner Study questions the respondent is prompted to provide the number of weekly hours worked *at the rate that she reports is her rate of pay.* The qualifier is included during the years 1979-1981 and 1989-1993 (both of which include recession periods), but not between 1982 and 1988 nor after the 1994 CPS redesign.

[14]In our baseline time series, we keep workers with BLS-imputted usual hours, and we use the CEPR-imputted values for those whose "hours vary" after 1994. Removing these workers from the sample has virtually no effect on the results when studying the data at a yearly frequency; see the online appendix.

[15]We use hours for individuals who are employed at the time of the survey and who are either at work or absent from work during the reference week. Workers on temporary layoffs are classified as unemployed, and therefore they are excluded from this measurement.

in part-time employment, which we use to construct measurements of worker stocks and flows before 1994. As is standard in the literature (see Polivka and Miller [1998] and Elsby et al. [2009]), we use multiplicative adjustment factors to reconcile the pre- and post-1994 levels of the time series of worker stocks.[16] By longitudinally linking respondents over consecutive months, we calculate flows across labor market states (including flows across the imperfectly measured full-time/part-time employment states before 1994). We then use a margin-error correction to make the series of flows calculated in this way consistent with the observed changes in stocks. Since we use the series of stocks adjusted for the 1994 break, we effectively remove the mismeasurement in flows prior to the CPS redesign.

U.K. Data. Our source of data for the U.K. is the Labor Force Survey (LFS), available from the U.K. Data Service.[17] The LFS is a survey of households living in private addresses designed to collect demographic and employment information on the U.K. population. The survey started in 1973 and was realized every two years during the first decade of its existence. It was then carried out annually between 1984 and 1991. From the spring quarter of 1992 onwards, the LFS assumed its current format, which is characterized by a longitudinal structure and quarterly frequency. The quarterly survey sampled households in Great Britain from 1992Q2 until 1994Q4, and started sampling U.K households (i.e. including Northern Ireland households) in 1995Q1. In the spring of 2006 the LFS moved from seasonal to calendar quarters.[18] Fortunately, the Office of National Statistics (ONS) produced a series of micro-data extracts based on calendar quarters going back to 1992Q2, which is the one we use in this paper. The current sample includes around 37,000 responding households per quarter and is composed of five rotating waves of equal size.

The LFS records usual and actual hours worked 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. Mirroring the U.S. data, we work with two sets of series of hours per worker, one at a yearly frequency and another at a quarterly frequency. The yearly series are computed using biennial extracts between 1977 and 1983, annual extracts from 1984 to 1991, and quarterly extracts from 1992 onwards. Until 1992, the LFS surveyed individuals only in the spring months of every year (April to June until 1984, and March to May until 1991). To obtain a consistent series at a yearly frequency, we linearly interpolate the data from 1977 to 1983 and, after 1992, use only observations from the spring quarter. The yearly series cover individuals in paid employment, whereas the quarterly series cover our preferred sample (individuals in private-sector paid employment) starting in the last quarter of 1993, when the variable identifying private-sector employment was first collected.

Since the LFS only introduced a longitudinal structure in the spring quarter of 1992 and the variable identifying private-sector workers only became available in 1993Q4, our data set with series of stocks and flows starts at that point.[19] To measure flows, we use the series of two-quarter longitudinal extracts

[16] We follow Polivka and Miller [1998] in computing the adjustment factors by taking the ratio of the mean value in 1994 to the mean value in 1993. The values that we obtain are typically between 1.10 and 1.15, in line with the authors' estimates (see Table 7.7 in their study). We test and discard any systematic break in January 1994 in the resulting time series. We do so by running regressions of the series against a high-order polynomial of time, seasonal dummies, and a dummy for the 1994 redesign of the CPS.

[17] See `https://www.ukdataservice.ac.uk/`.

[18] LFS seasonal quarters are: Winter (December to February), Spring (March to May), Summer (June to August) and Autumn (September to November), while calendar quarters are 1 (January to March), 2 (April to June), 3 (July to September) and 4 (October to December). Unless otherwise mentioned, U.K. quarters refer to calendar quarters.

[19] 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

provided by the U.K. Data Service. Those series are based on seasonal quarters from 1993Q4 until 1997Q1 and on calendar quarters from 1997Q2 onwards.[20] Since the series of quarterly cross sections are all based on calendar quarters, the margin-error adjustment allows us to deal with potential breaks in the series of flows.

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:

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

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. 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 plots the two counterfactual series (the dashed and dashed-dotted lines) along with the actual series of hours per worker (solid line) based on the yearly data. The gray-shaded areas indicate recessionary episodes identified by the National Bureau of Economic Research (NBER). Starting with the behavior of the solid line, its average value over the sample period is 38.9 weekly hours. 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 the Twin Recessions of the early 1980s). Beyond cyclical variation around recessions, hours per worker display substantial low-frequency variation across decades. The decline in hours per worker observed between the late 1960s and the early 1980s was followed by a steady increase in the following 15 or so years. So much so that, by the mid-1990s, hours per worker had returned to the value observed at the start of the sample period.

Moving to the behavior of the dashed and dashed-dotted lines, we observe a clear co-movement between them and the solid line. The two counterfactual series move procyclically and contribute to the fall in hours per worker during each recessionary episode. On the 'eyeball metric', the dashed-dotted line appears quantitatively important to explain low-frequency changes in hours per worker

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 consistent time series of gross flows.

[20] The two-quarter micro-data extract for the last seasonal quarter of 1996 is not available, and we therefore use the corresponding five-quarter extract.

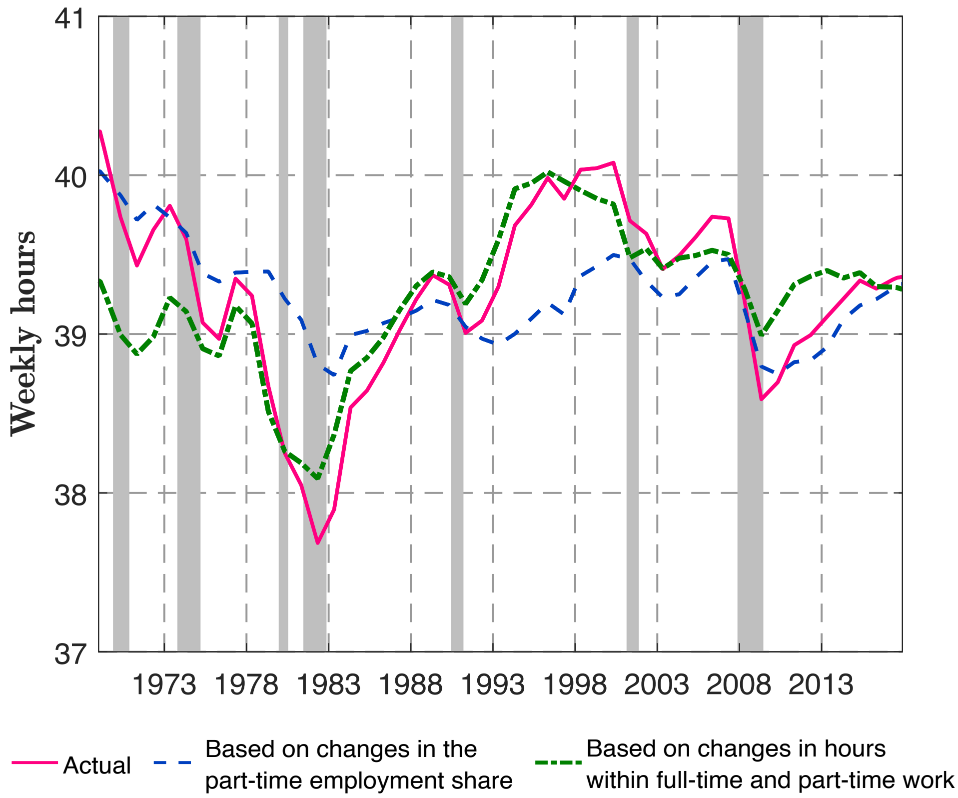


Figure 1: U.S. Hours per Worker, 1969–2017: All Working-age Individuals

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

across decades. By comparison, the dashed line appears particularly important to explain the drop in hours during the larger recessionary episodes (the 1973-1975 recession, the Twin Recessions of the 1980s and the Great Recession), as well as its slow recovery during the three more recent recessions.

Decomposing Changes in Hours per Worker. To quantify the role of part-time employment to cyclical fluctuations at the intensive margin, we focus primarily on the variation in hours per worker around recession periods. 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 period s and any future period 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 is a series of chain-weighted changes in hours per worker driven by changes in the part-time employment share.[21] We use it to define the following coefficient:

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

$\gamma_{s,t}$ (or gamma coefficient) exactly quantifies the contribution of the part-time employment share to changes in hours per worker between period s and period t.

Table 1 reports, for each of the six recessions covered by our yearly series, both delta and gamma coefficients computed from the recession's peak to trough years and from the peak year to the first year after the trough. The latter values are supposed to capture the contribution of part-time work to the sluggish recovery in hours per worker. To fix ideas, consider the first recession, which started in 1969. The delta coefficient indicates that, after one year, hours per worker dropped by 0.52 hours among working-age individuals (or by 1.33 percent relative to the level of hours per worker in 1969). The gamma coefficient tells us that the increase in part-time employment accounted for 48.5 % of that drop in hours per worker. Focusing on the dynamics from the peak year to the year after the trough, hours per worker decreased by more (0.70 hours) and the contribution of the part-time employment share was slightly lower at 44.1%.

Table 1: Change in U.S. Hours per Worker

		Working age			Prime age		
		$\Delta h_{s,t}$	$\frac{\Delta h_{s,t}}{h_s}$ (%)	$\gamma_{s,t}$ (%)	$\Delta h_{s,t}$	$\frac{\Delta h_{s,t}}{h_s}$ (%)	$\gamma_{s,t}$ (%)
$s = 1969$	$t = 1970$	-0.52	-1.33	48.5	-0.45	-1.09	36.8
	$t = 1971$	-0.70	-1.77	44.1	-0.71	-1.69	30.7
$s = 1973$	$t = 1975$	-0.37	-0.95	84.8	-0.57	-1.37	63.4
	$t = 1976$	-0.22	-0.56	51.6	-0.35	-0.85	53.9
$s = 1980$	$t = 1982$	-0.83	-2.17	49.7	-0.92	-2.31	40.4
	$t = 1983$	-0.63	-1.66	77.6	-0.69	-1.74	63.8
$s = 1990$	$t = 1991$	-0.34	-0.86	42.2	-0.31	-0.75	29.5
	$t = 1992$	-0.20	-0.51	78.3	-0.19	-0.47	44.1
$s = 2001$	$t = 2002$	-0.50	-1.26	43.8	-0.66	-1.60	30.5
	$t = 2003$	-0.64	-1.62	36.4	-0.81	-1.96	29.5
$s = 2007$	$t = 2009$	-1.09	-2.75	51.8	-1.17	-2.85	46.4
	$t = 2010$	-0.97	-2.46	61.3	-1.07	-2.61	52.4
1969 – 2017			$\beta = 41.3$			$\beta = 35.1$	

Notes: Current Population Survey, yearly data, individuals in private-sector paid employment. $\Delta h_{s,t}$ reports the change in the levels of hours per worker between year s and year t. $\frac{\Delta h_{s,t}}{h_s}$ reports the corresponding change relative to the peak of each recession. $\gamma_{s,t}$ reports the contribution of the part-time employment share to the change in hours per worker, $\Delta h_{s,t}$. β reports the variance contribution (in percent) of changes in the part-time employment share to changes in hours per worker.

Scanning through the numbers reported for the remaining recessions in Table 1 leads to the same conclusion, viz. that part-time work plays a predominant role in the dynamics of hours per worker in

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

cyclical swings. In the average recession, part-time employment explains just over half of the drop in hours per worker in a peak-to-trough sense: the average of the peak-to-trough $\gamma_{s,t}$'s shown in Table 1 is 53.5%. That contribution is higher (58.2%) when we also consider the recovery period. The gamma coefficients obtained among prime-age workers are smaller, but are nevertheless high across all recessions. 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.[22] Bearing in mind the greater labor force attachment of prime-age workers, these findings are quite remarkable. We would expect to find substantially more sluggishness in workers' full-time/part-time employment status, making most of the adjustment occur via changes in hours within each employment type. 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 regarding the importance of part-time work are actually more pronounced when we focus on prime-age individuals.

To conclude the analysis based on the yearly data, in the bottom row of Table 1 we summarize the contribution of part-time employment for the short-run dynamics of hours per worker over the whole sample period. We do it using the following coefficient:

$$\beta \equiv \frac{\mathbb{C}\text{ov}\left(\Delta h_{t-1,t}, \Delta\widetilde{h}_{t-1,t}\right)}{\mathbb{V}\text{ar}(\Delta h_{t-1,t})}, \tag{5}$$

with $\Delta\widetilde{h}_{t-1,t} = \sum_{i=F,P}\left(\omega_t^i - \omega_{t-1}^i\right)\frac{h_{t-1}^i + h_t^i}{2}$ denoting changes in hours per worker driven by changes in the part-time employment share between two consecutive periods. The reported β coefficients provide a useful counterpart to the results based on the $\gamma_{s,t}$'s, as they measure the role of part-time work to the dynamics of the intensive margin during both tranquil times and economic downturns. As one would expect from inspecting Figure 1, the variance contribution of part-time employment to year-to-year changes in hours per worker is smaller, reflecting its reduced role during non-recessionary periods. However, the β's remain fairly elevated at 41.3% among working-age workers and 35.1% among prime-age workers.

A Closer Look at Recessions. To provide a richer characterization of adjustment during recessions, we perform a similar analysis based on the quarterly data. Figure 2a shows, for each of the four more recent recessions, the series of actual hours per worker and two counterfactual series holding either the h_t^i's or ω_t^P fixed to their value at the recession peak (denoted as quarter 0 on the horizontal axis). All three series are expressed in percentage change relative to quarter 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 3.01% from peak to trough. The delta coefficient indicates the corresponding change in levels, which amounts to -1.16 hours. Hours per worker continued to fall for one quarter after the

[22] The two sets of columns in Table 1 indicate that fluctuations in hours per worker are not substantially different among prime-age individuals. Young workers have comparably 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 shall 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]).

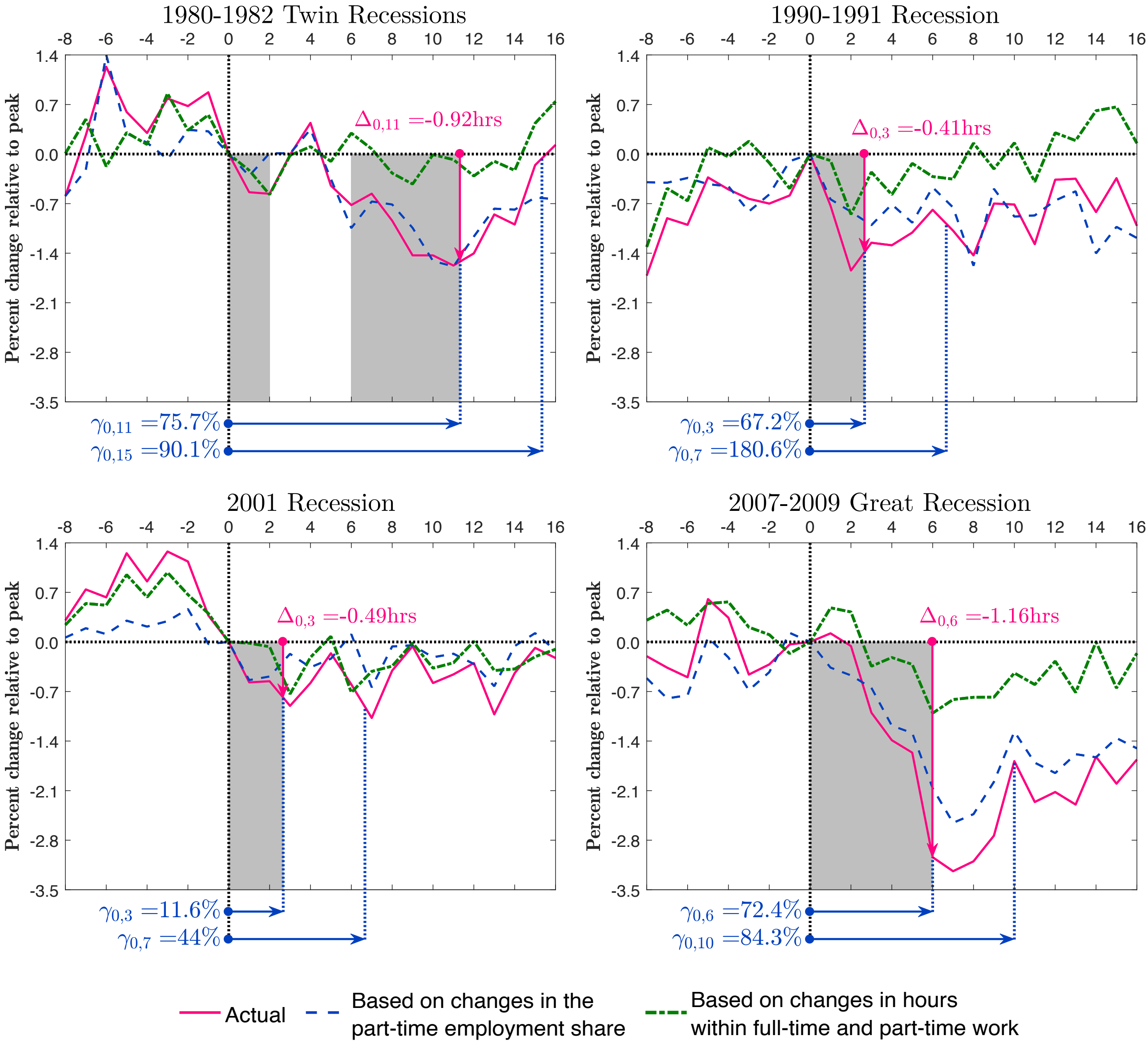


Figure 2a: Change in U.S. Hours per Worker during Recessions: All Working-age Individuals

Notes: Current Population Survey, quarterly data, working-age individuals in private-sector paid employment. The solid line shows the actual series of hours per worker. The dashed (dashed-dotted) line shows the counterfactual series constructed from changes in the part-time employment share (hours within part-time and full-time work). All series are in percentage 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.

recession and recovered slowly in the ensuing period, so much so that they remained 1.65% below their pre-crisis 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 gamma coefficients are respectively 72.4 and 84.3%.

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.[23] The $\gamma_{s,t}$'s confirm this visual inspection: the part-time employment share explains over 70% of

[23]Hours per worker behave quite differently during the 2001 recession. They take their biggest hit during the two

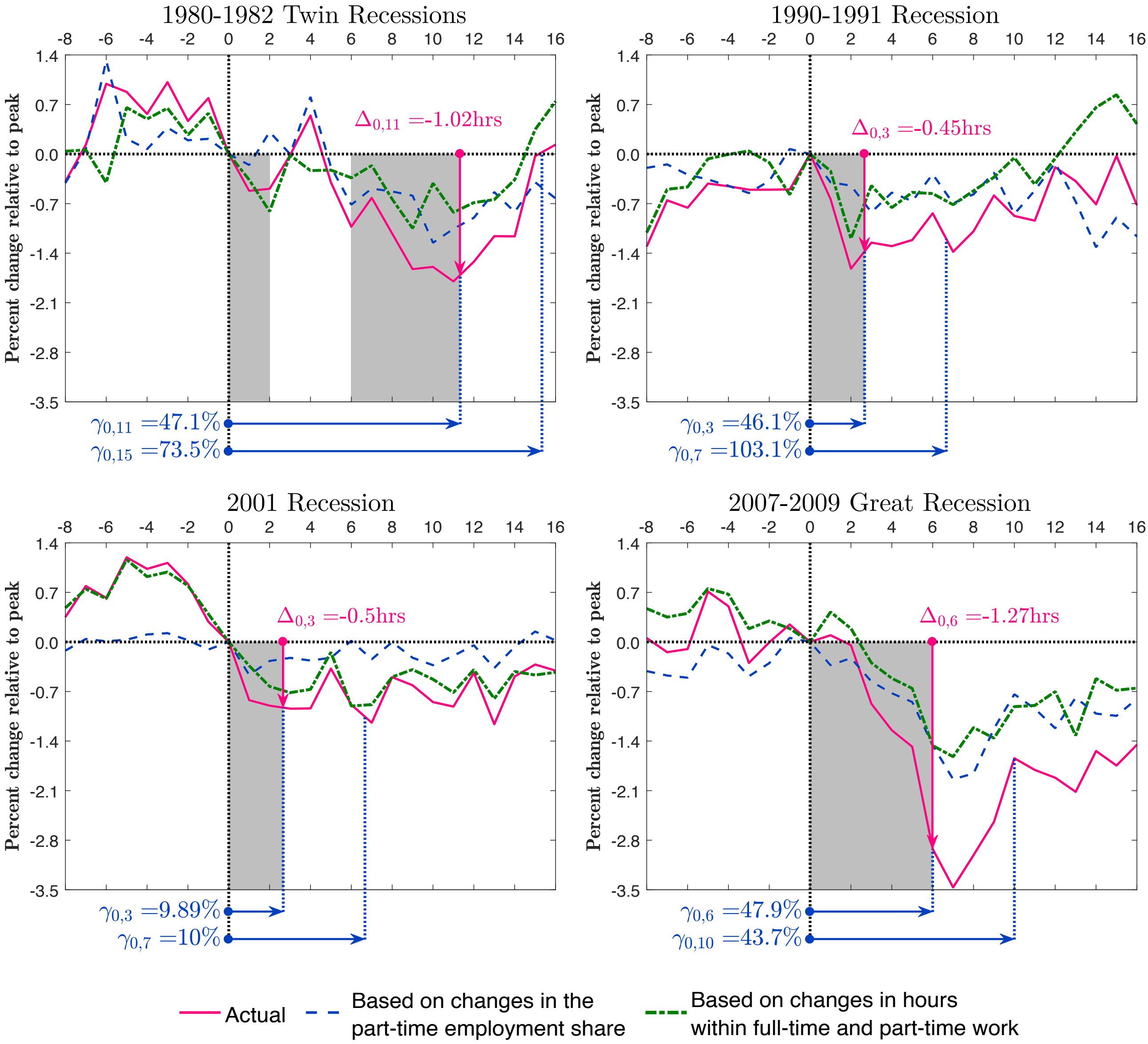


Figure 2b: Change in U.S. Hours per Worker during Recessions: Prime-age Individuals

Notes: Current Population Survey, quarterly data, prime-age individuals in private-sector paid employment. The solid line shows the actual series of hours per worker. The dashed (dashed-dotted) line shows the counterfactual series constructed from changes in the part-time employment share (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.

the peak-to-trough drop in hours per worker in three out of the four recessions covered by the quarterly data.[24] The frequency of these data allows us to highlight an additional fact, namely that the

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 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]).

[24] 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

part-time employment share is largely responsible for the slow dynamics of hours per worker during the recovery period. In all four recession periods, we find that the $\gamma_{s,t}$'s increase with each quarter after the trough for at least one year. During both the Twin Recessions and the Great Recession, for instance, the $\gamma_{s,t}$'s begin to decrease 'only' 7 quarters after the trough.

Figure 2b displays the same information based on the sample of prime-age workers. The conclusions are very similar to those obtained for working-age individuals, viz. the importance of part-time work in dragging the recovery of hours per worker in the year immediately after the end of the recession. The difference between the gamma coefficients computed in quarterly data and yearly data is lower among prime-age workers.

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).[25] As illustrated in the plot, the business-cycle history of the U.K. after 1977 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 32.5 hours. This secular evolution is punctuated by clear cyclical swings during recession periods. In what concerns the role of part-time employment, the differences with respect to the U.S. are stark. 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 trend in hours per worker, while the evolution of hours within part-time and full-time work 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 co-movement of the dashed and solid lines, which is particularly striking 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 analyze 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)). We start by analyzing results based on yearly data, displayed in Table 2. The changes in hours per worker (measured by $\Delta h_{s,t}$ from peak to trough) confirm what is already apparent in Figure 3: hours per worker drop sharply during recessions. Among working-age individuals the peak-to-trough changes are -3.53 hours in the 1980s recession, -0.81 hours in the 1990s recession and -0.51 hours in the Great Recession. The values obtained for prime-age workers are of similar magnitude but somewhat smaller. Interestingly, while the magnitude of the peak-to-trough drop in hours per worker 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 the $\gamma_{s,t}$'s is negligible in the recessions of the 1980s and 1990s – with the exception of the 1990s recession in the working-age sample, where the contribution of part-time employment is 40.7%. 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 78.6 and 86.7 % of the dynamics of hours per worker, respectively for working-age and prime-age individuals. Similar to the U.S., the beta coefficients for the U.K are

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.

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

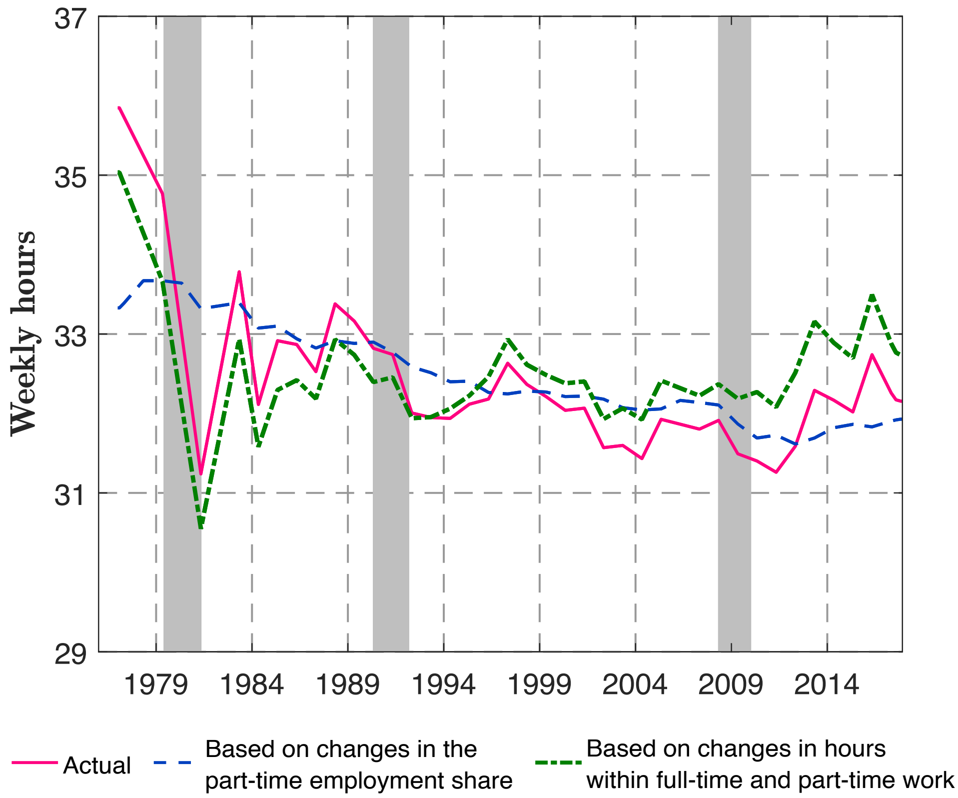


Figure 3: U.K. Hours per Worker, 1977-2017

Notes: Labor Force Survey, yearly data, working-age individuals in paid employment. The solid line shows the actual series of hours per worker. The dashed (dashed-dotted) line shows the counterfactual series of hours per worker constructed from changes in the part-time employment share (hours within part-time and full-time work). Gray-shaded areas indicate ECRI recession periods.

Table 2: Change in U.K. Hours per Worker

		Working age			Prime age		
		$\Delta h_{s,t}$	$\frac{\Delta h_{s,t}}{h_s}$ (%)	$\gamma_{s,t}$ (%)	$\Delta h_{s,t}$	$\frac{\Delta h_{s,t}}{h_s}$ (%)	$\gamma_{s,t}$ (%)
$s = 1979$	$t = 1981$	-3.53	-10.1	9.16	-3.52	-10.2	5.12
	$t = 1982$	-2.26	-6.49	12.8	-2.25	-6.54	6.14
$s = 1990$	$t = 1992$	-0.81	-2.48	40.7	-0.64	-1.92	11.4
	$t = 1993$	-0.87	-2.65	46.7	-0.64	-1.94	9.96
$s = 2008$	$t = 2010$	-0.51	-1.60	78.6	-0.39	-1.19	86.7
	$t = 2011$	-0.65	-2.05	56.3	-0.49	-1.50	55.7
$1977 - 2017$			$\beta = 7.93$			$\beta = 4.54$	

Notes: Labor Force Survey, yearly data, individuals in paid employment. $\Delta h_{s,t}$ reports the change in the levels of hours per worker between year s and year t. $\frac{\Delta h_{s,t}}{h_s}$ reports the corresponding change relative to the peak of each recession. $\gamma_{s,t}$ reports the contribution of the part-time employment share to the change in hours per worker, $\Delta h_{s,t}$. β reports the variance contribution (in percent) of changes in the part-time employment share to changes in hours per worker.

smaller than the gamma coefficients. In the case of the U.K they are quite a lot smaller (always below 10%). Although this can be explained to a great extent by the fact that the sample covers many more non-recessionary periods, it still suggests a somewhat more limited role for part-time employment in the dynamics of the intensive margin compared to the U.S.

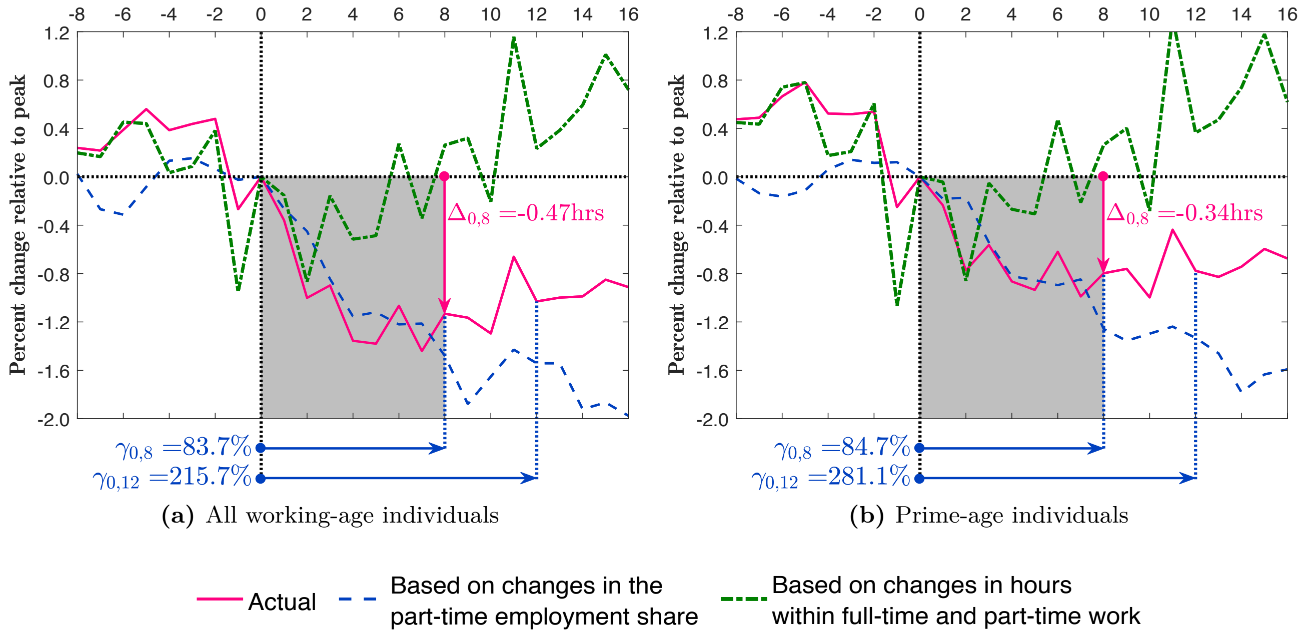


Figure 4: Change in U.K. Hours per Worker during the Great Recession

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 (dashed-dotted) line shows the counterfactual series constructed from changes in the part-time employment share (from changes in hours within part-time and full-time work). All series are in percentage 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 worker 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 (83.7 and 84.7%, respectively for working-age and prime-age individuals) and severely drags its recovery during the recession's aftermath (the gamma coefficients measured from the peak to one year after the trough are 215.7 and 281.1%, respectively for working-age and prime-age individuals). 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 those 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 and 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 constitute distinct labor market states.[26] 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

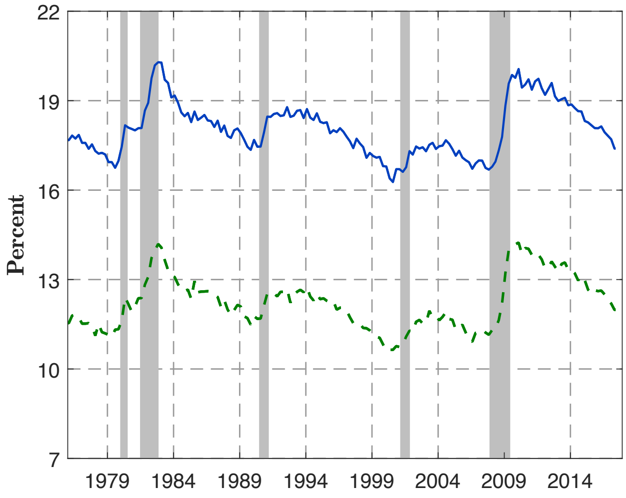
Having established Fact 1, we direct our attention to the behavior of the part-time employment share. Figure 5 tracks the evolution of this share over the past four decades in the U.S. and U.K. labor markets. The solid and dashed lines in Figures 5a and 5b denote the part-time employment share among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

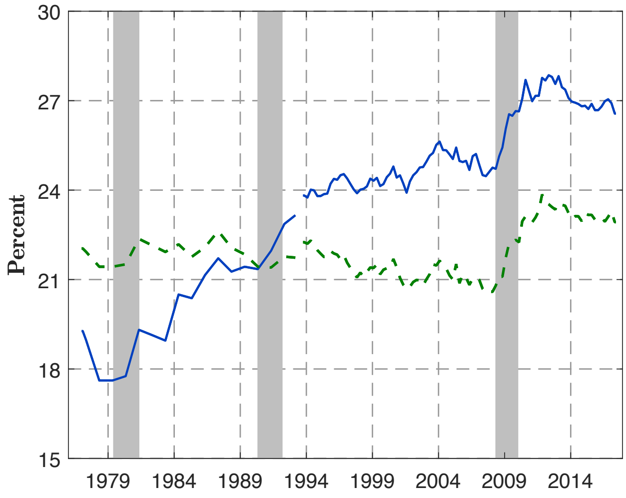
The second remarkable fact visible in Figure 5 is the strong countercyclicality of part-time work. In both plots the solid and dashed lines shoot up in recessionary periods – indicating a quick shift in the composition of employment towards part-time work – and post-recession periods are characterized 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.

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

[26] 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 D 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.



(a) United States



(b) United Kingdom

Figure 5: Part-time Employment Share, U.S. 1976-2017 and U.K. 1977-2017

Notes: Fig. 5a: Current Population Survey, quarterly average of monthly data. Sample: individuals in private-sector paid employment. Fig. 5b: Labor Force Survey, yearly data from 1977 to 1993, quarterly data from 1994 to 2017. Sample: individuals in paid employment (1977-1993) and in private-sector paid employment (1994-2017), with the yearly series adjusted to match the average of the quarterly series. The lines show the share (in percent) of workers in part-time employment. Gray-shaded areas indicate NBER and ECRI recession periods.

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. At the same time, while U.K. part-time employment has been stable among the prime-aged, it trends upwards among working-age individuals and it is unclear whether this trend affects the cyclicality of the part-time employment share. The fact that the cyclical response in the Great Recession is equally large in both samples suggests that is not the case. In our view, the increase in the use of part-time employment during the Great Recession is likely due to the increased flexibility in labor adjustment in the U.K. This hypothesis is at the center of a number of recent papers (see Blundell et al. [2014], Gregg et al. [2014] and Elsby et al. [2016]). They show that: (i) despite the much greater drop in output in the Great Recession compared to previous recessions, the drop in employment was much lower (our paper makes the same point regarding hours per worker); (ii) the flipside of this extraordinary resilience of employment during the Great Recession is the extent of downward real-wage adjustment (particularly among job stayers), which was far greater compared to previous downturns. We provide a more detailed discussion of the evolution of U.K. part-time employment in the online appendix.

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 us 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:

$$\boldsymbol{\ell}_t = \begin{bmatrix} F & P & X & U & N \end{bmatrix}_t^{\prime}. \tag{6}$$

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

$$\boldsymbol{\ell}_t = \boldsymbol{M}_t \boldsymbol{\ell}_{t-1}, \tag{7}$$

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.

In Section 2 we described how we measure worker flows using data from the CPS and the LFS. We make several adjustments to those basic series to obtain our estimates of transition probabilities. First, as mentioned in Section 2, we apply a margin-error correction (Poterba and Summers [1986] and Elsby et al. [2015]). This procedure makes the entries of $\boldsymbol{M}_t$ consistent with changes in the stocks (i.e. the elements of $\boldsymbol{\ell}_t$). Second, we correct the time series to account for systematic seasonal variation. Last, we perform a time-aggregation bias correction (Shimer [2012]). In Appendix A we provide more details about these adjustment procedures. We work with quarterly transition probabilities for both countries throughout the analysis.[27]

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 3 reports 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 45% (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 (10.1% 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 full-time work (19.8% in the U.S., 7.5% in the U.K.), followed by transitions to non-participation (13.9% in the U.S., 4.58% in the U.K.). Third, the most likely destination for a full-time worker is towards part-time employment (4.61% in the U.S., 2.24% in the U.K.). Fourth and last, the patterns we just highlighted also hold among prime-age workers.

Table 3 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 pattern 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 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

[27] For the U.S., we calculate quarterly transition probabilities by linking the 1st to the 4th (or 5th to 8th) interview of CPS respondents. 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. Notice that the margin-error adjustment addresses the mismeasurement of worker flows due to sample attrition (as we match CPS respondents several months apart).

Table 3: 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}	4.61	3.24	2.24	1.81
p^{FX}	0.97	0.97	1.27	1.18
p^{FU}	3.03	2.52	1.67	1.22
p^{FN}	1.51	1.11	0.80	0.44
$\sum_{i\neq F} p^{Fi}$	10.1	7.84	5.98	4.65
	(ii) Part-time employment			
p^{PF}	19.8	23.4	7.50	6.84
p^{PX}	2.50	3.06	2.01	2.08
p^{PU}	8.68	6.97	2.79	1.88
p^{PN}	13.9	9.55	4.58	2.43
$\sum_{i\neq P} p^{Pi}$	44.8	43.0	16.9	13.2
	(iii) Other and non-employment			
p^{XF}	2.78	2.79	1.66	1.63
p^{XP}	1.55	1.19	0.72	0.60
p^{UF}	29.7	33.5	12.3	12.5
p^{UP}	18.7	12.8	9.63	7.78
p^{NF}	2.70	3.20	0.59	0.44
p^{NP}	5.45	3.76	2.77	1.65

Notes: United States: Current Population Survey, 1976-2017. United Kingdom: Labor Force Survey, 1994-2017. 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.

from non-participation into private sector paid employment (viz. p^{NP}/p^{NF}) is 4.7 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 inflows and outflows, 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, transition probabilities from non-employment to private-sector paid employment (full-time or part-time) fall at the onset of recessions and recover slowly as the recovery sets in, and transition probabilities from private-sector paid employment to unemployment jump upwards in the early stages of recessions, but return to previous levels much faster. The key observation is that these patterns are *quantitatively* more pronounced for transition probabilities in and out of full-time work, compared to their part-time work counterparts. For example, when we observed that p^{FU} drops more relative to p^{PU} during recessions, this should contribute to an increase in share of part-time employment. In other words, 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.[28] Specifically, we extend the dynamic variance decomposition developed by Elsby et al. [2015] to our Markov-chain model.[29] 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:

$$\beta^{ij} = \frac{\mathbb{C}\text{ov}\left(\Delta\omega^P_{t-1,t}, \Delta\widetilde{\omega}^P_{t-1,t}\right)}{\mathbb{V}\text{ar}(\Delta\omega^P_{t-1,t})}. \tag{8}$$

$\Delta\widetilde{\omega}^P_{t-1,t}$ 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:

$$\sum_{i\neq j} \beta^{ij} \approx 1. \tag{9}$$

Panel A. of Table 4 displays the results of the variance decomposition.[30] 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-a-vis working-age individuals (53.5 vs 45.3%). In the U.K, β^{PF} is higher than β^{FP} in the working-age sample (41.0 vs 27.5%), while the opposite is observed for the prime aged (28.0 vs 45.2%).

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

[29] Their out-of-steady-state decomposition method is particularly suited for our application, as the dynamics of 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, one needs to keep track of the effects on current stocks of lagged changes in flow hazards.

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

Table 4: 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}	45.3	53.5	27.5	45.2
β^{PF}	23.0	19.6	41.0	28.0
$\beta^{FP} + \beta^{PF}$	68.3	73.1	68.5	73.2
	(ii) Other and non-employment			
β^{X}	4.42	2.72	11.5	14.4
β^{U}	15.0	8.35	10.6	11.0
β^{N}	11.2	15.8	7.31	7.85
Total	98.9	100.0	97.9	106.4
	B. Peak-to-trough change in the Great Recession			
	(i) Full- and part-time employment			
γ^{FP}	59.3	67.4	60.2	56.6
γ^{PF}	25.5	14.3	95.1	33.1
$\gamma^{FP} + \gamma^{PF}$	84.8	81.7	155.3	89.7
	(ii) Other and non-employment			
γ^{X}	-3.91	-4.56	19.8	18.3
γ^{U}	23.2	25.2	-7.6	-8.8
γ^{N}	-4.03	-2.41	-67.6	0.7

Notes: United States: Current Population Survey, 1976-2017. United Kingdom: Labor Force Survey 1994-2017. 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 explained 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 $\beta^{U} = \sum_{i=P,F} \beta^{iU} + \sum_{j=P,F} \beta^{Uj}$. We report the full list of variance contributions in Table C1 of the appendix. Inspection of those contributions shows, first, a remarkable similarity across countries, second, a strong consistency with the standard dynamics of employment (the betas have the right signs) and, third, little evidence in favor of the "non-employment reallocation" hypothesis (the betas cancel each other out). To illustrate this last point, consider, for example, the net contribution of unemployment measured by β^{U} in Table 4. It masks almost exactly offseting values of β^{UF} (positive) and β^{UP}(negative). In fact, the role of unemployment in the cyclical dynamics of part-time employment is mostly driven by p^{FU}(whose variation is not offset by that of p^{PU}). Similarly, the role of non-participation in the dynamics of the part-time employment share is mostly due to p^{PN}, and β^{NF} (positive) and β^{NP} (negative) cancel each other out. These movements in non-employment flow hazards captured by the β^{ij}'s (the *gross* variance contributions) are interesting in their own right. Yet, put together they are quantitatively much less important to explain the short-run behavior of the part-time employment share compared to p^{FP} and p^{PF}.

So far, 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 4 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.[31] 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-employment 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, hardly ever fully recover 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. In this section, we put forward a hypothesis of *variable labor utilization* to rationalize the source of these fluctuations, and draw on the wealth of auxiliary information available in U.S. and U.K. labor force surveys to confront it 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

[31] We report the γ^{ij}'s for the other U.S. recessions in the online appendix. They provide qualitatively, and in most cases quantitatively, the same picture of labor market dynamics as that conveyed by the coefficients for the Great Recession.

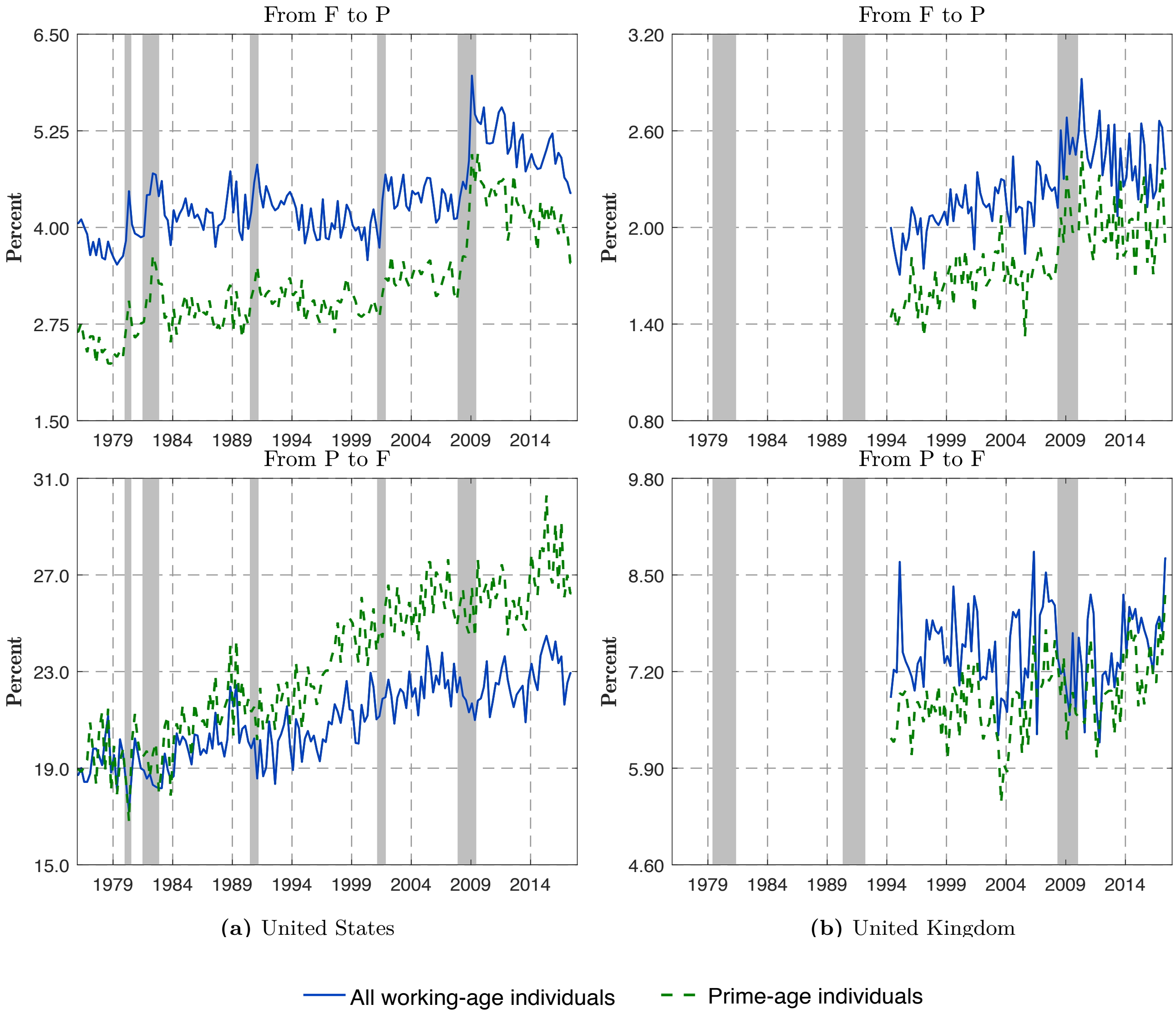


Figure 6: U.S. and U.K. Transition Probabilities between Full-time and Part-time Employment

Notes: Fig. 6a: Current Population Survey, quarterly average of monthly data, 1976-2017. Fig. 6b: Labor Force Survey, quarterly data, 1993-2017. 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.

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 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 employment margin 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.[32] In the LFS, we use information on the length of time of continuous employment with the same employer, which is recorded in months.

Table 5: 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	85.1	86.9	87.1	89.7
P to F	82.5	85.8	77.5	85.3
	(ii) Contribution to the variation of p^{FP} and p^{PF}			
F to P	84.3	86.0	91.1	96.3
P to F	76.7	87.0	70.9	78.8

Notes: United States: Current Population Survey, 1994-2017. United Kingdom: Labor Force Survey, 1994-2017. 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 5 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

[32] 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.

to contradict a common finding that jobs have fixed working hours (e.g. Blundell et al. [2008]). We discuss this issue in greater detail in Section 6.

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 5. 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 6 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% for working-age and prime-age workers. 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).[33] 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 6 we provide evidence that changes in hours at the worker level exhibit some lumpiness.[34] 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.

[33]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.).

[34]Panel (ii) of Table 6 focuses on job-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 6: 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		18.2	17.6	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	10.4	10.8
		2	18.8	19.1	7.45	7.54
		3	8.06	7.06	3.78	3.77
	full days	1	11.9	13.4	7.99	7.30
		2	3.72	3.74	3.01	3.09
	other		47.4	46.6	67.4	67.5
P to F	1/2 days	1	11.3	11.4	10.6	11.7
		2	20.8	20.8	8.00	8.29
		3	8.82	7.81	4.10	3.98
	full days	1	11.1	12.6	7.55	7.40
		2	3.38	3.48	2.56	2.37
	other		44.6	43.9	67.2	66.2

Notes: United States: Current Population Survey, 1994-2017. United Kingdom: Labor Force Survey, 1994-2017. Sample: individuals in private-sector paid employment. Panel (i) reports the change in hours (in absolute values) among employer-stayers and employer-movers who change employment states (FP, PF). Panel (ii) reports the distribution of hours changes among employer-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 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., involuntary part-time workers are 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.[35]

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 countries. 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.[36] 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

[35]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.

[36]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".

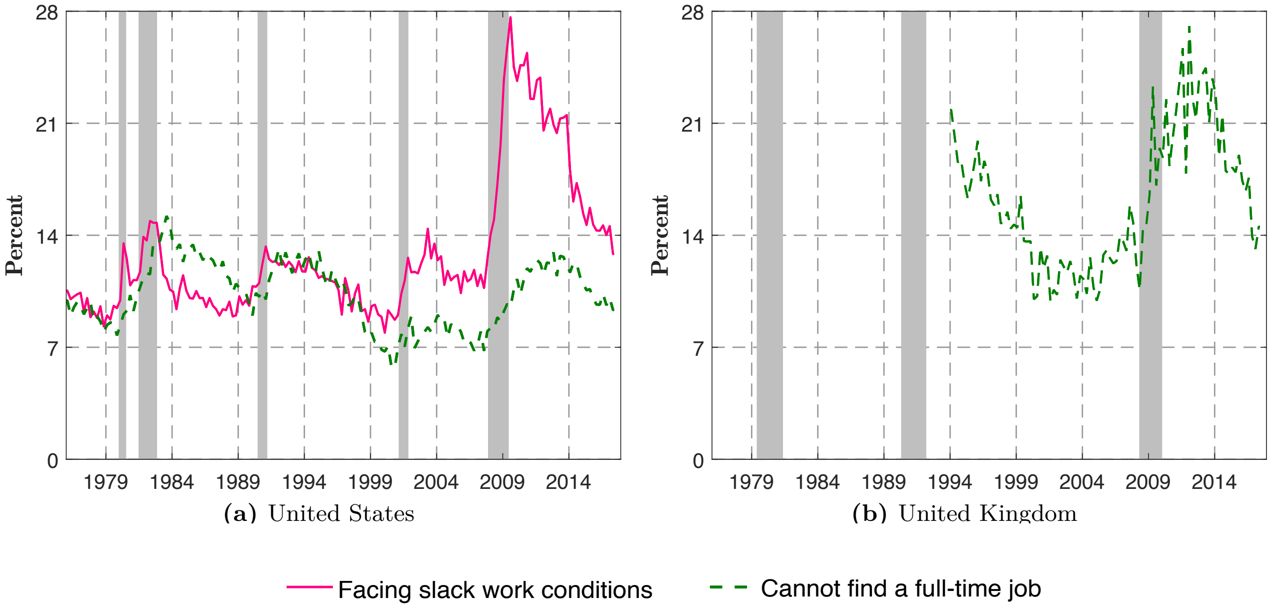


Figure 7: U.S. and U.K. Involuntary Transitions towards Part-time Employment

Notes: Fig. 7a: Current Population Survey, quarterly average of monthly data, 1976-2017. Fig. 7b: Labor Force Survey, quarterly data, 1994-2017. Sample: working-age individuals in private-sector paid employment. The lines show the share (in percent) of the flows into part-time employment explained by involuntary part-time work, i.e. 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.

Table 7: 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) Share of P inflows			
F, slack work	working age	9.26	57.8	30.6	48.1	120.0
	prime age	12.4	51.9	24.8	42.4	94.0
U, N, ~~full-time job~~	working age	5.41	97.8	-1.00	32.2	37.5
	prime age	5.01	98.5	5.47	50.1	12.8
			(ii) Share of F to P flows			
F, slack work	working age	16.9	57.2	28.8	43.5	110.6
	prime age	19.1	52.7	23.3	43.2	90.7

Notes: Current Population Survey, 1976-2017. Sample: working-age individuals in private-sector paid employment. The two upper (lower) rows of panel (i) reports the share of the flows into P accounted for by full-time workers (F) facing slack work conditions (non-employed workers (U, N) who cannot find a full-time job). Panel (ii) reports the share of flows from F to P accounted for by full-time workers facing slack work conditions. 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.

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 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.

We take advantage of the richer information available in the CPS in Table 7. Panel (i) reports statistics on the shares of part-time employment inflows coming from two sources: full-time workers who become part-timers due to slack work (first row, denoted 'F, slack work') and non-employed workers who cannot find a full-time job (second row, denoted 'U, N, ~~full-time job~~'). These can be seen as measuring two alternative explanations for the increase in involuntary part-time work. The first column shows that, on average over the sample period, 'F, slack work' and 'U, N, ~~full-time job~~' account, respectively, for about 10 and 5% of part-time employment inflows. The remaining columns report the peak-to-trough change (in percent) of those two shares during the four recessions covered in our data. Both shares increase dramatically in all recessions (excluding 'U, N, ~~full-time job~~' in the 1990-1991 recession), but that increase is consistently higher for 'F, slack work' (with exception of the Twin Recessions). In other words, in recessionary periods the composition of part-time employment inflows shifts to these two sources, but more so towards full-time workers facing slack work conditions. Panel (ii) presents the same statistics but focuses on transitions from full-time to part-time employment, and looks at the share of those transitions due to slack work conditions. On average, slack work explains 16.9 and 19.1% of F to P flows, respectively for working-age and prime-age individuals. The other columns indicate that the contribution of slack work to those transitions is magnified during recessions, especially during the Great Recession.

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 D.

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 26 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 D1 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).[37] Since multiple jobholders often combine a full-time job and a part-time job, 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 that 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 D2 of the appendix, are quantitatively very close to the baseline ones – the U.S. results are slightly more sensitive, but the differences remain negligible. This partly follows from the fact that multiple jobholders account for a small share of employment, and that their propensity to take on or give up a second job exhibits no discernible cyclical pattern (Lalé [2015]). 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.[38] 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.

In order to gauge the sensitivity of our findings to the definition of part-time employment, we re-compute our results based on a threshold of 30 usual hours (see Table D3). The main effect of lowering the threshold that determines full-time employment is to dampen the baseline results, particularly in the U.S. where the contribution of part-time employment to the dynamics of hours per worker becomes lower. Nonetheless, even in the U.S., Facts 1 to 5 are robust to this alternative definition of part-time employment. A likely explanation of U.S. results is 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 (which is built upon the "Monday–Friday 9am–5pm" full-time employment norm that prevails in the U.S.). The U.K. results are almost unchanged, which is consistent with the notion that the 30-hours cutoff is more frequently used in that country.

[37] The U.S. and the U.K. have similar multiple jobholding rates, namely at around 5 percent of total employment. In the U.S., this multiple jobholding rate is lower than that implied by establishment-level data such as that from the Current Employment Statistics program used by Frazis and Stewart [2010]. This slight discrepancy, however, is unlikely to explain why multiple jobholding does not drive on our results.

[38] In the U.S., whether an employee is considered full-time or not is determined by the employer, viz. the Fair Labor Standards Act does not define full-time or part-time employment (see `http://www.dol.gov/general/topic/workhours/full-time`; last accessed on December 4, 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 December 4, 2017).

6 Summary and Discussion

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. In this concluding section, firstly, we relate our findings to previous evidence on labor-supply adjustment and, secondly, explore the implications of our findings for research in macro and labor economics.

6.1 Relation to Previous Literature

Our findings offer a new perspective on two important questions in the literature. The first question concerns the degree to which jobs have fixed working hours. A widely accepted view is that they do have fixed hours (see e.g. Chetty et al. [2011]), so that in order to adjust their labor supply workers need to change job. The evidence we produce on the extent and magnitude of changes in individual working hours at the same employer seems to run counter to this. To resolve the apparent inconsistency, it is important to bear in mind the source of variation used to establish the facts underlying this view. The labor-supply studies obtain their findings from shocks to individual-level preferences for working hours. For instance, Altonji and Paxson [1992] find that plausible shocks to worker preferences lead to much greater adjustment in working hours when associated with a job change.[39] Blundell et al. [2008] and Benito and Saleheen [2013] reach the same conclusion for the U.K. using similar sources of variation. Another piece of evidence in favor of the existence of hours restrictions are the large differences between desired and actual working hours recorded in some labor force surveys (see e.g. Kahn and Lang [1991] and Dickens and Lundberg [1993] for the U.S., and Bryan [2007] for the U.K.). In our analysis the source of variation is not explicit, but we interpret reallocation between full-time and part-time employment at the same employer as originating from shocks to firms (e.g. productivity or demand shocks).[40] This is consistent with the much greater variation in full-time/part-time reallocation during cyclical swings, which is when a large number of firms is subject to negative shocks.

In our view, there is no reason to expect a similar response to these two different types of shocks. Indeed, a differential response would be consistent with a model where firms offer different packages of (fixed) working hours, but hold the right to reset the amount of hours worked for ongoing employment relationships as a response to firm-level shocks. This idea is elegantly put in Robert Hall's chapter in the Handbook of Macroeconomics (see Hall [1999]), when interpreting the empirical evidence of small variation in working hours (obtained in negative tax experiments) in light of the neoclassical labor-supply model. '*For good reasons relating to asymmetric information, workers delegate to their employers the determination of weeks of work. Workers shop among employers with different policies for setting weeks of work, but once the worker accepts a job, the weeks of work required on that job are largely out of the worker's control. (...) if an event occurs that is personal to the worker, but not within*

[39] To proxy shocks to worker preferences, they consider changes in family composition, changes in the spouse's health status, etc. Using the same data (PSID), Altonji and Paxson [1988] show that workers who are laid off are likely to experience a greater change in hours compared to those who move job voluntarily.

[40] In addition to the more fundamental difference in the source of variation, compared to our paper the papers cited in this paragraph typically focus on smaller samples (e.g. lone mothers with children, laid off workers or employed individuals who experienced a financial shock), a lower frequency of hours changes (typically on annual changes in hours worked) and sample period (non-recessionary periods).

the class of events (such as disability) contemplated by the employment arrangement, it is unlikely that the employer will agree to a reduction in weeks ad hoc (...) *The finding of small reductions in weeks of work* (...) *is not inconsistent with the hypothesis that much larger reductions can occur when the marginal revenue product of labor declines in a downturn. One is unprecedented and unfamiliar, completely new to the environment under which employment arrangements have evolved; the other is exactly within the historical experience that shaped those arrangements* (Hall, 1999, pp. 1148-1149).[41]

The second question concerns the estimation of intertemporal (Frisch) elasticities of labor supply. A key debate in the literature concerns the relation between estimates produced in microeconometric studies (micro) and those obtained by calibrating labor-supply models to fit cyclical variation in total hours worked (macro) (see e.g. Keane and Rogerson [2015]). Chetty et al. [2013] review the existing evidence and argue that intensive-margin elasticities of labor supply, viz. those governing the response of hours worked (conditional on employment) to a temporary wage change, estimated in quasi-experimental studies and those derived from aggregate studies are of similar magnitude (around 0.5). To calculate the macro intensive-margin elasticity they combine estimates of total hours elasticities (i.e. the sum of intensive- and extensive-margin elasticities, with values between 2.6 and 4) available in the literature with an estimate of the contribution of the intensive margin to the variation in total hours of 1/6.[42] Our findings suggest that variation in hours per worker around cyclical swings does not only, or even mainly, reflect movements along individuals' labor supply curve. Rather, much like the extensive margin, the macro intensive margin seems to be determined to an important extent by aspects beyond the worker's choice. Therefore, the notion that labor-supply models calibrated using micro estimates of intensive-margin labor-supply elasticities would explain the bulk of short-run fluctuations in hours per worker seems unjustified. In the same way that evidence on the importance of unemployment for cyclical variation in employment has informed the development of macro-search models to explain fluctuations on the extensive margin, we think our empirical evidence offers a motivation for models where the intensive margin does not reflect only adjustment along a labor-supply curve.

6.2 Implications for Future Research

Going forward, our analysis is potentially relevant to several strands of research in macro and labor economics. First, the lumpiness in changes in individual hours that we uncover calls for different modeling strategies than those commonly used in the literature on labor supply. Specifically, some recent papers model labor adjustment on the extensive and intensive margins jointly (see e.g. Rogerson and Wallenius [2009] and Erosa et al. [2016] for lifecycle settings and Chang et al. [2014] for a heterogeneous-agent economy), but few consider the discrete nature of adjustments in hours per worker. To our knowledge, the main exception is Chang et al. [2011] who propose a model in which workers can be employed only full-time or part-time (a specification much in line with our results).[43] In addition to discrete changes in hours worked, our analysis also highlights that the distribution of hours changes among workers is heterogeneous in the cross section: while some workers suffer large reductions in working hours, others experience no change in hours. Overall, we think our analysis provides guidance on, and some empirical tests for, the representation of the intensive margin postulated in dynamic labor-supply models.

Second, in light of our hypothesis of variable labor utilization, an account of firms' adjustment

[41] Hall [1999] refers to the number of "weeks of work", while our findings pertain to "hours per week". *Mutatis mutandis*, the argument holds with equal force.

[42] Their figure is on the low end of available estimates. U.S. data suggest a value closer to 1/3.

[43] 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.

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.[44] 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 one 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 effort 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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Appendix

A Data

In Section 2 we describe how we construct the raw series of hours per worker and of workers stocks and flows based on various data sources. Here, we provide more details on the procedures we implement and on the additional adjustments we make to obtain the final set of series used in our analysis.

U.S. Data on Hours per Worker.

- The quarterly data on hours worked in full-time and part-time employment (Section 3) are computed using an employment status based on actual hours combined, when possible, with longitudinal matching. Specifically, for employed respondents who are in either rotation group 1 or 5 of the CPS, we use longitudinal matching to retrieve information on their hours worked in the subsequent months of the survey (conditional on employment and a successful longitudinal link).[45] In keeping with the notion of 'usual work schedule' defined in the CPS Interviewing Manual [2015], we then classify as part-time workers individuals who have the majority of their employment spells flagged with less than 35 actual hours. The table below explains on a case-by-case basis how we implement our definition:

# employment spells	# empl. spells < 35 hours to be classified as part-time	# longitudinal links 0	1	2	3
1	1	7.60	3.02	1.31	14.7
2	2	–	3.22	1.81	11.2
3	2	–	–	2.35	23.3
4	3	–	–	–	31.4

  That is, we classify as part-time workers individuals who work less than 35 actual hours in: 1 out of 1, 2 out of 2, 2 out of 3, or 3 out of 4 spells of employment. We experimented other approaches to define part-time employment. We chose this definition over others because it maximizes consistency between our time series and the series where the full-time/part-time employment status is defined using usual hours after January 1994 (see the online appendix).
  The triangular matrix in the above table gives the likelihood in percent of each combination (number of longitudinal links × number of employment spells), conditional on being employed in the first month of the observation window. Only 7.60% of employed respondents from either rotation group 1 or 5 cannot be matched forward at least once. For these individuals, the full-time/part-time status is based on 1 observation of their actual hours worked. More than half (23.3+31.4=54.7%) of CPS respondents from rotation group 1 or 5 can be matched longitudinally over the 4 consecutive interview months and are employed in at least 3 of those 4 months. On average from 1976 to 2017, 90.1% of working-age respondents from rotation group 1 or 5 can be linked to their subsequent CPS interviews at least once, and 78.3% can be linked three times.[46]

- Before aggregating the resulting data to a quarterly frequency, we correct the values of the time series at several dates where substantial variations in actual hours are caused by a disruption of

[45] We use the household and personal identifiers along with a age/sex/race filter to match CPS respondents.

[46] This is in line with the matching rates typically achieved with CPS data, taking account of adverse factors such as sample non-response, mortality, migration, and recording errors. Notice, meanwhile, that our approach is to assign a full-time/part-time employment status even to respondents who cannot be matched longitudinally.

regular work activities. The dates of these corrections include September 1981, 1987, 1992, 1998, 2009, 2015 (when the Labor Day holiday fell on the Monday of the CPS reference week), and February 1978 and January 1996 (when major winter storms hit parts of the United States).[47] We replace the outliers by the average of the observations' first two lags and leads. Lastly, we remove seasonal variation using the U.S. Census bureau's X-13ARIMA-SEATS program before aggregating the monthly series to a quarterly frequency.

U.K. Data on Hours per Worker.

- As indicated in the description of the yearly data in Section 2, usual and actual hours include paid and unpaid overtime except between 1977 and 1983 (when hours of unpaid overtime were not recorded). There is no ideal method to address this issue, so we make no adjustment for this discrepancy.

- In the quarterly data, we replace the outliers in the series of actual hours in 1997Q1 and 2006Q2 by the average of each observation's fourth quarter lag and lead, and subsequently implement the seasonal adjustment procedure based on X-13ARIMA-SEATS.

- In constructing both series we use quarterly weights calculate by the ONS and provided in the micro-data files.

U.S. and U.K Data on Workers Stocks and Flows.

- We use cross-sectional and longitudinal weights (computed by the BLS and the ONS respectively for the U.S. and the U.K.) to construct labor market stocks and gross flows. These weights are provided in the micro-data files of the CPS and the LFS.

- Systematic seasonal variation is removed 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.

- We 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 transition probabilities (computed from longitudinally-linked data). We use the adjustment procedure proposed by Elsby et al. [2015].

- Last, we 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. To address this issue, we adapt Shimer [2012]'s continuous-time correction method to our setup.

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:

$$\boldsymbol{\ell}_t = \boldsymbol{M}_t \boldsymbol{\ell}_{t-1} \tag{10}$$

[47] We are not the first to point out these data issues. Cociuba et al. [2012] adjust their data on hours worked to control for deviations caused by the Labor Day. The seasonal adjustment procedure of the Bureau of Labor Statistics [2010] accounts for deviations from normal seasonal patterns caused by unusual events, such as major winter storms.

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 (10) by a reduced-Markov chain

$$\tilde{\boldsymbol{\ell}}_t = \tilde{\boldsymbol{M}}_t \tilde{\boldsymbol{\ell}}_{t-1} + \boldsymbol{q}_t, \tag{11}$$

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

Solving for system (11)'s steady state (we use an upper-bar throughout the analysis to indicate a steady state) we obtain:

$$\bar{\tilde{\boldsymbol{\ell}}}_t = (\boldsymbol{I} - \tilde{\boldsymbol{M}}_t)^{-1} \boldsymbol{q}_t. \tag{12}$$

After some algebraic manipulation, it can be shown that the system of equations (11) has the following partial-adjustment representation:

$$\Delta \tilde{\boldsymbol{\ell}}_t = \boldsymbol{A}_t \Delta \bar{\tilde{\boldsymbol{\ell}}}_t + \boldsymbol{B}_t \Delta \tilde{\boldsymbol{\ell}}_{t-1}, \tag{13}$$

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 (13), one can express this system in its distributed lag form:

$$\Delta \tilde{\boldsymbol{\ell}}_t = \overbrace{\boldsymbol{A}_t \Delta \bar{\tilde{\boldsymbol{\ell}}}_t}^{\text{effect of current steady-state change, } \boldsymbol{E}_{0,t}} + \underbrace{\sum_{k=1}^{t-2} \prod_{n=0}^{k-1} \boldsymbol{B}_{t-n} \boldsymbol{A}_{t-k} \Delta \bar{\tilde{\boldsymbol{\ell}}}_{t-k}}_{\text{effect of past steady-state changes, } \sum_{k=1}^{t-2} \boldsymbol{E}_{k,t-k} \Delta \bar{\tilde{\boldsymbol{\ell}}}_{t-k}} + \overbrace{\prod_{k=0}^{t-2} \boldsymbol{B}_{t-k} \Delta \tilde{\boldsymbol{\ell}}_2}^{\text{effect of initial condition}} . \tag{14}$$

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 (14) 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:

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

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 (10)) is:

$$\dot{\tilde{\boldsymbol{\ell}}}_t = \tilde{\boldsymbol{H}}_t\tilde{\boldsymbol{\ell}}_t + \boldsymbol{g}_t, \tag{16}$$

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:

$$\bar{\tilde{\boldsymbol{\ell}}}_t = -\tilde{\boldsymbol{H}}_t^{-1}\boldsymbol{g}_t. \tag{17}$$

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 (15), we substitute in the respective series of first-order approximations to changes in steady-state stocks ($\Delta\bar{\tilde{\boldsymbol{\ell}}}_t$) into equation (14).[48] 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 (15), which implies the following decomposition of the variance of changes in labor stocks:

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

$\sum_{k=0}^{t-2}\boldsymbol{E}_{k,t-k}\frac{\partial\bar{\tilde{\boldsymbol{\ell}}}_{t-k}}{\partial h_{t-k}^{ij}}\Delta\lambda_{t-k}^{ij}$ 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 from equation (18) that:

$$\mathbb{V}\mathrm{ar}(\Delta\tilde{F}_t) \approx \sum_{i\neq j}\mathbb{C}\mathrm{ov}\left(\Delta\tilde{F}_t, \left[\sum_{k=0}^{t-2}\boldsymbol{E}_{k,t-k}\frac{\partial\bar{\tilde{\boldsymbol{\ell}}}_{t-k}}{\partial\lambda_{t-k}^{ij}}\Delta\lambda_{t-k}^{ij}\right]_{1,1}\right). \tag{19}$$

Dividing both sides of equation (19) by $\mathbb{V}\mathrm{ar}(\Delta\tilde{F}_t)$ yields:

$$\sum_{i\neq j}\beta_{\tilde{F}}^{ij} \approx 1, \tag{20}$$

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:

$$\beta_{\tilde{F}}^{FP} = \frac{\mathbb{C}\mathrm{ov}\left(\Delta\tilde{F}_t, \left[\sum\limits_{k=0}^{t-2}\boldsymbol{E}_{k,t-k}\frac{\partial\bar{\tilde{\boldsymbol{\ell}}}_{t-k}}{\partial\lambda_{t-k}^{FP}}\Delta\lambda_{t-k}^{FP}\right]_{1,1}\right)}{\mathbb{V}\mathrm{ar}(\Delta\tilde{F}_t)}. \tag{21}$$

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

[48] 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 $\boldsymbol{B}_t$.

linear approximation:

$$\Delta\omega_t^P \approx \frac{\Delta\tilde{P}_t(1-\omega_{t-1}^P) - \Delta\tilde{F}_t\omega_{t-1}^P}{\tilde{P}_{t-1} + \tilde{F}_{t-1}}. \tag{22}$$

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 Additional Information

Table C1 complements Table 4 presented in Section 4 by reporting the variance contributions to the dynamics of the part-time employment share of flows hazards between other states (X, U, N) and each employment state (F, P).

D 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 D1 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 show counterfactual changes that would have been observed had the composition of employment not shifted during the recession. 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. An analysis of U.K results leads to very similar conclusions.

- In Table D2 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). This column is based on the period from 1994 onwards for reasons of data availability. 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 D3 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 C1: Variance Analysis of the U.S. and U.K. Part-time Employment Shares

	United States		**United Kingdom**	
	Working age	Prime age	Working age	Prime age
	(i) Full- and part-time employment			
β^{FP}	45.3	53.5	27.5	45.2
β^{PF}	23.0	19.6	41.0	28.0
$\beta^{FP}+\beta^{PF}$	68.3	73.1	68.5	73.2
	(ii) Other forms of employment			
β^{XF}	0.20	-0.70	3.20	5.71
β^{XP}	1.82	0.95	2.24	6.35
β^{FX}	1.29	0.36	2.43	0.03
β^{PX}	1.10	2.11	3.67	2.27
β^{X}	4.42	2.72	11.5	14.4
	(iii) Unemployment			
β^{UF}	12.9	8.70	9.21	9.37
β^{UP}	-11.5	-7.59	-7.12	-6.20
β^{FU}	16.0	12.0	11.2	8.99
β^{PU}	-2.36	-4.74	-2.70	-1.15
β^{U}	15.0	8.35	10.6	11.0
	(iv) Non-participation			
β^{NF}	4.21	2.77	2.86	2.44
β^{NP}	-2.56	2.27	-4.21	2.27
β^{FN}	-1.50	-1.41	-1.11	0.07
β^{PN}	11.0	12.2	9.78	3.07
β^{N}	11.2	15.8	7.31	7.85
Total	98.9	100.0	97.9	106.4

Notes: United States: Current Population Survey, 1976-2017. United Kingdom: Labor Force Survey 1994-2017. The table reports the variance contributions to quarterly changes in the part-time employment share of: transition between employment states (F, P) in panel (i), and transition from other states (X, U, N) to employment states in panels (ii) to (iv). The last row shows the sum $\beta^{FP}+\beta^{PF}+\beta^{X}+\beta^{U}+\beta^{N}$. All entries are reported in percent.

table follows the same structure as Table D2. For the U.S., we are able to extend the data used to establish Facts 2 and 5 all the way back to 1976 (by using multiplicative adjustment factors and a margin-error correction as described in Section 2 and Appendix A). 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 Fact 1, and to a smaller extent for Facts 2 and 3. As we have suggested in the text, those differences may be related to movements between a weekly schedule of 5 days of 8 hours (40 hours) to 4 days of 8 hours (32 hours), which are missed by the alternative definition considered here. Since the full-time employment norm in the U.S. is the "Monday–Friday 9am–5pm" schedule, our baseline definition should mpore aptly capture these discrete movements. Table D3 shows that the U.K. results are also weakened, but the differences are quantitatively negligible. In that country, it is not unusual to define part-time employment using a threshold of 30 hours worked per week.

Table D1: 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 D2: 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	-1.16 : 72.4	-1.15 : 68.6	-0.47 : 83.7	-0.47 : 82.6
$\Delta h_{s,t}$: $\gamma_{s,t}$ – Peak to one year after trough	-0.64 : 84.3	-0.62 : 85.1	-0.22 : 215.7	-0.18 : 241.9
Fact 2				
β^{FP} : β^{PF} : $\beta^{PF} + \beta^{FP}$	45.3 : 23.0 : 68.3	43.4 : 23.4 : 66.8	27.5 : 41.0 : 68.5	28.1 : 39.9 : 68.0
Fact 3				
Variance contribution of transitions at the same employer: p^{FP} : p^{PF}	84.3 : 76.7	85.5 : 76.0	91.1 : 70.9	92.6 : 74.4
Fact 4				
Average abs. change in weekly hours worked: F to P : P to F	13.1 : 12.5	12.6 : 13.4	11.7 : 11.7	11.4 : 11.3
Fact 5				
Share of involuntary transitions to part-time average : peak-to-trough change	23.1 : 18.0	24.1 : 18.2	13.9 : 10.1	13.7 : 10.9

Notes: United States: Current Population Survey, 1994-2017. United Kingdom: Labor Force Survey, 1994-2017. Sample: Individuals in private-sector paid employment. 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 4, 5 and 6 in the text. For Fact 4 the changes in hours refer to employer stayers. 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 D3: 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	-1.16 : 72.4	-1.16 : 49.5	-0.47 : 83.7	-0.47 : 83.2
$\Delta h_{s,t}$: $\gamma_{s,t}$ – Peak to one year after trough	-0.64 : 84.3	-0.64 : 47.2	-0.22 : 215.7	-0.22 : 180.5
Fact 2				
β^{FP} : β^{PF} : $\beta^{PF} + \beta^{FP}$	45.3 : 23.0 : 68.3	37.7 : 22.2 : 59.9	27.5 : 41.0 : 68.5	27.8 : 34.4 : 62.2
Fact 3				
Variance contribution of transitions at the same employer: p^{FP} : p^{PF}	84.3 : 76.7	76.6 : 71.9	91.1 : 70.9	92.0 : 72.3
Fact 4				
Average abs. change in weekly hours worked: F to P : P to F	13.1 : 12.5	14.1 : 14.2	11.7 : 11.7	12.7 : 12.7
Fact 5				
Share of involuntary transitions to part-time average : peak-to-trough change	23.1 : 18.0	21.4 : 15.2	13.9 : 10.1	16.8 : 12.1

Notes: United States: Current Population Survey, 1994-2017 (1976-2017 for Fact 2 and Fact 5). United Kingdom: Labor Force Survey, 1994-2017. Sample: Individuals in private-sector paid employment. 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 4, 5 and 6 in the text. For Fact 4 the changes in hours refer to employer stayers. 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.