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ABSTRACT

Employment Adjustment and Part-time Jobs: The U.S. and the U.K. in the Great Recession*

We document that fluctuations in part-time employment play a major role in movements in hours per worker, especially during cyclical swings in the labor market. Building on this result, we propose a novel representation of the intensive margin based on a stock-flow framework. The evolution of part-time employment is predominantly explained by cyclical changes in transitions between full-time and part-time employment, which occur overwhelmingly at the same employer and entail large changes in individuals' working hours. We discuss implications for a large class of macroeconomic models that map individual decisions along the extensive/intensive margins onto aggregate labor market outcomes.

JEL Classification: E24, E32, J21

Keywords: employment, hours, part-time work, Great Recession

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1 Introduction

The separation of adjustment in total hours worked in adjustments in employment (the extensive margin) and hours per worker (the intensive margin) is a central distinction in modern business cycle analysis. By using micro-data on labor market flows, recent research has significantly advanced our understanding of the macro-behavior of the extensive margin (Shimer [2012], Elsby et al. [2015]). In contrast, our understanding of the intensive margin remains largely informed by the behavior of aggregate time series of hours per worker calculated among the stock of employed workers (Rogerson and Shimer [2011], Ohanian and Raffo [2012]).[1] A limitation of analyses based on stocks and aggregate data is that they are unclear about the sources of variation in the variable of interest. In this paper, we overcome this limitation by showing how to cast the intensive margin in a stock-flow framework, and use it to study the sources of short-run variation in hours per worker. The picture that emerges from applying our method is a rich and novel characterization of the dynamics of the intensive margin.

Our description of the macro-behavior of the intensive margin based on a stock-flow framework can be seen as addressing two main concerns. The first is that a proper assessment of fluctuations at the intensive margin requires accounting for its interactions with the extensive margin. This follows from the observation that cyclical adjustment in employment affects different workers differently, which likely imparts a composition effect on the evolution of hours per employed worker (see Bils [1985]; Solon et al. [1994] and recently Daly et al. [2011]). Our approach takes stock of this observation by describing the two margins of labor adjustment in a unified setup. Specifically, it can disentangle the time-series variation in hours per worker that stems from fluctuations on the extensive margin. The second concern is that the behavior of labor market stocks provides limited information on the short-run adjustment of the labor market. In dynamic labor markets, the short-run evolution of labor stocks is the result of a complex interaction of flows of workers across different labor market states. Therefore, to understand the sources of fluctuations in hours per worker one needs a framework explicitly based on the behavior of worker flows. By using a stock-flow framework to describe the dynamics of the intensive margin, we shield our conclusions from potential stock-flow fallacies. More importantly, by doing so we obtain a rich informational basis that can be used to more closely scrutinize existing theoretical explanations for fluctuations in hours per worker, or to develop new ones.[2]

To cast the intensive margin within a stock-flow framework, we first show that its short-run behavior admits a surprisingly simple empirical representation. Using labor force survey micro-data for the United States (U.S.) and the United Kingdom (U.K.) over the past two decades, we show that movements in hours per worker are readily described by separating employment into part-time and full-time work. In the context of the Great Recession, the fall in hours per worker is almost exclusively driven by the evolution of the part-time employment share (the number of part-time workers among those employed), which is very strongly countercyclical. Conversely, hours per worker in part-time and full-time jobs fluctuate relatively little and hence explain but a small part of the fall in hours per worker during this period. This insight allows us to characterize the cyclical variation on the

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

[2] Several explanations emphasizing labor-supply responses show that workers accept low-hours jobs as a stepping-stone to full-time work (Blank [1989]) and/or to avoid the risk of long-term unemployment following a job loss (Farber [1999]). These explanations predict a tight link between flows into employment and shifts in hours per worker. Alternatively, demand-driven explanations grounded on implicit-contract models with variable hours predict that following a shock to demand/productivity hours adjust at the worker-firm level (see e.g. Beaudry and DiNardo [1995] and Sigouin [2004]).

intensive margin through the dynamics of the part-time employment share. To operationalize this representation of the intensive margin, in a subsequent step we develop an empirical framework based on a Markov chain model, and draw on a vast literature that uses this modeling framework to describe the dynamics of unemployment/employment by the behavior of transition probabilities across labor market states (see e.g. Darby et al. [1985]; Abowd and Zellner [1985]; Fujita and Ramey [2009]; Shimer [2012] and Elsby et al. [2015]). In our model, in addition to unemployment and non-participation, workers can be in part-time or full-time employment in the salaried private sector.[3] We use our measurement framework and the wealth of auxiliary information available in the labor force surveys of both countries to uncover the mechanisms underlying the dynamics of part-time employment.

We establish the following facts for the two countries:

1. Fluctuations in hours per worker are largely driven by changes in part-time employment. During the Great Recession the latter account for over 80% of the peak-to-trough change in hours per worker, and virtually all of the persistence in the years that follow the initial shock.

2. Cyclical fluctuations in transition rates between full-time and part-time jobs explain over 70% of the variation in the part-time employment share.

3. Transitions at the same employer account for over 90% of the variation in transitions between part-time and full-time jobs. Several empirical features of this reallocation are consistent with the view that firms vary the intensity of labor utilization in response to shocks.

4. From the workers' perspective, transitions between full-time and part-time at the same employer do seem to entail a discrete change of labor market state, as the change in the number of working hours is sizable (on average, 12 hours, or one and a half working days).

In terms of more substantive results, our approach delivers a novel understanding of fluctuations on the intensive margin. First, rather than focusing on the relatively small magnitude of changes in average hours per worker (like stocks-based analyses would), our results underscore sizable changes in hours experienced by a small fraction of individuals (those who move between part-time and full-time jobs).[4] Consider for instance the peak-to-trough changes observed in the Great Recession. While the former perspective would note that the average employed worker experienced a drop in working hours of about 0.4-1.5 hours, our characterization stresses that as much as 3 percentage points of those employed saw their schedule of working hours decrease by 12 hours on average. Second, our framework allows us to test two competing hypotheses regarding the dynamic behavior of the part-time employment share and, by extension, of hours per worker. One hypothesis would contend that the increase in the part-time employment share observed during the Great Recession results from the greater relative cyclicality of full-time jobs versus part-time ones. If employers' adjustment on the hiring and firing margins occurs disproportionately in full-time vs. part-time jobs, then the share of part-time jobs will increase in recessionary periods, when more firms lay off workers and reduce hiring. Alternatively, the countercyclicality of the part-time employment share can take place via adjustments on the intensive margin at the firm level. Specifically, employers may reduce labor utilization during downturns by slowing down transitions of their employees from part-time to full-time jobs, as well as

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

[4] Historically, in the U.S. and the U.K., adjustment in hours per worker accounted for between a quarter to one third of fluctuations in total hours.

increasing the number of transitions in the reverse direction. The facts summarized above strongly support the latter hypothesis.

Despite its simplicity, there are good reasons to believe that our binary partition of the schedule of working hours can apprehend well some of the constraints faced by individuals operating in both markets. In the U.S. and the U.K. there exist policies based on thresholds of working hours that affect the incentives of both workers and firms in choosing part-time vs. full-time employment.[5] The distinction between part-time and full-time jobs also has some empirical justification. In both countries, there is vast evidence of the presence of a part-time wage penalty, whereby in a similar job a part-time worker earns a lower hourly wage compared to an equally skilled full-time worker.[6] Finally, part-time employment is a notional category in the two countries' labor force surveys, allowing us to distinguish increases in part-time work that are involuntary from the worker's perspective. Therefore, while recognizing that a lot more could be learned from considering the evolution of the whole, continuous distribution of hours worked, we think our binary partition captures a number of relevant features, as well as yields new insights on the functioning of both labor markets.

The empirical findings we establish contribute primarily to the literature documenting business cycle facts. To our best knowledge, there are only two studies focusing on aggregate labor adjustment based on micro-data: Cooper et al. [2007] and Trapeznikova [2014], who use quarterly establishment-level data respectively from the U.S. and Denmark. They document that changes in hours and employment are both quantitatively important and find evidence of a degree of substitution between them.[7] Our results are consistent with those facts. We add to this literature by using worker-level micro-data spanning a period of two decades (including the Great Recession) in two countries, and by exploring the longitudinal dimension of the data in the estimation of worker flows.[8] Clearly, a strength of micro-data (either at the establishment- or worker-level) is to provide a much finer decomposition of aggregate patterns. An application of our empirical method to other labor markets may shed some light on the sources of observed cross-country differences in terms of the importance of fluctuations at the intensive margin (see Rogerson and Shimer [2011] and Ohanian and Raffo [2012]).[9]

In addition to documenting new facts, our characterization of the intensive margin has implications for a large class of macroeconomic models. In Section 7 we describe those implications for several strands of the theoretical literature that have been building explicitly on micro-data facts to understand aggregate labor-market dynamics. The first implication concerns the mapping between time allocated to market work and labor services, which is key to understand labor-supply responses to aggregate changes such as shocks and policy reforms (see e.g. Prescott and Wallenius [2012]). Our findings can provide guidance on the parametrization and micro-foundations of this mapping. The second set of

[5]For example, the Affordable Care Act of 2010 introduced penalties for employers with 50 or more employees who did not provide health insurance to their full-time workers; see e.g. Even and Macpherson [2015]. Buchmueller et al. [2011] find that Hawaii's more stringent mandated health insurance for workers working above 20 hours led to an increase in the share of part-time work. 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) (see Blundell et al. [2008] and Blundell and Shephard [2012]).

[6]See Aaronson and French [2004] and Hirsch [2005] for the U.S., and Manning and Petrongolo [2008] and Connolly and Gregory [2008] for the U.K.

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

[8]Blundell et al. [2013] use cross-sectional data from the labor force surveys of the U.S., the U.K. and France to study the contribution of hours per worker to total hours. Their investigation focuses on long-run trends and life-cycle patterns, and hence it does not address business cycle fluctuations and transitions across labor market states.

[9]There is a disagreement over the relative importance of the intensive margin in aggregate data. Ohanian and Raffo [2012] argue that standard deviations indicate a quantitatively important role for the intensive margin, but van Rens [2012] reaches the opposite conclusion by studying peak-to-trough changes in the same dataset.

implications relates to the fact that changes in hours are concentrated on a small fraction of employed workers rather than uniformly distributed among them. This feature can affect the calibration of heterogeneous agents models in the vein of Chang and Kim [2006], as well as change the way the performance of these models is assessed. Finally, as Rogerson and Shimer [2011] highlight, there is often a fruitful interaction between empirical evidence on worker flows and the development of search-theoretic models of the labor market. Therefore, we also discuss implications for this literature, especially in relation to a new vintage of search models featuring a notion of firm size (see e.g. Elsby and Michaels [2013]; Schaal [2012]; Kaas and Kircher [2015]). Several empirical results of our paper can be used to investigate quantitatively the joint movements in hours and employment implied by those models.

The paper is organized as follows. Section 2 presents our data, definitions and measurements. Section 3 elaborates on the close relationship between fluctuations in hours per worker and the evolution of the part-time employment share. In Section 4 we decompose the evolution of part-time employment in the variation of transition probabilities across labor market states. Section 5 provides further details on transitions between full-time and part-time jobs and summarizes our empirical results in an hypothesis of variable labor utilization. Section 6 analyzes several alternative hypotheses. Section 7 discusses implications for macroeconomic models of the labor market. Section 8 concludes.

2 Data, Definitions and Measurements

This section presents our data sources, sample and definitions of the main concepts used in our analysis.

2.1 Data Sources

We use micro-data from the labor force surveys of the U.S. and the U.K. Before presenting them in more detail, we emphasize a number of common features. First, the data are available at a relatively high frequency (monthly for the U.S., quarterly for the U.K.) and span the same period (1994-2015), covering over two decades of labor market activity and different phases of the business cycle. Second, both have a longitudinal component that can be used to match respondents across two consecutive periods. In so doing, we are able to identify workers' transitions across labor market states and construct measurements of gross labor market flows. Third, the individual variables used to circumscribe the sample and measure labor market objects can be made consistent across surveys. This ensures comparability between the figures we report for the U.S. and the U.K.

The Current Population Survey

For the U.S. we use data from the Current Population Survey (CPS). The CPS has informed the majority of studies on worker flows in the U.S. labor market. 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. Before January 1994 the CPS only collected individuals' actual hours worked during the reference week. Following the survey's re-design in 1994, the CPS started collecting information on the number of usual hours worked, in addition to actual hours. As explained in Subsection 2.4, only the latter allows accurate measurement of part-time work. For this reason we use data from January 1994 onwards.

In each monthly file of the CPS, about three-quarters of respondents were already in the sample in the previous month. The underlying rotational structure is as follows: CPS respondents are interviewed for four consecutive months, are rotated out of the survey for eight months, and are included in the survey again for four consecutive months. By matching individuals from the non-rotation groups across surveys, we can observe transitions over a time horizon of one month and measure monthly labor market flows.[10] Our CPS-based calculations of labor market stocks use the so-called final weights, while our calculations of flows use the longitudinal weights.

The Labor Force Survey

Our source of data for the U.K. is the Labor Force Survey (LFS). The LFS came into existence in 1973, but structural changes were introduced in the Spring quarter of 1992, in 1996 and again in 2006.[11] The LFS collects demographic and employment information on around 44,000 responding households per quarter.[12] Similar to the CPS, the LFS follows a rotating sample. The sample is divided into five waves of equal size, with each household being followed for five consecutive quarters. In every quarter, one wave exits the sample and is replaced by a wave of entering households.

We use two types of data extracts from the LFS, available from the U.K. Data Service webpage: quarterly cross sections and two-quarter longitudinal extracts, both starting in the first quarter of 1994 (1994q1). The latter contain a subset of variables for the same group of individuals across two consecutive quarters, allowing us to calculate labor market transitions. The rotational structure of the survey implies that about 80% of the individuals from the corresponding cross-sectional dataset are included in the two-quarter longitudinal extracts. Finally, the Office of National Statistics (ONS) produces personal weights designed to account for non-response bias and obtain population estimates, as well as longitudinal weights that further account for sample attrition. These weights are included in the micro-data files and we use them in our calculations.

2.2 Sample

Our sample includes civilians of working age (men and women between 16 and 64 years old) who are not unpaid family workers or workers on a Government Training Scheme.[13] This sample restriction is dictated by the lack of comparability between the hours of unpaid family workers and those of other employed workers, and by the lack of information on hours worked for individuals on a Government Training Scheme. These two categories represent a very small proportion of the workforce, making this sample restriction effectively innocuous. Among the employed population, we focus primarily on individuals who hold a primary private-sector salaried job. For the U.S., this definition comprises salaried workers in the non-farm business sector. In the U.K., the ONS does not report results for the non-farm business sector. However, a very close counterpart can be obtained by restricting the

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

[11] The survey became quarterly in 1992. In 1996, the survey was extended to include Northern Ireland, so that the sample is representative of households living in private addresses in Great Britain until 1995, and in the U.K. thereafter. Finally, in 2006 the survey moved from seasonal to calendar quarters. LFS seasonal quarters are: Winter (December to February), Spring (March to May), Summer (June to August) and Autumn (September to November), while calendar quarters are 1 (January to March), 2 (April to June), 3 (July to September) and 4 (October to December).

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

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

sample to employees whose current main job is provided by the private sector. In both countries, the population of private-sector salaried workers represents a very large share of total employment: 69.8% in the U.S. and 62.9% in the U.K. We focus on the private sector to avoid confounding factors that arise from the distinct patterns of turnover across different forms of employment, like government jobs and self-employment.

2.3 Measurements of Hours Worked

Both labor force surveys collect information on total usual and total actual weekly hours worked. Usual hours measure an individual's normal work schedule, including any paid or unpaid overtime, provided it is considered part of the normal work schedule. Actual hours refer to hours at work during the survey's reference week. In the CPS, information on hours is obtained by asking surveyed individuals the following questions: *'How many hours per week do you usually work at your main job?'* and *'Last week, how many hours did you actually work in your main job?'*. In the LFS the questions are almost exactly the same: *'How many hours per week do you usually work in your (main) job/business?'* and *'Thinking now about the seven days ending Sunday (. . .), how many hours did you actually work in your (main) job/business?'*. In the next section we will present results based on both measurements. To calculate the series of hours per worker, we trim the distributions of hours from below at 1 hour and above at 97 and 99 hours, respectively for the U.K. and the U.S.

2.4 Definition of Part-time Work

A key operational definition in this paper is that of part-time jobs. A part-time job is one in which the usual number of hours worked per week is below a specified threshold. We base our choice of a metric of hours worked and the relevant threshold on definitions used by the Bureau of Labor Statistics (BLS) in the U.S. These choices allow us to employ the same definition of part-time status across the two countries. For the U.S., we use total usual hours per week, which includes usual paid and unpaid overtime hours. In the U.K., we use what the LFS defines as the number of total usual hours worked in the reference week, which includes hours of paid and unpaid overtime work. For both countries we define a part-time job as one in which the metric of hours is less than 34 hours (inclusive). Of course, it is possible to use a different threshold to define part-time status in both surveys. Alternative definitions of part-time status affect the level of part-time employment, but not the main patterns we document (transitions, business-cycle fluctuations, etc.). We return to this issue in Section 6.

3 Hours per Worker and Part-time Employment

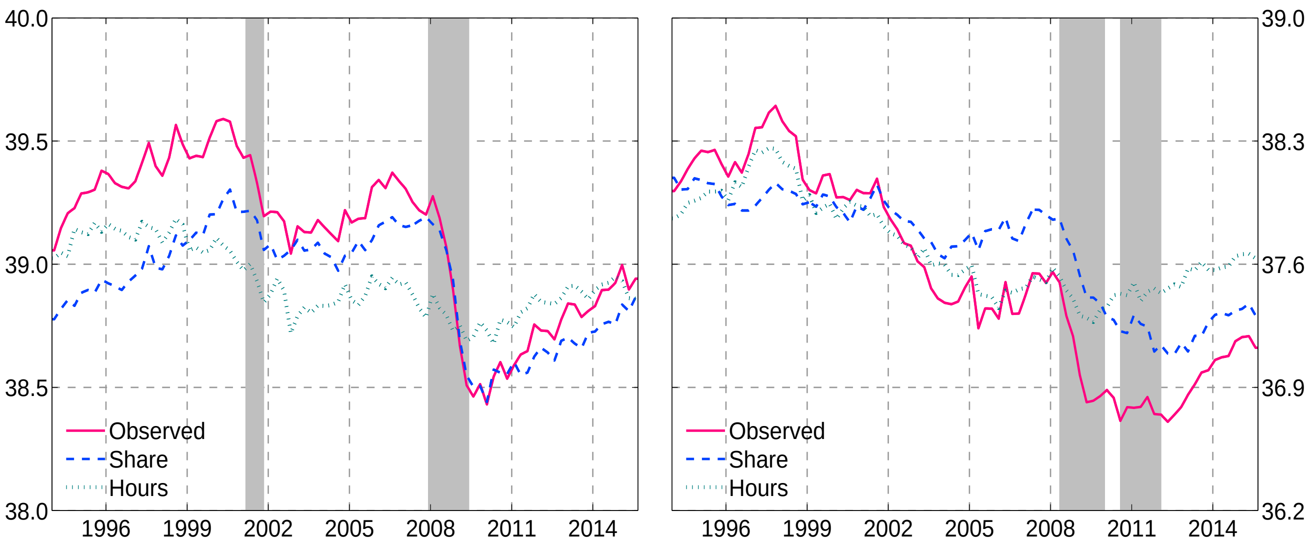
In this section, we describe the evolution of hours per worker based on the partition of jobs into part-time and full-time. Despite its simplicity, this characterization allows us to account for about half of the short-run variation of hours per worker during the sample period, and virtually all of its dynamics during the Great Recession, by dint of one variable (the part-time employment share). The source of this finding is the high incidence of part-time work in both labor markets and the pronounced countercyclicality of the part-time employment share. We document large differences in average hours worked in part-time and full-time jobs, suggesting that worker reallocation across these two job categories entails a change in labor market state.

3.1 Some Simple Accounting

To describe the intensive margin we start by noting a useful identity. Hours per worker at time t (h_t) can be represented by 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) jobs and h_t^F (h_t^P) is hours per worker in full-time (part-time) jobs. 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 choose to focus on the part-time employment share, ω_t^P. According to equation (1), fluctuations on the intensive margin can be separated into changes in hours per worker in part-time and full-time jobs and the evolution of the part-time employment share (ω_t^P). As will become clear momentarily, fluctuations in part-time employment play a prominent role in the behavior of hours per worker. To grasp this fact visually we use equation (1) to construct counterfactual series of hours per worker that hold respectively 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.[14]



(a) United States

(b) United Kingdom

Figure 1: Observed and Counterfactual Hours per Worker

Notes: Sample: private-firm salaried workers. Based on seasonally adjusted series of usual hours per worker and the part-time employment share at a quarterly frequency. The U.S. series are quarterly averages of the monthly series. Gray-shaded areas indicate recessionary periods.

Figure 1 plots the two counterfactual series (the dashed and dotted lines) along with the observed series of hours per worker (solid lines). The gray-shaded areas indicate recessionary episodes.[15] During the sample period the dynamics of hours per worker exhibit some differences across the two countries. This is partly the result of a different business-cycle histories. While the labor markets of both countries experienced the effects of the Great Recession, only the U.S. economy suffered a short recession in

[14]In this section of the paper all calculations are based on quarterly series both for the U.S. and the U.K. To aggregate the U.S. series from monthly to quarterly frequency we take three-month averages of seasonally adjusted series.

[15]For the U.S. we use recession dates as identified by the National Bureau of Economic Research. The corresponding dates are 2001m03–2001m11 for the 2001 recession and 2007m12–2009m06 for the Great Recession. We use recession dates from the Economic Cycle Research Institute for the U.K. as these are obtained through a similar methodology (see `https://www.businesscycle.com/`). The four dates of the so-called double dip recession in the U.K. are 2008m05–2010m01 followed by 2010m08–2012m02.

2001. Besides this, the U.S. series of hours per worker exhibits a more salient procyclical pattern (increasing prior to recessions and falling steeply in downturns), whereas the U.K. series features a downward trend in addition to the cyclical build up starting around 2005 and the marked decline in the Great Recession. The dashed lines capture the role of the part-time employment share in this evolution. As can be seen in Figure 1a, in the U.S. the dashed line tracks closely the increase in the solid line that precedes both the 2001 recession and the Great Recession, and it matches almost exactly the decline beheld in the Great Recession, as well as the sluggish recovery during the recession's aftermath. In the U.K. similar patterns are also visible. Even more strikingly than in the U.S., in Figure 1b the dashed line moves in tandem with the solid line throughout the whole second half of the sample period. The dotted lines gauge the role of fluctuations in hours per worker in part-time and full-time jobs to the overall evolution of the series of hours per worker. The clear co-movement between the series indicates that fluctuations in hours in the two job types also play a role in the dynamics of the intensive margin. However, that effect seems to be absent, or very diminished, during the Great Recession and its aftermath.

3.2 Decomposing Changes in Hours per Worker

To quantify more precisely the role of the two sources of changes shaping short-run fluctuations on the intensive margin, we construct two series of chain-weighted changes and use them to decompose changes in observed hours per worker. Starting from equation (1), the observed change in h_t between some period s (say, the beginning of the recession) and any future time period t (denoted $\Delta h_{s,t}$), can be decomposed into (i) changes in the employment share of part-time and full-time jobs $\Delta_{s,t}^{\text{share}}$ and (ii) changes in hours per worker within each job category $\Delta_{s,t}^{\text{hours}}$.[16] That is:

$$\Delta h_{s,t} \equiv h_t - h_s = \Delta_{s,t}^{\text{share}} + \Delta_{s,t}^{\text{hours}}, \tag{2}$$

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

$$\Delta_{s,t}^{\text{share}} \equiv \sum_{\tau=s}^{t-1} \sum_{i=F,P} \left(\omega_{\tau+1}^i - \omega_\tau^i\right) \frac{h_\tau^i + h_{\tau+1}^i}{2} \text{ and } \Delta_{s,t}^{\text{hours}} \equiv \sum_{\tau=s}^{t-1} \sum_{i=F,P} \left(h_{\tau+1}^i - h_\tau^i\right) \frac{\omega_\tau^i + \omega_{\tau+1}^i}{2}. \tag{3}$$

Based on equation (2) one can produce a number of relevant coefficients. The first of these relates the variance of changes in hours per worker to the covariance between it and each of the two series of chain-weighted changes. This allows us to summarize the contribution of fluctuations in the two sources to the variation in hours per worker over the whole period in the following coefficient:

$$\gamma^j = \frac{\mathbb{C}\text{ov}(\Delta h_{t-1,t}, \Delta_{t-1,t}^j)}{\mathbb{V}\text{ar}(\Delta h_{t-1,t})} \tag{4}$$

for $j \in \{\text{share}, \text{hours}\}$. The estimates are displayed in panel A. of Table 1. Over the whole sample period, fluctuations in the part-time employment share account for just about half of the variation on the intensive margin in the U.S. and in the U.K. (resp. 56.7 and 49.5%).[17] In our view, these figures already indicate a substantial role for part-time employment in the dynamics of hours per worker.

[16] As in equation (1) since there are two categories of employment, we only need to keep track of one of them.

[17] Our estimated gamma coefficients are almost exactly the same as the coefficients obtained from shift-share decompositions, which weigh all the observations in each counterfactual series by a constant weight (say, the sample mean of the decomposed series). Those results are available upon request.

First, in γ^{share} movements in the shares ω_t^i are constrained by the identity $\omega_t^F = 1 - \omega_t^P$, whereas in γ^{hours} the two variables h_t^P and h_t^F move without a systematic relationship between them. Second, and more importantly, the sample period includes many quarters of tranquil economic times (compared to cyclical swings), during which we expect hours worked to be adjusted within part-time and full-time jobs.[18] Conversely, we expect the part-time/full-time margin to be more important in face of large economic shocks.

Table 1: Links between Changes in Hours per Worker and Part-time Employment

A. Variance contributions (Sample Period)

	United States	United Kingdom
γ^{share}	56.7	49.5
γ^{hours}	43.3	50.5

B. Cumulative changes (Great Recession)

	United States		United Kingdom	
	End of recession 2007q4–2009q2	Two years later 2007q4–2011q2	End of recession 2008q2–2012q1	Two years later 2008q2–2014q1
$\Delta h_{t_0,t_1}$	-0.75	-0.63	-0.83	-0.53
$\Delta^{\text{share}}_{t_0,t_1}$	-0.62	-0.61	-0.68	-0.52
$\Delta^{\text{hours}}_{t_0,t_1}$	-0.13	-0.02	-0.15	-0.01
$\Delta^{\text{share}}_{t_0,t_1}/\Delta h_{t_0,t_1}$ (%)	82.4	96.7	82.3	97.8

Notes: Sample: private-firm salaried workers. Based on seasonally adjusted series of usual hours per worker and the part-time employment share at a quarterly frequency. For the U.S., the series are quarterly averages of the monthly series. For the U.K. where the Great Recession involved a double-dip, the end of recession date is the end of the second recession (2012q1).

To illustrate this last point further, we analyze the recessionary episode that is common to both economies, which is also the period where the largest fluctuations in hours per worker take place. Panel B. in Table 1 reports the cumulative changes in hours per worker since the beginning of the Great Recession measured at the end of the recession and two years into the recovery period. Focusing on the last row of each panel, the message conveyed by this exercise is a strong one. For both labor markets, the evolution of the part-time employment share explains 82% of the drop in usual hours on impact. Moreover, the recessionary increase in part-time employment accounts for virtually all of the persistence in hours per worker (just under 100% two years after the end of the recession). In other words, had the shares of part-time jobs remained at their pre-recession levels in both countries, hours per worker would have fully recovered by mid 2011 in the U.S. and by early 2014 in the U.K.

3.3 Results based on Actual Hours

So far we have presented results based on a measure of usual hours worked. In business-cycle analyses it is common to measure the intensive margin using actual hours. In our view, both measurements are relevant to study the intensive margin. The time series of hours per worker (usual and actual) behave

[18] Inspection of the unsmoothed series used in Figure 1 suggests that a substantial fraction of the variance attributed to fluctuations in hours in each job type comes from very high-frequency movements.

quite similarly, although there also are some differences which suggest that they measure different concepts. In both countries the levels of the series of actual hours are lower than those of usual hours and they exhibit greater high-frequency variation. This is consistent with the fact that only actual hours track movements due to workers' sickness, holidays and days off and other idiosyncratic high-frequency phenomena which reduce the actual work schedule vis-a-vis the usual one. More important for the purposes of our analysis, the two series also display slightly distinct cyclical patterns. In particular, the series of actual hours shows a greater cyclical response in the U.S., while the opposite occurs in the U.K. Since our goal is to highlight the similar role played by part-time employment in the cyclical dynamics of the intensive margin in both countries, we first presented results based on usual hours. However, the results based on actual hours are also interesting in their own right (some would argue they are more relevant) and bring to light some surprising differences in the patterns of labor adjustment on the intensive margin across the two countries. We now briefly discuss those results.

Table 2: Decomposition of Changes in Hours per Worker, Results based on Actual Hours

A. Variance contributions (Sample Period)

	United States	**United Kingdom**
γ^{share}	32.4	45.6
γ^{hours}	67.6	54.4

B. Cumulative changes (Great Recession)

	United States		**United Kingdom**	
	End of recession 2007q4–2009q2	Two years later 2007q4–2011q2	End of recession 2008q2–2012q1	Two years later 2008q2–2014q1
$\Delta h_{t_0,t_1}$	-1.45	-0.85	-0.36	-0.06
$\Delta^{\text{share}}_{t_0,t_1}$	-0.67	-0.63	-0.64	-0.48

Notes: Sample: private-firm salaried workers. Based on seasonally adjusted series of actual hours per worker and the part-time employment share at a quarterly frequency. For the U.S., the series are quarterly averages of the monthly series. For the U.K. where the Great Recession involved a double-dip, the end of recession date is the end of the second recession (2012q1).

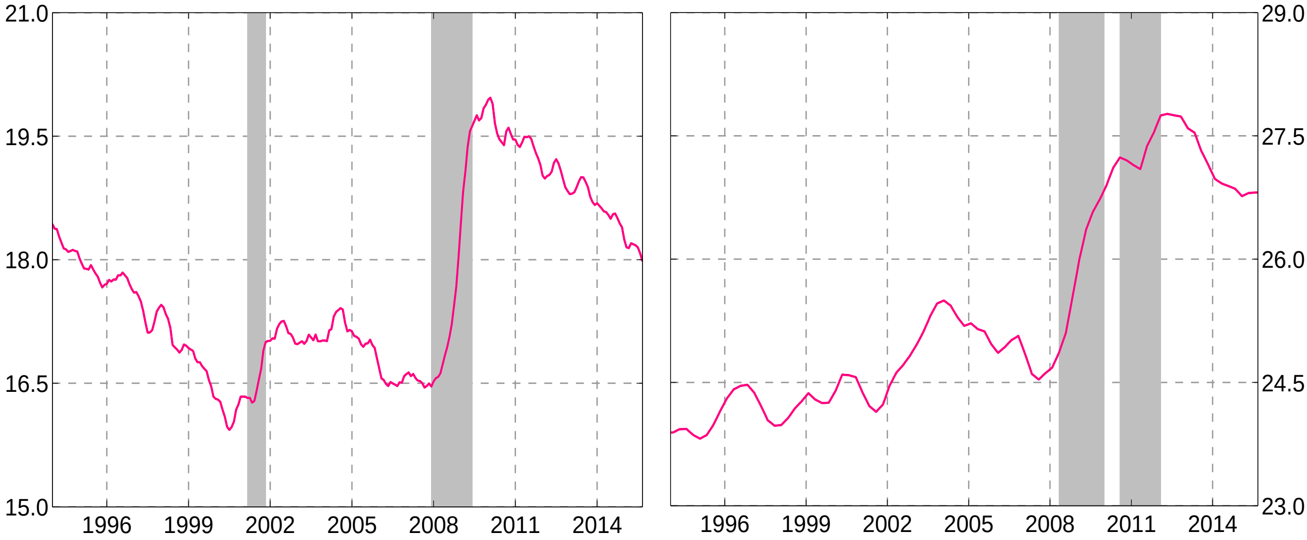
Table 2 shows the main results presented so far using a measure of actual weekly hours worked. Over the sample period, fluctuations in the part-time employment share account for 32 and 45% of fluctuations in actual hours per worker, respectively in the U.S. and the U.K. (γ^{share} in panel A). When we focus on the Great Recession (panel B.), the cross-country differences are even greater. In the U.S. the part-time employment share accounts for a large fraction of the drop in hours per worker (46% at the end of the recession and 74% two years later). There is a simple explanation for this: changes in hours per worker in full-time jobs also drop substantially during the downturn, contributing to the overall drop in hours per worker.[19] In the U.K., we observe the opposite pattern: actual hours per worker in each job type recover very quickly after the initial drop (even before the end of the first dip), so that the large jump upwards in the part-time employment share more than accounts for the drop in hours per worker from peak to trough. As we go further in time, the recovery in actual

[19] Hours per worker in part-time jobs actually increase, but the magnitude of the change is about the same as the one observed for full-time jobs.

hours is fully achieved, while the elevated levels of part-time work persist. In other words, in the U.K. movements in actual hours per worker damp the larger changes in usual hours.

3.4 Part-time Work

Having established the quantitative importance of fluctuations in part-time employment for the cyclical dynamics of the intensive margin, we now direct our attention to the behavior of the part-time employment share. Figure 2 tracks the evolution of the share of workers employed in part-time jobs over the past two decades. The first remarkable fact concerns the extent of part-time employment. Part-time work represents a large fraction of total employment in both labor markets: on average 17.7% in the U.S. and 25.4% in the U.K. The cross-sectional relevance of part-time employment has been studied in detail in the U.K. (see e.g. the 2008 special issue of *The Economic Journal* on Women's part-time work). By contrast, in light of the high levels of part-time employment reported for the U.S., it is surprising that hitherto this feature of the U.S. labor market has not been further highlighted.



(a) United States

(b) United Kingdom

Figure 2: Part-time Employment Share

Notes: Sample: private-firm salaried workers. Based on seasonally adjusted series of the part-time employment share. Gray-shaded areas indicate recessionary periods.

To our best knowledge the very strong countercyclicality of part-time employment visible in the plots in Figure 2 has not been documented before in the literature. In both plots the solid lines shoot up in recessionary periods, indicating a quick shift in the composition of employment towards part-time jobs. The cyclicality of the part-time employment share is more pronounced in the U.S. compared to the U.K. Focusing on the Great Recession, from trough to peak the part-time employment share in the U.S. rose by just over 3 percentage points (from 16.4% to 19.5%). The U.K. labor market witnessed a similarly large increase in levels, from 24.7% to 27.6%. A second remarkable feature of Figure 2b is the behavior of the part-time employment share in the Great Recession's aftermath. By the end of 2015 part-time employment shares were still well above their pre-crisis levels. The elevated levels of part-time employment in the aftermath of the Great Recession are consistent with the evolution of other labor market indicators (such as the high levels of the unemployment rate) and support the notion that the recovery was a sluggish one. However, while the unemployment rates in both countries are now back to their pre-crisis levels, the part-time employment shares remain above them.

Up to this point we have remained silent about what distinguishes part-time from full-time jobs beyond their statistical definition. In Table 3, we highlight their differences in terms of average usual hours worked, separately for the whole sample period and during the Great Recession.[20] Workers employed in full-time jobs work on average twice as many hours as those in part-time jobs. The figures are remarkably consistent across the U.S. and U.K., particularly in full-time jobs. On the other hand, part-time workers in the U.K. work on average fewer hours than their U.S. counterparts. This, and the fact that part-time workers are relatively more numerous in that labor market, explains the lower level of aggregate hours per worker in the U.K. vs the U.S. (cf. Figure 1).

Table 3: Average Usual Weekly Hours per Worker

	United States		**United Kingdom**	
	Sample period	Great Recession	Sample period	Great Recession
Full-time	42.6	42.4	43.9	43.4
Part-time	21.9	22.3	19.4	20.1

Notes: Sample: private-firm salaried workers. Based on averages of seasonally adjusted series of usual hours per worker.

Further inspection of the data (not reported in the table) also reveals that hours per worker in full-time (part-time) jobs have diminished (increased) over the past two decades in both countries. Notwithstanding, the main observation is that changes in the part-time employment share play an important role in the aggregate because of the large differences in hours worked across the two job categories.[21] We will see that these large differences are similarly present at the worker level, when individuals move across the part-time/full-time margin, indicating that such movements entail an actual change in labor market status.

4 The Dynamics of Part-time Employment

In this section we develop a model that describes the dynamics of part-time employment in terms of the underlying worker flows. This representation allows us to accurately decompose the sources of fluctuations at the intensive margin and, by extension, quantify the role played by the extensive margin in those dynamics. Our main finding is that the bulk of fluctuations in hours per worker is attributable to movements in transition rates between part-time and full-time employment in private-sector salaried jobs. The transition probability from full-time to part-time is very strongly countercyclical, while the reverse transition is procyclical (albeit less clearly synchronized with the business cycle).

[20] The results based on a measure of actual hours lead to the same conclusions.

[21] For sake of space, in Table 3 we characterize the distributions of hours worked in the two types of jobs only by their sample means. In Appendix B we show histograms of the distributions of usual and actual hours in the two countries. The empirical distributions show some heterogeneity in hours worked within each job type (more so in part-time than in full-time jobs). The distributions of hours worked are also remarkably persistent. Our rather quick treatment of differences in hours in levels stems from the fact that we do not take it as the main object of interest. Instead we focus on the distribution of hours changes. In fact, the patterns of the intensive margin that we document are not clearly visible by, say, contrasting the distribution of hours before and during the Great Recession. This is not surprising. Despite the large steady-state increase in the share of employed workers in part-time jobs observed from the pre-crisis period to the Great Recession, it represents a small fraction of overall employment. In the same way that flows (not stocks) are the relevant object to document the cyclical dynamics of the extensive margin, changes in hours (not their levels) are the relevant object to track the cyclical dynamics of the intensive margin at the worker level. We will provide a detailed analysis of the distribution of hours changes in Section 5.

4.1 Framework

Our stock-flow framework classifies employed workers in one of three states: in a private-sector salaried job on a part-time basis (P) or on a full-time basis (F), or in any other form of employment (X). This residual state includes all other jobs in our sample: whenever a worker is employed in the public sector, or is self-employed, we count her in the stock of workers in state X.[22] This state is useful because it allows to distinguish part-/full-time reallocation that occurs within private-firm salaried jobs from that taking place through different employment sectors. When not employed individuals can be either in unemployment (U) or non-participation (N). The vector of the stocks of workers in each state in period t is defined in the following way:

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

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

$$\boldsymbol{\ell}_t = \boldsymbol{M}_t \boldsymbol{\ell}_{t-1}, \tag{5}$$

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.[23] We obtain estimates of transition probabilities using series of labor-market stocks and flows as per the protocol described in Appendix A.1. We adjust these time series to account for systematic seasonal variation, margin-error (Poterba and Summers [1986], Elsby et al. [2015]) and time-aggregation bias (Shimer [2012]) (details are also provided in Appendix A.1). To obtain transition probabilities that can be compared across the two countries, we convert the estimated quarterly transition probabilities for the U.K. to a monthly frequency.[24]

4.2 Long-run Dynamics

Columns (1) and (3) in Table 4 report averages of the monthly transition probabilities over the whole sample period. We start by remarking the similarities between the long-run (average) behavior of part-time employment in the two countries. First, part-time work appears as a rather transitory form of employment. In every month in the U.S. (U.K.), roughly 30% (6%) of those working part-time move to a different labor market state in the following period. The corresponding numbers for full-time employment are much smaller (7% for the U.S. and 2% for the U.K.). In fact, 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 of a part-time worker is towards a full-time position (17.9% in the U.S., 2.56% in the U.K.), followed by transitions to non-participation (6.91% in the U.S., 1.56% in the U.K.). Third, part-time workers account for a large fraction of new entrants into full-time employment (3.85% for the U.S. and 0.87% for the U.K.; not reported in the table). As we will see momentarily, the strong dynamic interaction between part-time and full-time employment that we just highlighted is key to explain the countercyclicality of the part-time employment share.

Table 4 also reveals a number of differences in part-time employment across the U.S. and the U.K. The most visible and striking feature is the extent of 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.

[22] We ignore unpaid family workers and workers on a Government Training Scheme; see Subsection 2.2.

[23] To simplify the notation, throughout this section we omit the t subscript from transition probabilities p^{ij} and from the corresponding flow hazard h^{ij}; see Appendix A.1 for a formal presentation.

[24] Specifically, we divide by three the eigenvalues of the continuous-time counterpart of the Markov transition measured at a quarterly frequency, and then calculate the transition probability using the usual identity $p^{ij} = 1 - e^{-h^{ij}}$.

Table 4: Transition Probabilities: Average and Change in the Great Recession

	United States		United Kingdom	
	Average	Change in the Great Recession (%)	Average	Change in the Great Recession (%)
	(1)	(2)	(3)	(4)
(i) Part-time employment				
p^{PF}	17.9	-0.39	2.56	-4.57
p^{PU}	4.25	5.53	0.95	9.65
p^{PN}	6.91	-9.91	1.56	-13.7
p^{PX}	0.83	11.7	0.67	-4.49
$\sum_{i \neq P} p^{Pi}$	29.9	-1.59	5.74	-4.84
(ii) Full-time employment				
p^{FP}	3.82	10.7	0.75	14.7
p^{FU}	1.76	23.2	0.57	11.3
p^{FN}	1.25	-6.23	0.27	-16.2
p^{FX}	0.53	32.6	0.42	0.01
$\sum_{i \neq F} p^{Fi}$	7.37	12.0	2.01	6.04
(iii) Unemployment, non-participation and other employment				
p^{UP}	10.4	-14.0	3.24	-24.7
p^{UF}	14.4	-19.1	4.31	-38.3
p^{NP}	2.62	-14.9	0.93	-19.6
p^{NF}	1.73	-17.8	0.19	-40.9
p^{XP}	0.31	24.8	0.24	-0.70
p^{XF}	0.95	30.1	0.55	-5.66

Notes: Based on series of stocks and flows corrected for seasonal variation, margin-error and time aggregation bias, expressed at a monthly frequency.

Our findings echo the patterns uncovered in cross-country studies on labor mobility (see e.g. Jolivet et al., 2006). Second, although non-participation is closely related to part-time employment in both countries – underscoring the view that part-time employment is often associated with lower labor force attachment –, that relationship is stronger in the U.K. The ratio of outflow transition probabilities from non-participation into private sector employment (viz. p^{NP}/p^{NF}) is 4.5 vs. 1.5, respectively in the U.K. and the U.S. A third difference concerns turnover linked to other forms of employment (X), which is far more important in the U.K. This difference is explained by the higher incidence of self-employment in the U.K.

4.3 Dynamics in the Great Recession

Having established the similarity across the two labor markets in terms of the long-run behavior of part-time employment, we now shift our attention to its short-run dynamics. To describe succinctly the cyclical dynamics of worker flows, we compare the sample means of transition probabilities during the Great Recession (GR hereafter) with that in the five-year period that preceded the downturn.

These are reported in columns (2) and (4) of Table 4. Rather than describing the dynamics of each transition probability, we organize the description of the main results in two competing explanations for the evolution of the part-time employment share during the GR.

H1. Reallocation within employment. The economic downturn is accompanied by a jump in $p^{FP}$and a drop in p^{PF}. Given the relative size of these flows, they are likely to play a major role in driving the dynamics of the part-time employment share. Therefore, a first hypothesis to describe fluctuations at the intensive margin is that they are driven by cyclical reallocation across full-time and part-time employment within private-sector salaried jobs.

H2. Reallocation through non-employment. Consistent with what the previous literature has documented (see e.g. Smith [2011] and Elsby et al. [2015]), we find that the dynamics of employment are similar in both countries. Specifically, during the GR: (i) the transition probabilities from non-employment (non-participation and unemployment) to employment (part-time or full-time) drop, (ii) the transition probabilities from employment (part-time or full-time) to unemployment increase, and, lastly, (iii) the transition probabilities from employment (part-time or full-time) to non-participation also fall. Furthermore, in both countries, full-time inflows from unemployment and non-participation (viz. p^{UF} and p^{NF}) are more cyclically sensitive than their part-time counterparts (resp. p^{UP} and p^{NP}).[25] Similarly, outflows from full-time work to unemployment augment relatively more in the recession compared their part-time counterparts. Hence, a competing description for the evolution of the part-time employment share is that it is driven by the stronger relatively cyclicality of full-time employment inflows to/from unemployment and non-participation vis-a-vis part-time employment. In other words, that fluctuations on the intensive margin are actually driven by movements on the extensive margin.

4.4 Variance Decomposition

In order to assess the quantitative importance of hypotheses *H1* and *H2*, we decompose the variation in the part-time employment share in the fractions accounted for by changes in each transition probability.[26] Specifically, we apply the dynamic variance decomposition developed by Elsby et al. [2015] to our Markov chain model.[27] The output of this exercise are a set of beta coefficients that quantify the contribution of any flow hazard h^{ij} to the variation in the part-time employment share ω_t^P:

$$\beta^{ij} = \frac{\mathbb{C}\text{ov}\left(\Delta\omega_{t-1,t}^P, \Delta\widetilde{\omega}_{t-1,t}^P\right)}{\mathbb{V}\text{ar}(\Delta\omega_{t-1,t}^P)}. \tag{6}$$

$\Delta\widetilde{\omega}_{t-1,t}^P$ denotes the first-difference in a counterfactual part-time employment share whose evolution is *only* based on the past and contemporaneous values of a particular flow hazard h^{ij}. In Appendix A.2 we show that the variation in the part-time employment share can be approximately decomposed into the variance contributions of each flow hazard. That is:

$$\sum_{i \neq j} \beta^{ij} \approx 1. \tag{7}$$

[25]The fact that the proportionate increase in p^{FU} is higher than that in p^{PU} is indicative of a greater cyclical sensitivity of the former transition probability.

[26]For sake of precision, in the text we refer to hazard rates h^{ij} associated to transition probability p^{ij}, as the dynamic decomposition is based on the former (see Appendix A).

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

In practice, to calculate each coefficient β^{ij}, we regress the series of counterfactual changes in the part-time employment share $\Delta\widetilde{\omega}^P_{t-1,t}$ (calculated as described in Appendix A.2) on the series of observed changes in the part-time employment share.

Table 5 displays the main beta coefficients estimated using the whole sample period for the U.S. and the U.K. labor markets.[28] The first observation is that the variance decomposition works extremely well. For both countries, the approximation error is less than 4% (cf. last row of the table) . The first panel of Table 5 displays the variance contributions of flow hazards across part-time and full-time jobs, as well as their joint variance contribution. These beta coefficients measure the importance of reallocation within private-sector salaried employment to the evolution of the part-time employment share. Compared to the other beta coefficients, they stand out by being much greater (all other flow rates have betas below or equal to 11%). Together, fluctuations in these two transition hazards account for about three quarters of the observed variation in the part-time employment share (76% in the U.S. and 71% in the U.K.).

Table 5: Part-time Employment Share Variance Contributions

	United States	**United Kingdom**
β^{PF}	35.7	39.7
β^{FP}	40.6	31.3
$\beta^{PF}+\beta^{FP}$	76.3	71.0
$\sum_{i=P,F}\beta^{iU}+\sum_{j=P,F}\beta^{Uj}$	8.05	10.9
$\sum_{i=P,F}\beta^{iN}+\sum_{j=P,F}\beta^{Nj}$	16.3	6.75
$\sum_{i=P,F}\beta^{iX}+\sum_{j=P,F}\beta^{Xj}$	3.00	7.98
$\sum_{i=U,N,X}\sum_{j=P,F}\beta^{ij}$	21.2	5.34
$\sum_{i=P,F}\sum_{j=U,N,X}\beta^{ij}$	6.11	20.3
$\sum_{i,i\neq j}\beta^{ij}$	103.6	96.6

Notes: Based on series of stocks and flows corrected for seasonal variation, margin-error and time aggregation bias.

These results provide a very clear answer to the question posed in the previous subsection. The predominant forces driving the dynamics of the part-time employment are movements of workers between part-time and full-time positions in private-sector salaried employment, which strongly supports *H1*. It is worth noting that, while the estimates of β^{PF} are very close (35.7 and 39.7 resp. for the U.S. and the U.K.), the estimated β^{FP} is fairly larger for the U.S. (40.6 vs 31.3%). One possible explanation for this difference resides in the fact that the U.K. escaped the 2001 recession. Indeed, as will be made clear in the next subsection, both p^{FP} and ω^P_t co-move very strongly with the business cycle.

By definition, the remaining variation in the part-time employment share is accounted for by variation in flow hazards between private-sector salaried jobs and the other three labor market states. The middle panels of Table 5 display the sum of the corresponding beta coefficients. The composition of the remaining sources of variation is somewhat different in the two labor markets. In the U.S., the highest share is accounted for by non-participation (16.3%), followed by unemployment (8.05%)

[28] To economize on space we only report the most relevant beta coefficients and/or sums of beta coefficients. The full set of beta coefficients are available upon request.

and other employment (3%). In the U.K., unemployment is the main driver of between-reallocation is unemployment (10.9%), followed by other employment (7.98%) and non-participation (6.75%). In any case, the results for both countries offer poor support to the validity of *H2*, as non-employment flows account for a quarter (24.1%) of the variation in part-time employment in the U.S. and one-sixth to one-fifth of that variation (17.7%) in the U.K.

To conclude this description, the bottom panel shows aggregates of beta coefficients associated to inflows from U, N and X to private-firm salaried jobs (first row) and outflows from private-firm salaried jobs to U, N and X (second row). The inflows to private-sector salaried jobs play a more important role in the dynamics of the part-time employment share in the U.S. (21.2 and 6.1% resp. for inflows and outflows). The same figures for the U.K. are respectively 5.34 and 20.3%. Overall, the greater importance of employment outflows to labor market dynamics in the U.K. vs. the U.S. is consistent with decompositions of the unemployment rate based on estimates of two- and three-state Markov chain models (see Elsby et al. [2009] and Shimer [2012] for the U.S., and Gomes [2012] and Smith [2011] for the U.K.).

4.5 The Dynamics of p^{PF} and p^{FP}

We now take a closer look at the dynamics of the transition probabilities between part-time and full-time jobs. The plots in Figure 3 display the time series of p^{PF} and p^{FP}over the whole sample period. The plots in the top panel display the evolution of p^{PF}. In the U.S., during the first decade of the observation window there is a clear upward trend in p^{PF}, which seems to be an important explanation for the steady decline in the part-time employment share during the same period (cf. Figure 2a). The behavior of p^{PF} in the U.K. is more stable during this period. Despite the differences in volatility, both series display a similar behavior from about 2005 until the end of observation window, alternating spikes up and down around the same level. Somewhat puzzlingly, there is no obvious change in that pattern during the Great Recession. This is not at all the case for the behavior for the transition probability from full-time to part-time employment, whose series are displayed in the bottom panel of Figure 3. In both countries p^{FP} increases sharply at the onset of the recession, reaching a peak at the end of the Great Recession in the U.S. and at the end of the 1st dip in the U.K.. It is also noticeable that both series flatten out after the first impact, but never really recover to their pre-crisis levels, and actually start increasing again from 2014 onwards. When we consider the whole observation window, the plot for the U.S. indicates that a similar pattern occurred in the 2001 recession. Additionally, in both countries we see a clear upward trend in this transition probability.

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 part-time and full-time jobs. In this section we advance a hypothesis to understand the source of these fluctuations, which we label *variable labor utilization*. This hypothesis posits that firms adjust the intensity with which they utilize their labor force in response to shocks to their environment. We assess its validity by producing a richer characterization of worker flows between part-time and full-time positions. We conclude our analysis by quantifying the importance of variable labor utilization for movements in hours per worker.

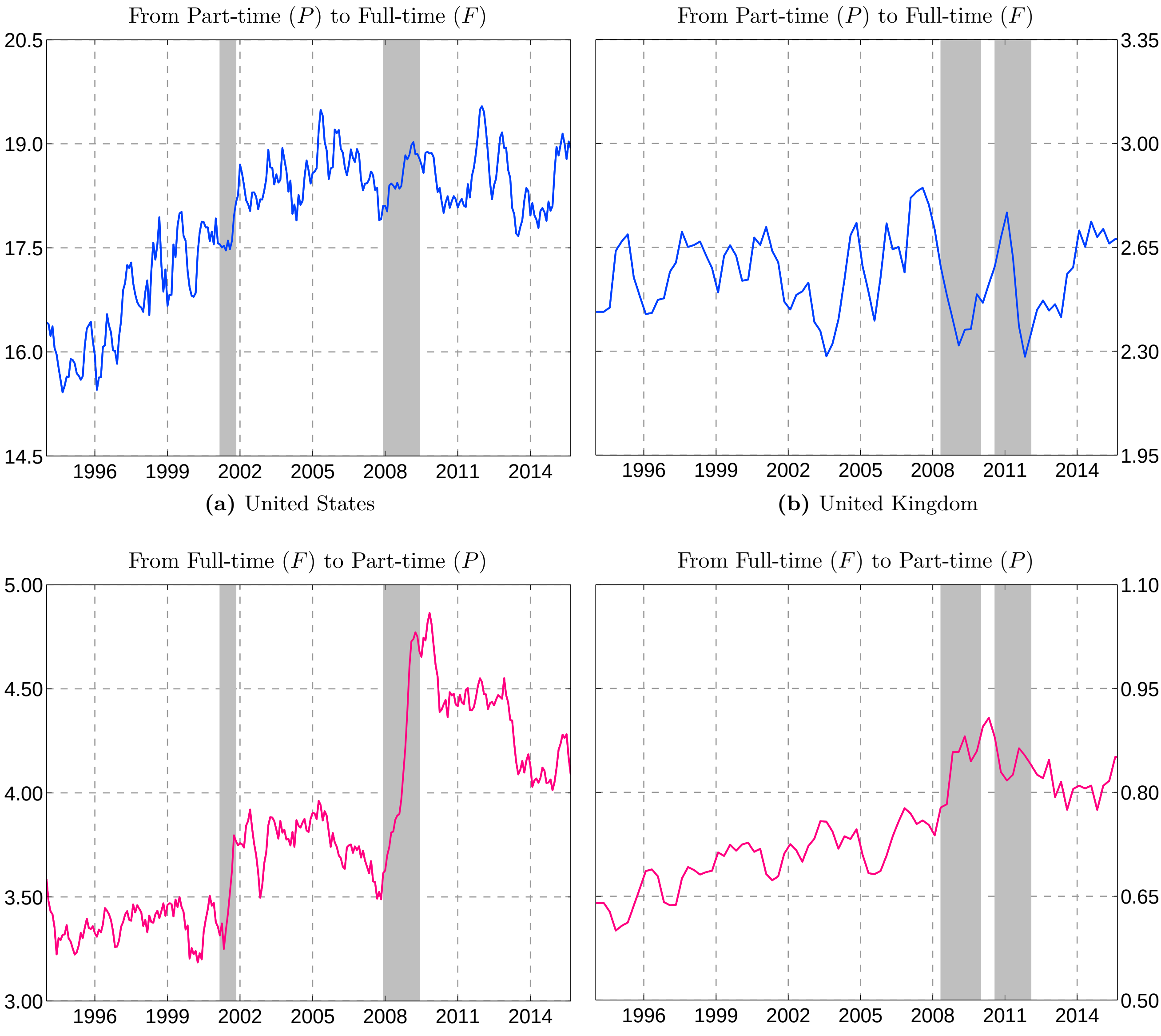


Figure 3: Transition Probabilities between Part-Time and Full-time Employment

Notes: Sample: private-firm salaried workers. Based on series of transition probabilities adjusted for seasonal variation, margin error and time aggregation, expressed at a monthly frequency. Gray-shaded areas indicate recessionary periods.

5.1 The Variable Labor Utilization Hypothesis

We conjecture that labor reorganization within the firm operates as an adjustment channel to various shocks. These shocks can affect either the firm's demand or the labor supply decisions of the firm's employees. The main idea is that in the presence of adjustment costs along the extensive margin (viz. hiring or firing costs), the intensive margin of labor adjustment (hours per worker) offers an alternative adjustment channel to smooth out the shock. 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. In labor markets where job requirements are increasingly specialized and suitable workers are hard to find, the opportunity cost of firing a worker can be very high. Moreover, in recessions workers' outside options are low, so that they more easily accept a reduction in labor income via a reduction in working 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 subsections 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 part-time and full-time margin (and vice versa) occur predominantly at the employer level. Second, we document that workers who move between part-time and full-time jobs at the same employer experience large changes in working hours. Last, we find that the incidence of involuntary part-time employment following a transition from full-time to part-time work at the same employer increased dramatically during the Great Recession and its aftermath.

5.2 Transitions between Full-time and Part-time at the Same Employer

We first quantify the importance of reallocation within the same employer for workers who move between full-time and part-time positions in two consecutive periods. We compute retention rates – the probability of remaining with the same employer – by estimating job-to-job transition probabilities in much the same fashion as Fallick and Fleischman [2004] and Gomes [2012] do, respectively, for the U.S. and the U.K. The CPS asks individuals who are in the survey and employed for two consecutive months whether they are employed with the same employer as in the previous month. The LFS collects information from individuals on the date at which they started working for their current employer (month/year), which can be used to measure the length of time of continuous employment with the same employer (in months). The structure of both surveys implies that estimates of retention rates are not subject to time aggregation bias.[29]

In the first column of Table 6 we report the sample means of the retention rates for transitions between part-time (P) and full-time (F) employment.[30] We also computed retention rates for workers who remained employed in the same job category in two consecutive periods, and found retention rates around 97-98% (not reported). The latter figures are not surprising in light of what we know about job-to-job mobility, which affects only a small percentage of the workforce. However, the fact

[29]For a worker reporting to be employed with the same employer on two consecutive periods we know that he experienced no intervening spells of either non-employment or employment with a different employer.

[30]To obtain monthly figures for the U.K. we first compute the quarterly series and then take its cubic root.

that the retention rates are similarly elevated for workers who move between part-time and full-time jobs (Table 6) is a new and surprising fact: whatever the transition we consider, the average retention rate is above 90%. It suggests that adjustments on the intensive margin occur predominantly within the firm, and possibly even within the same job. This evidence seems to contradict a common finding that jobs have fixed working hours, so that in order to adjust their labor supply workers need to move jobs (see Blundell et al. [2008] and references therein). In other words, it suggests that firms in the U.S. and the U.K. have flexibility in adjusting the working hours of their employees.

Table 6: Transitions at the Same Employer

	Average Retention Rate	Variance Contribution (%)
United States		
From P to F	92.8	92.2
From F to P	93.9	95.2
United Kingdom		
From P to F	91.8	89.2
From F to P	95.4	96.8

Notes: Sample: private-firm salaried workers. Based on stocks and flows corrected for seasonal variation, margin-error and time aggregation bias, expressed at a monthly frequency.

To better understand cyclical reallocation between part-time and full-time jobs at the same employer, we compute p^{FP} and p^{PF} conditional on staying with the same employer. Figure 4 shows the monthly time series of those transition probabilities in both countries over the sample period. The more salient fact in the four plots is how closely the conditional transitions resemble their unconditional counterparts (cf. Figure 3). The levels of the conditional transitions are slightly higher than the unconditional ones (note that the vertical axis is adjusted upwards for the top left chart), but the behavior over time is almost exactly the same. This indicates that within-firm reallocation is a constant feature of adjustment on the intensive margin, viz. not exclusive of either upturns or downturns. To quantify more precisely the role of transitions at the same employer for the variation of p^{FP} and p^{PF}, we report their variance contributions in the second column of Table 6.[31] The estimated coefficients indicate that the dynamic evolution of transition probabilities between part-time and full-time jobs at the same employer account for 92 and 89% of the full transition probability respectively for the U.S. and the U.K. The coefficients for the reverse transition are even higher at 95 and 97%, respectively.

5.3 Changes in Hours Worked at the Worker Level

If firms are unable (e.g. because workers threat to quit) or reluctant (e.g. due to internal adjustment costs) to change the working hours of their employees, at the worker level we should not observe large

[31] To be precise, the transition probabilities p^{FP} and p^{PF} can both be written as the sum of two joint probabilities: transition at the same employer and transition accompanied by a change in employer. The first joint probability is calculated as the product of unconditional probability and the respective retention rate. The second column of Table 6 displays the coefficient obtained by regressing the unconditional transition probability on the respective joint transition probability at the same employer. In the regression both variables are in first-differences.

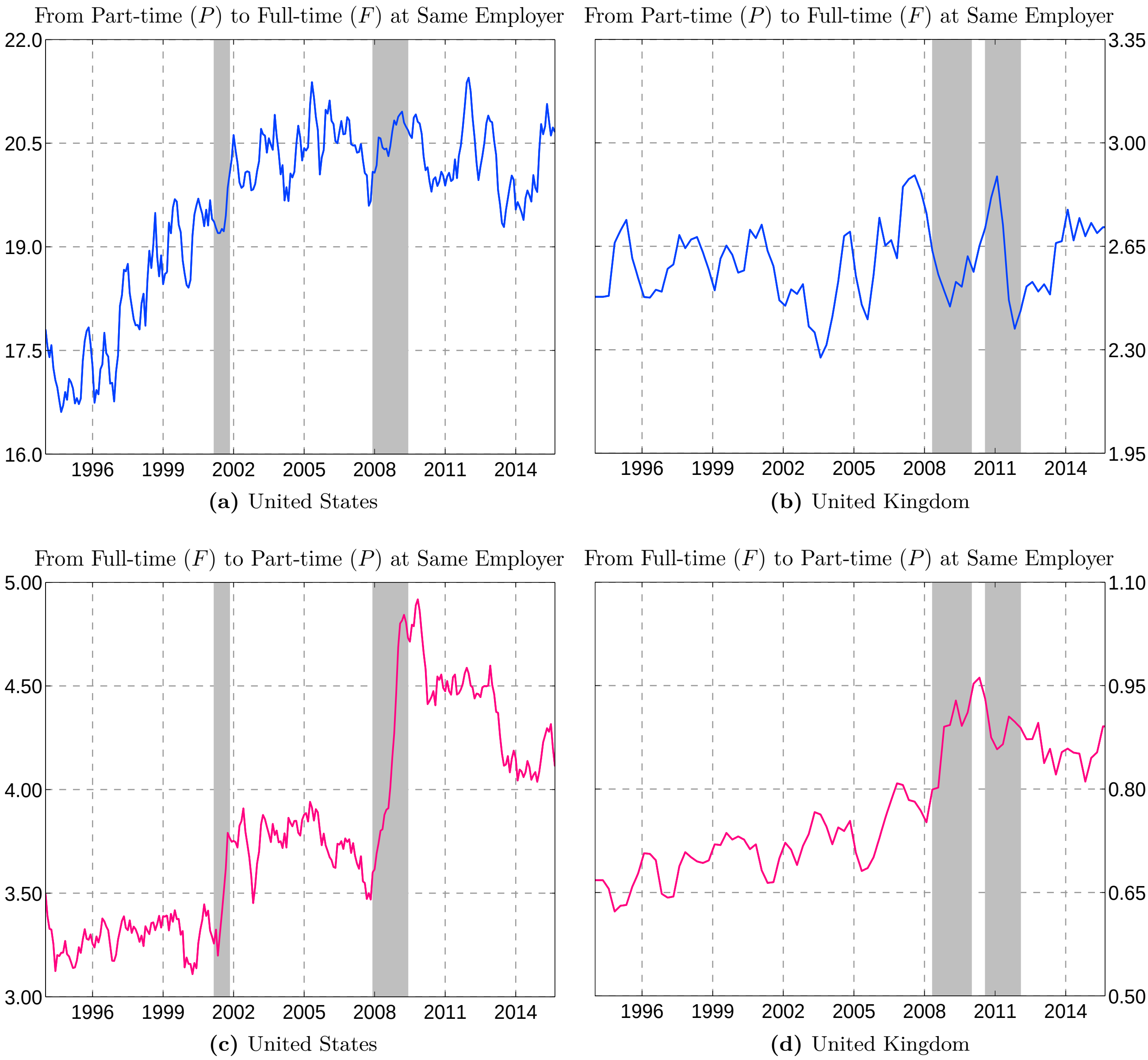


Figure 4: Transitions between Part-Time and Full-time Employment at the Same Employer

Notes: Sample: private-firm salaried workers. Based on series of transition probabilities adjusted for seasonal variation, margin error and time aggregation, expressed at a monthly frequency. Gray-shaded areas indicate recessionary periods.

changes in individuals' working hours for those workers who remain employed with the same employer. To confront that prediction, in Table 7 we report the average change in usual hours for workers who stay at the same employer in two consecutive periods, calculated in two episodes: the Great Recession, and a five-year period immediately before it. For comparison, we compute the same statistics for those who change employers (movers).

Inspection of Table 7 leads to some straightforward remarks. The first and more striking is that average changes in working hours for those moving between full-time and part-time positions at the same employer are large, both in normal and recessionary periods. They range between 12 and 13 weekly hours in the U.S. and the U.K., i.e. one and a half working days. These figures contrast with those measured for workers who remain in the same employer but do not change position, with values around zero in both full-time and part-time jobs. Second, compared to workers who in addition to a change of state (part-time or full-time) also move employer, the numbers are lower (about 5 to 6 hours less).[32] This observation suggests that, in terms of changes in working hours, reallocation within the same employer may be distinct from an actual job change. In addition to consistency with the variable labor hypothesis, both remarks lead us to sidestep concerns that the increase in the part-time employment share is driven by transitions involving a small, economically negligible, change in hours worked.

Table 7: Average Change in Hours across Job Types

	Pre-recession period		Great Recession	
	Stayers	Movers	Stayers	Movers
United States				
From F to P	12.6	17.3	12.3	17.8
From P to F	-12.7	-17.0	-12.3	-17.4
Stay in F	0.07	0.64	0.04	0.42
Stay in P	-0.20	-0.03	-0.21	-0.01
United Kingdom				
From F to P	13.1	19.5	12.3	19.1
From P to F	-12.2	-17.8	-12.1	-18.8
Stay in F	0.11	1.19	0.08	1.51
Stay in P	-0.11	-0.18	-0.06	-0.14

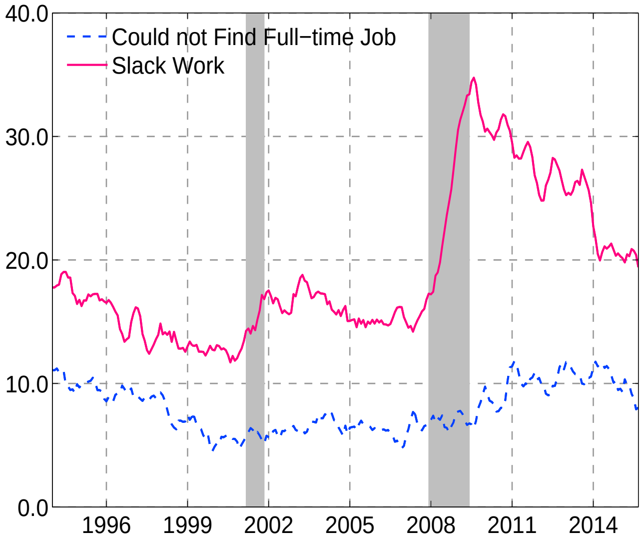
Notes: Sample: private-firm salaried workers. Based on averages of seasonally adjusted series of usual hours per worker. The pre-recession period comprises observations from the five-year period before the Great Recession in each country.

[32] It is interesting to notice that, although the mean change in hours for transitions at the same employer is considerably lower than the difference in mean working hours across the two job categories (cf. Table 3), 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.).

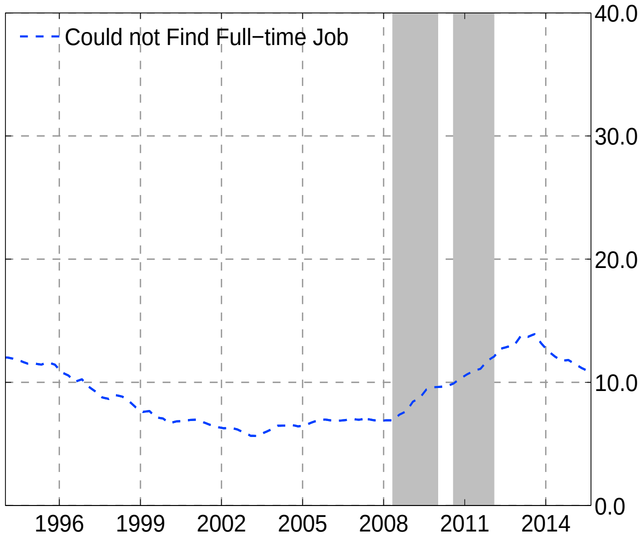
5.4 Involuntary Transitions to Part-time Work at the Same Employer

The idea that firms can vary the intensity with which they utilize labor, and that doing so (via lower labor compensation) allows them to reduce operating costs, suggests that economic downturns are periods of elevated reductions in labor utilization. This phenomenon is likely reinforced by the fact that workers' bargaining power is lower in recessions, which makes it easier for firms to engage in labor reorganization. In line with this story, we observe that the fraction of involuntary part-time workers increases dramatically during economic downturns.

Both the BLS and the ONS ask survey respondents the reasons for working part-time. This allows us to identify involuntary part-time work. In the U.S., involuntary part-time workers are those individuals who report working part-time for economic reasons. The BLS lumps together two situations to define part-time work for economic reasons: the inability to find a full-time job and part-time work that stems from slack work/unfavorable business conditions. In the U.K., the LFS asks respondents who report working on a part-time basis if they accepted a job with a lower schedule of working hours because they could not find a full-time job.[33]



(a) United States



(b) United Kingdom

Figure 5: Incidence of Involuntary Part-time Work in Transitions towards Part-time Jobs

Notes: Sample: private-firm salaried workers. Based on series of transition probabilities adjusted for seasonal variation, margin error and time aggregation, expressed at a monthly frequency. Gray-shaded areas indicate recessionary periods.

Figure 5 plots the share of transitions from full-time to part-time at the same employer which are involuntary from the workers' perspective. The first reason for involuntary part-time work recorded by the CPS, the inability to find a full-time job, is similar to the definition used by the LFS. In the two plots, the dashed lines denote the share of entrants to part-time work who do so because they cannot find a full-time job. The levels and countercyclical pattern of the dashed series are very similar in the two countries. The solid line on left-hand side plot measures the share of individuals who are working part-time this period because of slack demand in their current job. The level of this series is about twice that of the dashed line in normal times and more strongly countercyclical (reaching 32% at the peak of the Great Recession). This suggests involuntary part-time work due to slack demand

[33]Since the question pertains to a decision taken at the time of acceptance of a new job, in every quarter we only consider responses for workers who just moved to a part-time job.

conditions plays a prominent role in the increase of the part-time employment share in the U.S.[34] This finding supports the view that firms adjust the hours of their employees downwards, and that, lacking a better alternative, workers accept a reduced schedule of working hours. Unfortunately, the LFS does not collect this information, so we cannot reach the same conclusion for the U.K. labor market. However, in light of the very strong resemblance between the two countries 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.

5.5 Taking Stock

By way of conclusion of our quantitative analysis, we attempt to answer the following question: What portion of fluctuations in hours per worker can be accounted for by the dynamics of transitions between part-time and full-time jobs at the same employer? To answer it, we construct counterfactual series of changes in hours per worker. Its main ingredient is the series of changes in the part-time employment share driven by movements over time in transition probabilities between part-time and full-time jobs at the same employer. To predict that series we first re-estimate the Markov chain model (equation 5) replacing the series of p^{PF} and p^{FP} by their counterparts at the same employer (i.e. the joint transition probabilities). Next, building on the structure of the chain-weighted series decomposition (cf. equation 2), we construct the series of changes in hours per worker by weighing changes in the part-time employment share by two-period averages of the series of hours per worker in full-time and part-time jobs (cf. equation (3)). Finally, we use this series to quantify the variance contribution of the dynamics of the part-time/full-time reallocation at the same employer to observed changes in hours per worker.

The results of that exercise show that, over the sample period, about 30% of the dynamics of hours per worker are explained by variable labor utilization (defined as transitions directly between part-time and full-time jobs at the same employer). In our view, this figure is far from negligible since, as noted in Subsection 3.2, periods of tranquil economic times outnumber periods of cyclical swings when we consider the whole sample. If we focus on the Great Recession and its aftermath, the share of the cumulative change in hours per worker accounted for variable labor utilization is 50% for the U.S. and 59% for the U.K., hence underscoring the importance of this channel during the slow recovery.

6 Robustness

In this section we describe a number of hypotheses that offer alternative explanations for our findings, as well as their interpretation, and report empirical results that lead us to reject them. To facilitate the interpretation of this section, we summarize the main results of the paper in Appendix B.4.

6.1 Hypothesis 1: Compositions Effects

A possible explanation for the countercyclical pattern of part-time employment in both the U.S. and the U.K. is that it results from changes in the demographic, occupation and industry structure of employment. If the business cycle shifts the composition of employment across labor market segments that differ in terms of their incidence of part-time employment, then the increase in the aggregate

[34] In a companion paper (Borowczyk-Martins and Lalé [2016]) we undertake a detailed investigation of involuntary part-time work in the U.S. labor market.

part-time employment share obtains mechanically. A common example concerns employment in construction, which is usually more responsive to the business cycle than employment in the service industries. Since part-time contracts are used more intensively in service industries relative to the construction sector, the part-time employment share may increase simply because in recessions the share of employment accounted for by service-based industries increases.

Assessment

For this hypothesis to be valid the distribution of part-time employment needs to be heterogeneous across different partitions of the employed population (e.g. by gender, age etc.). To obtain a preliminary assessment of those patterns, we compare the composition of overall employment with that of part-time employment, and describe the incidence of part-time employment in different groups of workers defined by demographic characteristics, occupations and industries of employment. For sake of space, we report these results in subsection B.3 of Appendix B. The main conclusion we draw from that exercise is that there is a significant degree of heterogeneity in part-time employment shares across different segments and that its extent and patterns are quite similar across the two countries.

To obtain a more complete assessment of the role of composition effects, we construct counterfactual part-time employment shares controlling for changes in the composition of employment in terms of demographic characteristics, occupations and industries.[35] We then compare the actual trough-to-peak change in the part-time employment share with the changes that would have obtained had the structure of the economy not evolved since the beginning of the Great Recession.

Table 8 reports actual and counterfactual trough-to-peaks in the part-time employment share in the U.S. and the U.K. labor markets.[36] Beginning with the U.S., the reference point is the observed trough-to-peak increase in the part-time employment share, of 3.13 percentage points (pp), displayed in column (1). As can be seen in columns (2)–(4), controlling for changes in the demographic characteristics of employed workers entails very similar trough-to-peak changes. As a matter of fact, changes in the composition of age and educational attainment of employment since the beginning of the Great Recession seem to have dampened the measured increase in the part-time employment share. On the other hand, the increase in the share of female workers has had the opposite effect. In any case, both effects are quantitatively negligible.

Columns (5)–(8) and (9)–(12) of Table 8 assess the contribution of labor reallocation across occupations and industries, respectively, to the evolution of the part-time employment share. Changes to the industry structure of employment have had a larger effect on the part-time employment share. When we shut down this channel, the increase in the part-time employment share is lower by about 0.6 pp. This figure is 0.4 pp when labor reallocation across occupations is shut down. Both, however, represent a rather modest composition effect when measured in relative terms: the first one amounts to only about one-fifth of the actual increase in the part-time employment share (2.53 vs. 3.13 pp).

[35] To calculate these counterfactual part-time employment shares, we first pool together the cross-sections spanning the period of the Great Recession along with the cross-section for the period immediately before the Great Recession (our "control group"). Denoting by t_0 the before-recession cross-section and by t_1 a given cross-section from the period $t_0 + 1$ onwards, we define an indicator that takes the value of one if an observation i is in cross-section t_1 and is zero if it is in cross-section t_0. We run a Logistic regression of this indicator against a set of individual controls and use this model to compute π_i, the predicted probability that an observation i is in cross-section t_1. We multiply the cross-sectional weight of observation i by $(1 - \pi_i)\,\pi_i^{-1}$ to obtain a re-weighed observation i that holds constant to their pre-recession levels the set of characteristics included in the regression.

[36] We only report results based on our sample of interest (private-sector employees). The findings are similar using less restrictive samples (e.g. including the self-employed, public sector etc.), indicating that selection into our preferred sample does not drive the results. Results are available on request.

Table 8: Assessing Hypothesis 1: Composition Effects

	Actual	Demographics			Occupation				Industry			
					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.	3.13	3.70	2.97	3.30	2.70	3.20	2.73	2.73	2.53	3.13	2.58	2.64
U.K.	3.11	4.31	4.06	4.92	2.51	4.11	4.04	3.76	5.31	6.09	5.24	4.56

Notes: All entries in the table are percentage point differences. Column (1): Actual trough-to-peak change in the part-time employment share. Columns (2)–(4): Counterfactual trough-to-peak changes controlling for a quartic in age (2), sex (3) and educational attainment (4). Column (5): Counterfactual trough-to-peak change controlling for occupation of employment. Columns (6)–(8) Counterfactual trough-to-peak changes controlling for occupation in addition to a quartic in age (6), sex (7) and educational attainment (8). Column (9): Counterfactual trough-to-peak change controlling for industry of employment. Columns (10)–(12): Counterfactual trough-to-peak changes controlling for industry in addition to a quartic in age (10), sex (11) and educational attainment (12). Education categories. U.S.: "Less than high-school", "High-school graduates", "Some college" and "College or higher education". U.K.: "Primary education (below GCSE)", "Secondary Education (A-level, GCSE or equivalent)" and "Higher Education or more". Occupations and Industries. US: Two-digit categories of the 2000 Census classification schemes. U.K.: Two-digit occupation groups of the Standard Occupational Classification of 2000. Since a new classification was introduced in 2011q1 (SOC 2011), trough-to-peak changes reported in columns (5) – (8) for the U.K. are computed in the period 2008q02 – 2010q04. The observed trough-to-peak in that interval is 2.57 percentage points. Industries are the 17 sections of the Standard Industry Classification of 1992.

These findings all point to the conclusion that changes in the part-time employment share are not driven by composition effects.

The results for the United Kingdom displayed in Table 8 convey a similar picture. This said, some remarks are in order. First, while the observed trough-to-peak in the part-time employment share is similar *in levels*, in relative terms the increase is smaller in the U.K. This means the recessionary response of part-time employment has been more modest in the U.K., which is consistent with the more modest response of unemployment observed in this country.[37] Second, even more so than in the U.S., shifts in the composition of employment by worker characteristics have dampened the increase in the part-time employment share in the U.K. Third, the trough-to-peaks controlling for occupational reallocation are calculated on a shorter time window due to data constraints (from 2008q2 to 2010q4).[38] In this period the actual trough-to-peak in the part-time employment share is 2.57 pp. Fourth, for some specifications counterfactual trough-to-peaks can be substantially larger than the observed one (up to 6.09 in column (6)). If anything, these results offer a stronger rejection of the composition effect hypothesis. In conclusion, the picture that emerges from this accounting exercise is a clear one: the composition effect hypothesis explains a negligible part of the recessionary increase in part-time work.

[37] The peak-to-trough of the unemployment rate was 5.7 pp for the U.S. and 3.2 pp in the U.K.

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

6.2 Hypothesis 2: Multiple Jobholding

Our main sample of interest includes individuals who, at the time of the survey interview, have more than one job (the so-called multiple jobholders). Multiple jobholders are likely to combine jobs with different schedules of working hours, say a full-time and part-time job, or two part-time jobs. Their inclusion in the sample may bias the evolution of the part-time employment share. For example, suppose that for the majority of these workers the second job is a part-time one, which they use 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 will result from the higher probability of multiple jobholders to remain in the sample with a part-time job. The inclusion of multiple jobholders is likely to be even more problematic in analyses based on worker flows. Consider an individual who holds a full-time job and a part-time job in period $t-1$ and who loses her full-time job at period t. Our accounting framework will erroneously record this case as an individual transition from full-time to part-time employment between $t-1$ and t.

Assessment

To purge our findings from the effects of multiple jobholders, we recompute the main results of our analysis based on a sample which excludes any individual who holds multiple jobs at either $t-1$ or t. The results are displayed in Table 9. The main conclusion is that most results are quantitatively very close to the baseline ones. In part, these results from the small share of employment accounted for by multiple jobholders. The U.S. results are slightly more sensitive. The coefficient γ^{share} increases almost 10 percentage points, attributing greater importance to variation in part-time employment to explain the dynamics of hours per worker. On the other hand, the beta coefficient associated to transitions from full-time to part-time, β^{FP}, is reduced by 7 percentage points. In the U.K. the most noticeable difference concerns the lower increase in the part-time employment share during the Great Recession (from 2.91 to 2.19 percentage points). Despite these differences, our findings are strongly robust to the removal of multiple jobholders.

6.3 Hypothesis 3: The 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.[39] As stated in the introduction, the fact that this definition informs specific legislation creates a relevant margin for the decisions of employers and employees. However, insofar as there are no technological factors determining the separation between a part-time and a full-time job at exactly 35 usual hours, or that existing institutions based on that threshold pose only a limited constraint on agents' decisions, our results should broadly hold for alternative definitions of part-time employment. On the other hand, we cannot rule out that part of what we label reallocation between part-time and full-time employment is the fabrication of small movements in individuals' working hours

[39] In the U.S., whether an employee is considered full-time or not is determined by the employer, viz. the Fair Labor Standards Act (FLSA) does not define full-time or part-time employment; see http://www.dol.gov/general/topic/workhours/full-time. When there is sufficient differentiation between full-time and part-time workers (so that the FLSA's rule of consistent treatment across employees is circumvented), it is not unusual not to pay benefits such as vacation pay, holidays, personal days, health-care, and retirement benefits for part-time employees. As a result, the threshold of 34 (sometimes 39) weekly hours *de facto* 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 usual hours per week (see the Government's information on part-time contracts in the following webpage https://www.gov.uk/part-time-worker-rights. We accessed the webpage last time on March 11 2016.

Table 9: Assessing Hypothesis 2: Multiple Jobholding

	United States	**United Kingdom**
γ^{share} – Sample period	65.7	49.2
$\Delta h_{t_0,t_1}$: $\Delta^{\text{share}}_{t_0,t_1}$ – Great Recession	-0.75 : -0.60	-0.80 : -0.66
$\Delta h_{t_0,t_1}$: $\Delta^{\text{share}}_{t_0,t_1}$ – 2 years after Great Recession	-0.63 : -0.61	-0.52 : -0.51
Peak to trough ω^P_t – Great Recession	2.94	2.19
β^{PF} : β^{FP} : $\beta^{PF} + \beta^{FP}$	33.2 : 32.3 : 65.4	40.3 : 31.6 : 71.9
Variance Contribution of Transitions at the Same Employer: p^{PF}: p^{FP}	93.9 : 96.8	90.4 : 97.8

Notes: Sample for the part-time employment share and hours: private-firm salaried workers. Changes in hours (second and third row) are based on seasonally adjusted series of usual hours per worker and the part-time employment share at a quarterly frequency. For the U.S., the series are quarterly averages of the monthly series. For the U.K. where the Great Recession involved a double-dip, the end of recession date is the end of the second recession (2012q1). The variance contributions (last two rows) are based on series of stocks and flows corrected for seasonal variation, margin error and time aggregation bias.

Table 10: Assessing Hypothesis 3: The Definition of Part-time Employment

	United States	**United Kingdom**
γ^{share} – Sample period	48.3	41.4
$\Delta h_{t_0,t_1}$: $\Delta^{\text{share}}_{t_0,t_1}$ – Great Recession	-0.78 : -0.45	-0.83: -0.61
$\Delta h_{t_0,t_1}$: $\Delta^{\text{share}}_{t_0,t_1}$ – 2 years after Great Recession	-0.66 : -0.48	-0.54 : -0.42
Peak to trough ω^P_t – Great Recession	2.06	2.42
β^{PF} : β^{FP} : $\beta^{PF} + \beta^{FP}$	34.1 : 24.2 : 58.3	54.4 : 30.7 : 85.1
Variance Contribution of Transitions at the Same Employer: p^{PF}: p^{FP}	93.0 : 94.3	90.5 : 96.7

Notes: Sample for the part-time employment share and hours: private-firm salaried workers. Changes in hours (second and third row) are based on seasonally adjusted series of usual hours per worker and the part-time employment share at a quarterly frequency. For the U.S., the series are quarterly averages of the monthly series. For the U.K. where the Great Recession involved a double-dip, the end of recession date is the end of the second recession (2012q1). The variance contributions (last two rows) are based on series of stocks and flows corrected for seasonal variation, margin error and time aggregation bias.

around the 35 hours threshold, and that would disappear or be severely dampened if an alternative threshold were used instead.

Assessment

In order to assess how sensitive our findings are to changes in the part-time threshold, we recompute our main results based on an alternative threshold of 30 usual hours. The results are displayed in Table 10. They show that the main effect of reducing the threshold that determines full-time employment is to dampen the baseline results. The peak to trough in the part-time employment share is lower in both countries and so is the contribution of part-time employment to the dynamics of hours per worker. Where the two countries differ is in the importance of reallocation between part-time and full-time jobs, which decreases in the U.S. and increases in the U.K. (in both cases by about 15 percentage points). In the U.S. that difference is fully accounted for by the reduction in the variance contribution of transitions from full-time to part-time employment, whereas in the U.K. the increase in explanatory power comes from the variation in p^{PF}. In sum, the results are weakened in the U.S. where a threshold of 30 hours is uncommon (compared to the usual cutoffs at 34 or 39 hours) and they are somewhat reinforced in the U.K. where the 30-hours cutoff is frequently used.[40]

7 Implications for Macroeconomic Analysis

During the past three decades, the macroeconomic literature has fruitfully addressed a number of puzzles regarding labor supply by introducing a non-linear mapping between time allocated to market work and labor services. One such puzzle, which has been the subject of great interest in the literature, is the discrepancy between macro- and micro-based estimates of the Frisch elasticity of labor supply.[41] As is well known, the combination of indivisible labor decisions and aggregation using Rogerson [1988]'s employment lotteries, as in the business cycle model of Hansen [1985], allows to rationalize the gap between those two estimates. The insight is that fluctuations in total hours at the macro-level become independent of the individual labor supply elasticity under indivisible labor. This disconnect is similarly present in heterogeneous agents economies as in Chang and Kim [2006]. There, the discrepancy occurs through aggregation along a non-degenerate distribution of reservation wages originating from idiosyncratic shocks and incomplete markets.[42] Last, this construct has also been used in models featuring both margins of labor adjustment (see e.g. Kydland and Prescott [1991]; Cho and Cooley [1994]; Osuna and Ríos-Rull [2003] and Chang et al. [2014] for business cycle applications, and Rogerson and Wallenius [2009] for an application to labor taxes, following Prescott [2004]).

Our findings concerning the discontinuous adjustment in working hours at the individual level, as well as the empirical success of a partition of jobs between part-time and full-time hours in capturing the dynamics of aggregate hours per worker, are relevant to confront and inform this largely theoretically-motivated construction.[43] Specifically, the fact that hours per worker adjust along the

[40] Several surveys in the U.K. use a definiton of part-time employment based on a cutoff of 30 usual hours.

[41] Given our overall focus on business cycle facts, we emphasize the Frish elasticity, which governs intertemporal labor supply responses. The Hicksian elasticity, on the other hand, is typically relevant for steady-state analyses of labor taxation; see Chetty et al. [2011], and Ljungqvist and Sargent [2011], Keane and Rogerson [2012] for an overview of the debates. In their review of the empirical evidence, Chetty et al. [2011] report that micro-based Frisch elasticities found in the literature are around 0.8 whereas the macro-based estimates are around 2.8.

[42] Intuitively, the non-convexity makes hours allocated to market work adjust discontinuously at the micro level. At the macro level, continuous adjustment in hours is obtained through aggregation. Therefore the macro-behavior of hours does not reflect the micro-level in this class of models.

[43] In fact, the distinction between part-time and full-time work has often been invoked to justify the assumption of

part-time/full-time margin suggests postulating a discontinuity in the mapping between time allocated to market work *conditional on working* and labor services.[44] The data moments produced by our analysis can serve as targets to calibrate functional forms that map time allocated to market work onto labor services, or be used to develop micro-foundations for the non-linear mapping. These may relate to technology constraints (structure of the production function, coordination of employees' schedules of working hours within the firm) and/or to individual preferences (disutility of participating in the workforce, valuation of joint leisure time within the household).[45] We conjecture that a mapping that embeds a discontinuity between part-time and full-time work will consistently generate a disconnect between macro- and micro-based estimates of the elasticity of labor supply. In addition, in light of what has been learned from indivisible labor, we conjecture that this mapping will further magnify the macro-elasticity of labor supply.

A second implication for labor supply models stems from our finding that changes in hours per worker are concentrated on a subgroup of employed workers. Distributional concerns are absent from representative agent models (see the review by Prescott and Wallenius [2012]) and/or need to be assumed away to maintain computational tractability (see e.g. Osuna and Ríos-Rull [2003]). In models that address distributional issues (Chang and Kim [2006], Chang et al. [2014]), this pattern of adjustments in hours is likely to affect macro- and micro-based elasticities of labor supply. The reason for this is that when changes in hours are concentrated at the cross-section rather than uniformly distributed, they are larger for those workers who change hours compared to the average change. This feature can strengthen the precautionary savings motive, and thereby affect the amount of heterogeneity needed to match aggregate moments in wealth, earnings and hours worked. At a normative level, it implies that the welfare implications of fluctuations in working hours are likely understated. We further note that in Chang et al. [2014], in order to match aggregate fluctuations in total hours, both margins of labor adjustment must be included. That is, the behavior of the extensive margin seems to be misrepresented when abstracting from the intensive margin, which exhibits low cyclical variation. In this respect, the behavior of the intensive margin documented in the previous sections poses a real challenge for labor supply models, because these should be simultaneously consistent with: (i) a non-degenerate distribution of hours worked and (ii) changes in average hours per worker driven by a small share of individuals who move across the part-time/full-time margin. Developing a model that replicates those facts is high on our future research agenda.[46]

The models discussed thus far map the labor supply decisions of individuals with well-defined preferences over consumption and leisure onto aggregate fluctuations in hours. Yet, an important message from Section 5 is that firms are likely to play an important role in shaping these fluctuations.

non-linear mapping between time allocated to market work and labor services. In an early discussion, Prescott [1986] writes that commuting effects, set-up costs, etc. "would make full-time workers more than twice as productive as otherwise similar half-time workers" (p.18). In recent investigations, it is common to assume that hours per worker are not perfectly substitutable with employment, in the sense that one full-time worker cannot be replaced by two part-time workers. This could be due to teamwork as in Osuna and Ríos-Rull [2003] or coordination issues as in Rogerson [2011].

[44] Consider for example the mapping used in Prescott et al. [2009], Rogerson and Wallenius [2009] and Chang et al. [2014]: h_t units of time supplied to the market are mapped onto $g(h_t) = \max\left\{0, h_t - \overline{h}\right\}$ of labor services, where $\overline{h} > 0$ is a minimum hour requirement. To capture differences between part-time and full-time employment beyond the difference in hours, one needs to introduce a discontinuity in g when $h_t > \overline{h}$.

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

[46] Incorporating differences between part-time and full-time employment is also relevant for labor supply models with a life-cycle component; see e.g. French [2005] and Low et al. [2010]. French [2005] considers a non-linear mapping between time of market work and labor services within a model that accounts for retirement. Part-time work could be instrumental in explaining the sharp fall in hours worked towards the end of the working life since this is partly driven by "bridge jobs" (Ruhm [1990]), many of which are part-time jobs.

The search-matching model, the modern workhorse for analyzing labor demand, is a natural setup to integrate our findings into a theory of fluctuations at the extensive and intensive margins.[47] There are at least two reasons for this. First, in many ways the adjustment patterns that we document indicate that workers and employers temporarily suspend full-time employment relationships during downturns. As such, the search-matching model is well equipped to understand why forward-looking worker-firm pairs maintain the job-match alive by adjusting labor costs. A similar protocol seems to underlie temporary layoffs and recalls, which have been analyzed through the lens of search-matching models (see Fernández-Blanco [2013] and Fujita and Moscarini [2013]). Second, a new vintage of search-matching models featuring a notion of firm size (see e.g. Elsby and Michaels [2013], Schaal [2012], Kaas and Kircher [2015]) offers a rich structure to understand firms' strategies to mitigate downsizing in bad times.[48] Since search frictions make adjustments along the extensive margin (hiring/firing) more costly, they may prompt adjustments using hours per worker. In light of our results, in a model with large firms, the intensive margin would amount to changing the fraction of workers who are employed part-time within firms. Our empirical findings provide a basis to validate the predictions of those models.

8 Conclusion

In this paper, we have established an empirical connection between fluctuations on the intensive margin (hours per worker) and movements in the share of part-time employment. We elaborated on this relationship to propose a stock-flow representation of the dynamics of the intensive margin. The importance of part-time employment we document could suggest that fluctuations at the intensive margin are driven by transitions in and out of employment by workers who take on and give up part-time jobs. Our analysis leads us to discard this explanation. Instead, by piecing together several facts regarding the behavior of labor market stocks and flows, we showed that fluctuations in hours per worker are consistently explained by the hypothesis of variable labor utilization at the firm level.

Our analysis focused on two decades of labor market activity, but the patterns we document are more pronounced during the expansions and recessions covered by our dataset. We conjecture that large economic shocks provide stronger incentives for firms to adjust their labor inputs. As a result, the role of the part-time employment margin is magnified during turbulent economic times. An equilibrium model with aggregate shocks and firms that adjust both employment and hours per worker would allow to verify this conjecture, and quantify the degree of substitution between different margins of adjustment over the business cycle.

[47] In our view, there is a close parallel between our study and two recent papers. Elsby et al. [2015] show that fluctuations in non-participation are an important driver of the cyclical dynamics of unemployment. Krusell et al. [2015] develop a theoretical model featuring both search frictions and a labor supply decision at the extensive margin, which they use to analyze the empirical patterns of gross worker flows between employment, unemployment and non-participation documented in Elsby et al. [2015].

[48] We note that Cooper et al. [2007] undertake a quantitative analysis along this line: they develop a general equilibrium model with frictions and adjustments in both the number of employees and hours per employee. They set worker bargaining power to zero to pin down wages, whereas an important advance of recent models is that wages are derived without imposing this restriction (see Elsby and Michaels [2013]).

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A Technical Appendix

The first subsection below provides details on how we construct and adjust the time series of labor stocks and flows. The second subsection contains a description of the dynamic variance decomposition.

A.1 Measurements of Stocks and Flows

The main objects of our analysis are labor-market rates (or shares) and transition probabilities. The ingredients necessary to compute them are stocks and gross flows. Each country's dataset is composed of a set of cross sections ordered by time $t = 1, \ldots, T$. Each cross section contains information (labor market status and population weights) on a number of individuals, indexed by $k = 1, \ldots, N_t$. Individuals' labor market states are captured in the data by a set of indicator variables $i_{i,t}$, where the indicator variable takes value of one if the individual is in a particular labor market state and zero otherwise. At any point in time, the stock of individuals in labor market state i is given by the weighted sum $i_t = \sum_{k=1}^{N_t} i_{k,t}\theta_{k,t}$, where $\theta_{k,t}$ is the cross-sectional weight of individual k at time t. To obtain gross labor flows, we sum the number of individuals who are in state j in the current period and who were in state i in the previous one, where the weight of each individual in the sum is given by the longitudinal weight, $\kappa_{k,t}$. Formally, the gross labor flow from state i to state j at time t is given by $ij_t = \sum_{k=1}^{N_t} i_{k,t-1} j_{k,t}\kappa_{k,t}$. After creating time series of labor stocks and gross flows, the measurements of interest are obtained as follows. A labor market rate (or share) is defined as the ratio between two stocks. A transition probability is defined by the ratio of a gross flow over a stock. For instance, the transition probability from unemployment to full-time employment at time t is given by the ratio of the gross flow from unemployment to full-time employment at time t over the stock of unemployed at $t-1$, i.e. $p_t^{UF} = UF_t/U_{t-1}$

After obtaining the raw time series of labor-market stocks and flows, we apply a series of consecutive adjustments described below.

Seasonal Variation

We remove systematic seasonal variation using the Census bureau's X-13ARIMA-SEATS program.[49] This program is a recent merger of the X12-ARIMA program previously used by the U.S. Census bureau and the TRAMO-SEATS program developed by the Bank of Spain. Our preferred method for detecting seasonal variations draws on the latter. Specifically, we estimate the seasonal components of our time series by applying the SEATS program, and when estimation fails we revert to the capabilities of the X12-ARIMA program to obtain an alternative estimate of seasonal components.[50]

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

Margin Error

Based on seasonally adjusted stocks and flows we calculate transition probabilities across labor market states, which we subsequently adjust to account for margin error. That source of error occurs because

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

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

gross flows obtained from longitudinally-matched survey data do not fully account for sample attrition and ignore entry and exit from the working-age population. As a result, the series of labor stocks implied by the gross flows series are in general inconsistent with the labor stocks computed using cross-sectional weights.

Our margin-error adjustment procedure is adapted from Elsby et al. [2015]. To recast the analysis of margin error within the context of Section 4, recall that we describe the dynamics of labor market stocks by means of a five-state Markov chain. We assume that the evolution of the vector of labor stocks at time t, denoted as $\boldsymbol{\ell}_t$, is given by $\boldsymbol{\ell}_t = \boldsymbol{M}_t \boldsymbol{\ell}_{t-1}$. Following Elsby et al. [2015], we rewrite the dynamics of changes in labor stocks as:

$$\Delta \boldsymbol{\ell}_t = \boldsymbol{L}_{t-1} \boldsymbol{p}_t, \tag{8}$$

where $\boldsymbol{p}_t$ is a column vector containing all p_t^{ij} such that $i \neq j$ and $\boldsymbol{L}_{t-1}$ is a conformable matrix of previous period labor stocks (in this equation and in the remainder of the appendix, $\Delta x_t \equiv x_t - x_{t-1}$ for any variable x). While in equation (8) $\boldsymbol{p}_t$ denotes stock-consistent transition probabilities, we only observe the non-adjusted ones, which we denote as $\breve{\boldsymbol{p}}_t$. The adjustment procedure consists in finding those vectors of transitions probabilities $\boldsymbol{p}_t$ that satisfy equation (8) (thereby guaranteeing that changes in stocks implied by the adjusted transition probabilities are consistent with observed changes in labor stocks) and minimize the weighted sum of squares of margin-error adjustments.

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

Time Aggregation Bias

The final adjustment we perform addresses the fact that discrete transition probabilities are subject to time aggregation bias, provided that the underlying worker mobility processes occur at a higher frequency than that of observation. We account for this possibility by adapting the continuous time-correction developed by Shimer [2012] to our setup. Our goal is to recover a transition matrix containing the unbiased transition probabilities p_t^{ij}, along with the elements of its continuous-time analog, the hazard rates h_t^{ij}. Let $\boldsymbol{H}_t$ denote the continuous-time analog of $\boldsymbol{M}_t$. The time aggregation correction explores the fact that, under certain conditions, there is a unique relationship between the eigenvalues of $\boldsymbol{M}_t$ and $\boldsymbol{H}_t$. If the eigenvalues of $\boldsymbol{H}_t$ are all distinct, it can be decomposed into the following expression $\boldsymbol{H}_t = \boldsymbol{V}_t \boldsymbol{C}_t \boldsymbol{V}_t^{-1}$, where $\boldsymbol{C}_t$ is a diagonal matrix of eigenvalues and $\boldsymbol{V}_t$ the matrix of associated eigenvectors. It can be shown that $\boldsymbol{M}_t = \boldsymbol{V}_t \boldsymbol{D}_t \boldsymbol{V}_t^{-1}$, where $\boldsymbol{D}_t$ is a diagonal matrix whose elements are the exponentiated eigenvalues in $\boldsymbol{C}_t$, and that this relationship is unique if the eigenvalues of $\boldsymbol{D}_t$ are, in addition to distinct, real and nonnegative. This equivalence can be used to obtain time series of estimates of the hazard rates $h_t^{i,j}$.

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

A.2 Dynamic Variance Decomposition

Starting from equation:

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

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

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

where $\tilde{\boldsymbol{\ell}}_t = \boldsymbol{\ell}_t / W_t$, $\boldsymbol{q}_t = \begin{bmatrix} p^{XP} & p^{XF} & p^{XU} & p^{XN} \end{bmatrix}_t'$ and $\tilde{\boldsymbol{M}}_t$ is rearranged accordingly.

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

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

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

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

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

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

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

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

The connection between flow hazards h_t^{ij} and steady-state stocks can be seen more clearly by looking at the expression of the continuous-time counterpart of the discrete-time Markov chain (equation (9)):

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

where the elements of matrices $\tilde{\boldsymbol{H}}_t$ and $\boldsymbol{g}_t$ are flow hazards h_t^{ij}.

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

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

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

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

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

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

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

Feeding the estimates of time series of hazard rates h_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 (13), and obtain series of counterfactual changes in labor stocks driven by current and past changes in each flow hazard.

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

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

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

Suppose we want to quantify the contribution of flow hazard h_t^{FP} to the variation in the stock of part-time workers denoted by $\tilde{P}_t$. It follows from equation (17) that:

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

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

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

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

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

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

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

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

This last equation allows us to obtain the coefficients β^{ij} analyzed in Subsection 4.4.

B Supplementary Information

B.1 Data Details

In addition to the adjustments described in Appendix A.1, we make a specific adjustments to the raw data of each country.

Adjustments to U.S. Series of Hours Worked

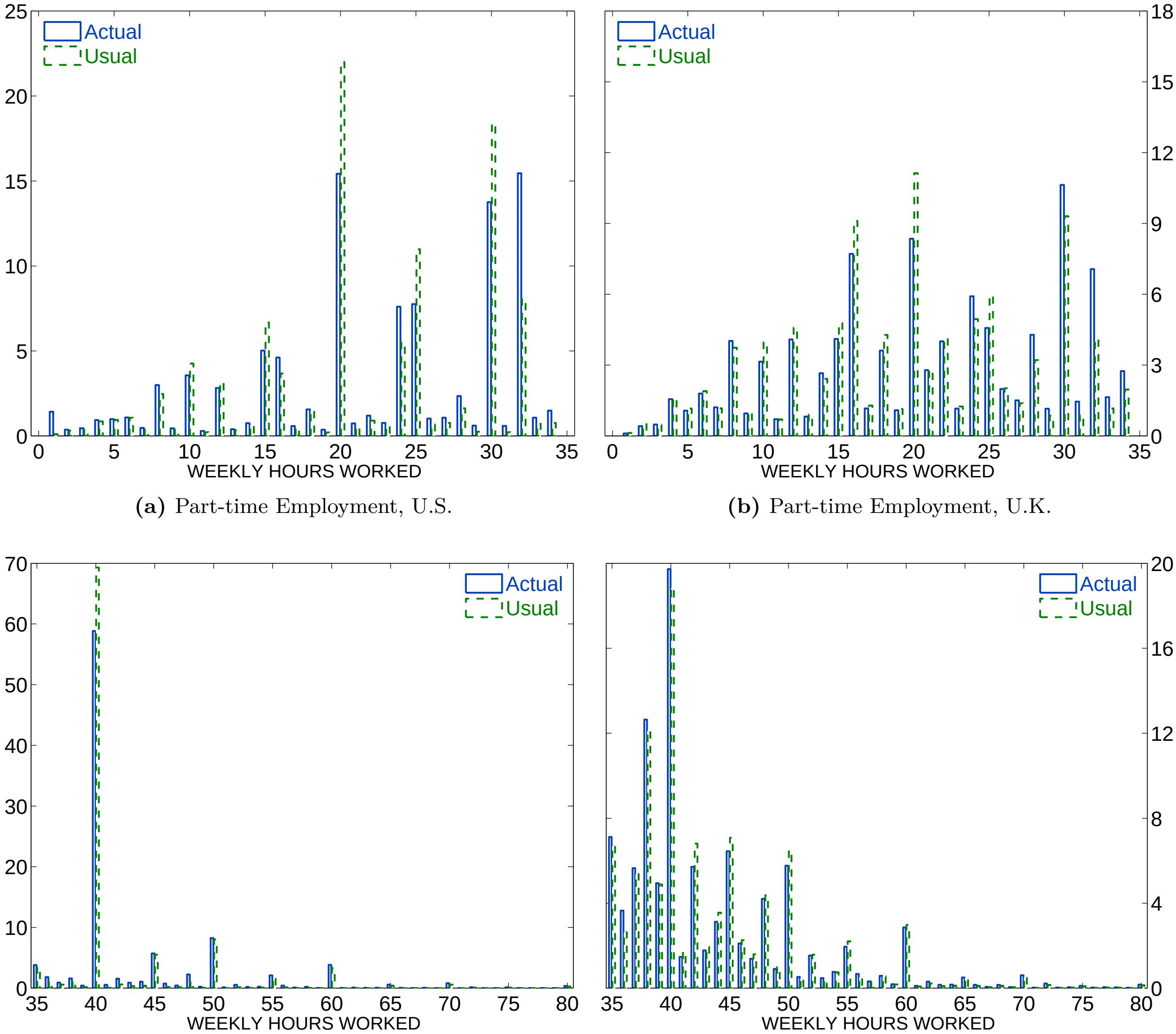
To obtain the series of actual hours per worker for the U.S., we must correct the values of the raw series at three dates: 1996m01, 1998m09, 2009m09 and 2015m09. The reason is that actual hours are measured over a reference week and hence they are subject to substantial variation when regular activities during that week are disrupted. This occurred in January 1996 when a major Winter storm hit parts of the United States. In September 1998, 2009 and 2015, the Labor Day holiday fell on the Monday of the reference week, cutting weekly hours by about one-fifth in those weeks. There is no ideal method to adjust the series of hours for those disruptions. Thus, we simply replace the value computed from the raw data by the average of the series' first two lags and leads.

Adjustments to U.K. Series of Gross Flows and Total Actual Hours per Worker

In constructing the series of worker flows in the U.K. we need to take into account the change in the LFS's periodicity, from seasonal to calendar quarters. The two-quarters micro-data extract corresponding to the last seasonal quarter of 1996 is not available from the U.K. Data Service. To overcome this limitation we compute worker flows in this quarter using the corresponding five-quarter extract. To obtain the unadjusted series of total actual hours we have to deal with outliers at 1997q1 and 2006q2, which greatly affect the estimated seasonal components. We replace these observations by the average between the homologous observations one year ago and one year ahead.

B.2 Descriptive Statistics on the Distributions of Hours Worked

Table 3 reports average weekly hours worked in part-time and full-time jobs. In this subsection we provide a richer characterization of the distributions of hours worked, as well as details on the sources of differences between usual and actual hours worked. Figure B1 shows histograms of weekly hours worked in part-time and full-time employment for the two countries.[51] The plots on the left panel are for the U.S. and those on the right panel for the U.K. The distributions of usual and actual hours are denoted respectively by dashed and solid lines. Examination of the fours plots indicates that the distributions of usual and actual hours exhibit some differences, which are more easily visible in the U.S. plots. We will have more to say on those differences momentarily. For the moment, let us comment on the distributions of usual hours for each country.



(a) Part-time Employment, U.S.

(b) Part-time Employment, U.K.

(c) Full-time Employment, U.S.

(d) Full-time Employment, U.K.

Figure B1: Distribution of Weekly Hours Worked

Notes: Sample: private-firm salaried workers, excluding multiple jobholders and individuals reporting zero usual or actual weekly hours. Based on monthly CPS files from 2004m01 to 2006m12 for the U.S. and quarterly cross sections of the LFS from 2004q1 to 2006q4 for the U.K.

The distribution of usual weekly hours worked in the U.S. is much more concentrated than that of the U.K. There are clear mass points in the interval between 20 and 50 hours, which is where most of the probability mass is concentrated. In full-time employment, the most common schedule seems to be

[51]We exclude multiple jobholders and employed individuals reporting zero usual/actual weekly hours.

five days of 8 hours each reflected by the mass point at 40 weekly hours. In part-time employment, the mass points are observed at intervals divisible by five, and also at 24 and 32 hours, both of which are divisible by eight. A workweek of 20 hours, for instance, could reflect five days of 4 hours each while a workweek of 32 hours could indicate four days of 8 hours each. By comparison, the distribution of usual hours in the U.K. is more evenly distributed within the same 20-50 hours interval. There are also mass points, but they are overall lower. The main difference between the distribution of usual hours in the two countries comes from the mass point at 40 weekly hours found in the CPS.

Table B1: Statistics on Reported Usual and Actual Weekly Hours

	Fraction of Workers Reporting Different Hours (%)	
	Usual > Actual	Actual > Usual
U.S.	12.2	10.9
U.K.	27.4	11.8
	Average : Median Difference Between Reported Hours	
	Usual > Actual	Actual > Usual
U.S.	10.5 : 8	7.7 : 5
U.K.	8.3 : 6	6.3 : 5

Notes: Sample: private-firm salaried workers, excluding multiple jobholders and individuals reporting zero usual or actual weekly hours. Based on monthly CPS files from 2004m01 to 2006m12 for the U.S. and quarterly cross sections of the LFS from 2004q1 to 2006q4 for the U.K.

Table B1 reports summary statistics on the differences in reported hours (usual vs. actual) at the individual level. In both countries the fraction of workers reporting higher actual vs. usual hours is around 11%. The fraction reporting higher usual hours is more than twice as high in the U.K. compared to the U.S. (27.4 vs 12.2% respectively). Adding up these numbers, we see that between a quarter (U.S.) and a third (U.K.) of individuals report different usual and actual hours of work. The bottom panel reports the average and median difference in hours for those individuals. We note that, conditional on reporting different usual and actual hours, the resulting difference can be large: on average, it ranges between 8.3 (6.3) hours and 10.5 (7.7) hours for the U.S. (U.K.). When usual hours are greater than actual hours, that difference is on average larger than when the opposite occurs.

B.3 Descriptive Statistics on Part-time Work

Tables B2 and B3 complement Subsection 6.1 in the text where we discussed the composition of part-time employment in the U.S. and the U.K. As one would expect, the composition of employment in terms of gender and age is very similar across the two labor markets (cf. columns (1) of panels A. to B.). That similarity extends to the composition of part-time employment, which is concentrated in women and younger individuals (aged 16 to 24) (cf. columns (2) of panels A. to B.). The younger take a large share of part-time jobs in the U.S., whereas women account for a greater share of part-time work in the U.K. The flipside of these patterns are sharp differences in the extent of part-time work across different groups of workers (cf. columns (3) of panels A. to B.). Although part-time is a pervasive form of employment (affecting all workers), women and the younger are disproportionately affected.

Table B2: Part-time Employment, Descriptive Statistics for the United States

	% of population		Part-time
	employed	part-time	share (ω^P)
	(1)	(2)	(3)
All	–	–	16.9
A. Gender			
Men	56.0	33.5	10.0
Women	44.0	66.5	25.2
B. Age (in years)			
16 to 24	18.1	45.2	42.2
25 to 34	24.4	16.6	11.5
35 to 44	24.9	15.4	10.5
45 to 54	21.7	12.9	10.1
55 to 64	10.9	9.9	15.4
C. Education			
Low	14.1	23.6	28.3
Middle	32.5	27.1	14.1
High	24.4	30.9	21.4
Very high	28.9	18.4	10.7
D. Occupation (top 5 by employment)			
Executive, Administrative and Managerial Occupations	8.8	2.3	4.4
Sales representatives, Commodities	8.6	17.9	35.5
Food Preparation and Services Occupations	6.7	17.3	43.9
Construction Trades (except Supervisors)	4.7	1.6	5.7
Motor Vehicle Operators	4.2	2.3	9.2
E. Industry (top 5 by employment)			
Retail Trade	22.7	44.0	32.8
Professional and Related Services	16.5	20.0	20.5
Manufacturing, Nondurable Goods	10.3	1.9	3.1
Construction	8.3	3.4	7.0
Finance, Insurance and Real Estate	8.2	4.8	9.8

Notes: Sample: private sector firm employees, based on monthly CPS files from 2004m01 to 2006m12. Panel C. Education: Low is “Less than high-school”, Middle is “High-school graduates”, High is “Some college” and Very high is “College or higher education”. Panels D./E. Occupation and Industry: Two-digit categories of the 2000 Census classification schemes. Statistics in the five occupations/industries with the highest share of private sector employment.

Table B3: Part-time Employment, Descriptive Statistics for the United Kingdom

	% of population employed	% of population part-time	Part-time share (ω^p)
	(1)	(2)	(3)
All	–	–	25.3
A. Gender			
Men	57.1	22.8	10.1
Women	42.9	77.2	45.5
B. Age (in years)			
16 to 24	19.3	28.9	37.9
25 to 34	24.1	17.2	18.1
35 to 44	25.1	22.7	22.9
45 to 54	19.3	16.4	21.6
55 to 64	12.2	14.8	30.8
C. Education			
Low	23.7	27.8	29.8
Middle	51.5	57.1	28.1
High	24.8	15.1	15.4
D. Occupation (top 5 by employment)			
Sales Assistants and Retail Cashiers	8.9	24.1	68.4
Functional Managers	6.0	1.4	5.9
Elementary Personal Service Occupations	3.9	10.1	70.3
Administrative Occupations in Finance	3.8	5.1	34.5
Transport Drivers and Operatives	3.5	1.4	9.7
E. Industry (top 5 by employment)			
Wholesale, Retail and Motor Trade	21.4	35.1	41.6
Manufacturing	19.6	6.8	8.7
Real Estate, Renting and Business Activities	13.6	10.1	18.8
Transport, Storage and Communication	8.4	4.3	12.9
Construction	7.4	2.5	8.6

Notes: Sample: private sector employees, based on quarterly cross sections of the LFS from 2004q1 to 2006q4. Panel C. Education: Based on Highest Qualification categories. Low is "Primary education (below GCSE)", Middle is "Secondary Education (A-level, GCSE or equivalent)" and High is "Higher Education or more". Panel D. Occupation: Two-digit occupation groups of the Standard Occupational Classification of 2001. Panel E. Industry: 19 sections of the Standard Industry Classification of 1992. Panels D./E.: Statistics in the five occupations/industries with the highest share of private sector employment.

Consistent with the differences cited above, there is greater heterogeneity in part-time employment shares by gender in the U.K. and by age in the U.S. For sake of space, we do not report time series by gender. We observe that the cyclical behavior of part-time employment is similar among men and women in the U.S., whereas in the U.K. part-time employment is more cyclical among women. For men in the U.K., part-time employment exhibits an upward trend over the whole sample period.

Since the education categories are not harmonized between the two surveys, it is perhaps unwise to make comparisons of employment and part-time employment across the two countries. One common feature that seems worth pointing out is the lower intensity of part-time employment among the more highly educated. To some extent the same concerns affect comparisons of the occupation and industry composition of employment and part-time work. At the risk of some imprecision, some common patterns emerge between the two countries. Part-time work is similarly composed of (mainly) sales and services occupations and retail trade. In both countries, the part-time employment share displays considerable variation among the main occupations and industries of employment. This is especially striking for occupations: part-time employment shares in the main occupations go from 4.4 to 43.9%, in the U.S., and from 5.9 to 70.3%, in the U.K. But the figures in those columns also highlight that part-time work is widespread, covering a nonnegligible share of employment in very distinct industries and occupations in both countries.

B.4 Summary of Baseline Results

Table B4 reports the main results of our analysis using a structure similar to the tables used to assess the validity of hypotheses 2 and 3 in Section 6.

Table B4: Summary of the Baseline Results

	United States	**United Kingdom**
γ^{share} – Sample period	56.8	49.5
$\Delta h_{t_0,t_1}$: $\Delta^{\text{share}}_{t_0,t_1}$ – Great Recession	-0.75 : -0.62	-0.83 : -0.68
$\Delta h_{t_0,t_1}$: $\Delta^{\text{share}}_{t_0,t_1}$ – 2 years after Great Recession	-0.63 : -0.61	-0.53 : -0.52
Peak to trough ω^{P} – Great Recession	3.05	2.91
β^{PF} : β^{FP} : $\beta^{PF} + \beta^{FP}$	34.5 : 39.6 : 74.1	39.7 : 31.3 : 71.0
Variance Contribution of Transitions at the Same Employer: p^{PF}: p^{FP}	92.2 : 95.2	89.2 : 96.8

Notes: Sample for the part-time employment share and hours: private-firm salaried workers. Changes in hours (second and third row) are based on seasonally adjusted series of usual hours per worker and the part-time employment share at a quarterly frequency. For the U.S., the series are quarterly averages of the monthly series. For the U.K. where the Great Recession involved a double-dip, the end of recession date is the end of the second recession (2012q1). The variance contributions (last two rows) are based on series of stocks and flows corrected for seasonal variation, margin error and time aggregation bias, expressed at a monthly frequency.