THE WELFARE EFFECTS OF INVOLUNTARY PART-TIME WORK

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Abstract

Employed individuals in the U.S. are increasingly more likely to work part-time involuntarily than to be unemployed. Spells of involuntary part-time work are different from unemployment spells: a full-time worker who takes on a part-time job suffers an earnings loss while remaining employed, and is unlikely to receive income compensation from publicly provided insurance programs. We analyze these differences through the lens of an incomplete-market, job-search model featuring unemployment risk alongside an additional risk of involuntary part-time employment. A calibration of the model consistent with U.S. institutions and labour market dynamics shows that involuntary part-time work generates lower welfare losses relative to unemployment. This finding relies critically on the much higher probability to return to full-time employment from part-time work. We interpret it as a premium in access to full-time work faced by involuntary part-time workers, and use our model to tabulate its value in consumption-equivalent units.

Keywords: Involuntary part-time work; Unemployment; Welfare

JEL codes: E21; E32; J21.

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1 Introduction

Labour market participants are subject to the risks of unemployment and involuntary part-time work.[1] While the welfare costs of unemployment, and the benefits of introducing public insurance programs against it, have been the subject of a vast literature, little is known about how involuntary part-time employment affects workers' welfare. The evolution of the United States' (U.S.) labour market over the past decade has generated great interest in this topic among policymakers and scholars. In her 2014 address to the annual Jackson Hole Conference, Federal Reserve Chair Janet Yellen listed involuntary part-time work among the top labour market "surprises" worth worrying about (Yellen [2014]). Research by economists at the Federal Reserve suggests that the unusually elevated levels of involuntary part-time employment observed over the past years are partly explained by structural changes in the U.S. labour market (see Valletta and Bengali [2013]; Canon et al. [2014]; Cajner et al. [2014]; Valletta et al. [2015]). Recently, Borowczyk-Martins and Lalé [2016b] document that the probability to work part-time involuntarily faced by employed individuals has increased during the past four decades, in absolute terms and even more so relative to the probability of becoming unemployed. In face of these facts, a natural question to ask is: how bad are spells of involuntary part-time work compared to unemployment spells?

In this paper we provide an answer to that question by means of a quantitative model, which we specify and calibrate to reflect the main features of the U.S. labour market and of existing public insurance programs against those risks. We start by making a stylized characterization of involuntary part-time work based on labour force survey data. We find, on the one hand, that involuntary part-time work and unemployment affect labour market participants with similar characteristics (full-time workers with strong labour force attachment) and by similar channels (both entail a loss of income relative to full-time employment earnings). On the other hand, in addition to differences in working hours, a key difference between them is that involuntary part-time workers are quickly brought back to full-time employment while staying in the same job, thereby avoiding the uncertainty and costs of job search. To interpret those differences, we develop a model describing the decision problem of a worker with preferences over consumption and leisure, who exerts search effort to generate job offers, and saves in the presence of incomplete markets and borrowing constraints. This allows us to focus on the key channels by which involuntary part-time work and unemployment affect workers' welfare: (i) exposure to different job destruction and reallocation risks, (ii) the expected income loss taking into account the availability (or not) of public income insurance against it, and (iii) the ability to allocate time between work, search and leisure.

We anchor the model to standard preferences and parameters capturing the dynamics and policies of the U.S. labour market. To calibrate the income loss suffered by involuntary part-time workers, we produce new empirical evidence on how the features of the main U.S. income insurance programs affect individuals in involuntary part-time work. We find that the earnings losses experienced by full-time workers who become employed part-time involuntarily are seldom covered by partial Unemployment Insurance and Short-Time Compensation schemes, and that other income insurance programs, such as the Earned Income Tax Credit, do not cover a large fraction of involuntary part-time

[1] In U.S. statistics individuals are in involuntary part-time employment if they work part-time (viz. less than 35 weekly hours) and either cannot find a full-time job or face slack demand conditions in their current job. This labour market state is also referred to as *part-time for economic reasons.*

workers.[2] To calibrate the parameters that determine the costs of job search, we use the optimality condition that relates them to the job-finding rate. We validate our calibration in two ways. First, the model captures the notion of part-time employment and unemployment as *involuntary* labour market states. Second, accumulated assets are depleted during spells of involuntary part-time work and unemployment, and the predicted consumption losses experienced during unemployment spells are consistent with existing empirical evidence.

In the absence of public income insurance, the income flow of involuntary part-time workers is similar to that of the uninsured unemployed. Since spells of involuntary part-time work are shorter, a back-of-the-envelope calculation suggests the worker is worse off in unemployment. The key question, however, is how much worse off she is, and what accounts for the bulk of that difference. We quantify these short-run welfare losses by simulating shocks that force full-time workers into either involuntary part-time work or unemployment. We find that those workers would need to be compensated in 8% (resp. 23%) of their consumption during the first quarter of a spell of involuntary part-time employment to be equally well-off in insured (resp. uninsured) unemployment. We also use our model to decompose this difference into three components: differences in labour earnings, a differential access to full-time work (which occurs only through search effort when unemployed) and the constraint in hours allocated to market activities (which is only active in involuntary part-time work). We show that the second component, the high transition rate at which part-time workers return to full-time employment, accounts for a large share of the welfare gap between involuntary part-time work and unemployment. We refer to this differential as the premium in access to full-time work faced by involuntary part-time workers, and estimate that it is worth 6 to 9% of consumption during the first quarter of a part-time employment spell.

Like unemployment, the risk of involuntary part-time work is strongly cyclical: in recessions, workers face a much higher probability to move from full-time to involuntary part-time work and a lower probability to do the reverse transition. This observation motivates us to calculate the welfare losses due to cyclical fluctuations in the risk of involuntary part-time work. We follow the approach first proposed by Lucas [1987], and that is commonly employed in the heterogeneous-agent incomplete-market literature to quantify the welfare costs of income fluctuations arising from the cyclicality of unemployment risk. After introducing business-cycle shocks in our framework, we find that cyclical fluctuations in involuntary part-time risk generate welfare losses around one-tenth of a percentage point in consumption equivalents. Furthermore, these losses amount to one-sixth of a percentage point when we inform our model with parameters reflecting the aftermath of the Great Recession, when involuntary part-time work was higher. Compared to the costs of unemployment fluctuations found in the literature, these numbers are much smaller, which dovetails well with the findings obtained in our baseline framework.

As highlighted in the opening paragraph, involuntary part-time work is becoming an important risk in the U.S. labour market when measured in terms of transition probabilities. Our main contribution is to go beyond this descriptive evidence by combining different data sources (on labour market dynamics, income differences and U.S. labour market institutions) and a dynamic, optimizing framework to assess the implications of this risk for consumption, leisure and welfare. Consistent

[2] We construct a dataset containing estimates of eligibility for the Earned Income Tax Credit, which allow to compute the potential coverage of the policy (Subsection 2.2). This dataset and an instruction file are provided on our webpages.

with the data sources that inform our characterization of involuntary part-time work (worker-level data covering individuals over short labour market spells), we focus on its short-run welfare implications and abstract from its broader macroeconomic consequences. We see our study as groundwork for a general-equilibrium analysis of involuntary part-time employment under incomplete insurance markets and frictions in the labour market.

The remainder of the paper unfolds as follows. In Section 2 we offer a succinct characterization of involuntary part-time employment and provide evidence on the degree of public insurance provided to individuals in this labour market state. Section 3 presents the quantitative framework. Section 4 describes how we parametrize it in line with the relevant features of the U.S. labour market. The numerical experiments used to assess the welfare effects of involuntary part-time work are performed in Section 5. Section 6 discusses our main findings and concludes. A host of additional information is provided in an online appendix.

2 Facts

In this section we present some facts on involuntary part-time employment in the U.S. labour market. The aim is to provide a stylized characterization of this labour market risk from the worker's perspective and to motivate the modelling approach developed in Section 3. We first review what we call "labour market facts". Then, we analyze the public income insurance programs in the U.S. that potentially cover involuntary part-time workers.

2.1 Labour Market Facts

We organize the description of the labour market facts around three main assertions and report evidence to substantiate each of its predicates.

1. Individuals who are commonly affected by involuntary part-time work are very alike the unemployed:
   - 1.1 they have similar demographic characteristics,
   - 1.2 and their short-run labour market histories reveal a close interaction with full-time employment.
2. Qualitatively, the risk of involuntary part-time work shares essential features with unemployment:
   - 2.1 it involves a constraint in desired labour supply,
   - 2.2 it is transitory,
   - 2.3 and it entails a substantial loss of income relative to full-time employment.
3. Quantitatively, the risks of involuntary part-time work and unemployment differ along the following dimensions:

3.1 involuntary part-time workers are actually working,

3.2 they face a high probability to return to full-time employment at their current employer,

3.3 but their income losses relative to full-time earnings are seldom compensated by a public insurance program.

We refer the reader to the online appendix for the full details of the calculations mentioned below. Unless otherwise stated, these are based on data from the monthly files of the Current Population Survey (CPS) from 1994 onwards.

Fact 1.1 In the CPS, one can distinguish between involuntary and voluntary forms of part-time employment.[3] Involuntary part-time workers are strikingly dissimilar to voluntary part-time workers across different dimensions of observed worker heterogeneity (gender, age, education and marital status). On the other hand, they are similar to the unemployed along those categories, especially so when we compare them to the unemployed with higher labour force attachment.[4]

Fact 1.2 The short-run labour market histories of unemployed and involuntary part-time workers reveal a strong connection with full-time employment. Full-time employment is the most relevant state of origin and destination for involuntary part-time workers: on average, 29.6% of them were employed full-time in the previous month, and a similar fraction (28.9%) will enter a full-time job next month. Like involuntary part-timers, the unemployed are more likely to have been or become full-time employed respectively in the previous and following month (18.3% and 15.8%).

Fact 2.1 The Bureau of Labor Statistics classifies part-time employment (less than 35 weekly hours; cf. footnote 1) as involuntary if the worker either cannot find a full-time job or faces slack business-related conditions in her current job. Since 1994, the CPS requires those individuals to report in addition that they want and are available for full-time work. One way to interpret this definition is that it captures a class of part-time workers that are partially unemployed; like (fully) unemployed workers, they are unable to work at their desired level of employment.

Fact 2.2 The transitory nature of both involuntary part-time work and unemployment is evidenced in the elevated probability experienced by workers in those two states to leave to a different labour market state. Using a stock-flow accounting framework, we estimate the average probability to leave involuntary part-time employment/unemployment at respectively 56.4% and 33.1% over a time horizon of one month.

Fact 2.3 On average, moving from full-time to involuntary part-time employment entails a labour income loss due to a reduction in paid hours by about 50%. In addition, after controlling for differences in job and workers characteristics, involuntary part-time workers earn, on average, a *hourly* wage that is between 11% (women) and 20% (men) lower than that of full-time workers.

Fact 3.1 This is the flip side of Fact 2.1: involuntary part-time workers are under-employed workers, but they are not unemployed. In the CPS Outgoing Rotation Group samples, we find that

[3] In the CPS interviews, the reasons for voluntary part-time employment include inter alia “Child care problems”, “Family/personal obligations”, “Health/medical limitations”, etc.

[4] We identify those workers by distinguishing the unemployed already in the workforce from new entrants and re-entrants, who display weaker attachment to the labour market.

workers in involuntary part-time employment work on average 24 hours, which compares to 43.7 hours for full-time workers.

Fact 3.2 Since 1994 the CPS allows one to identify employment transitions that occur across different employers. Using this information we find that the vast majority (90.4%) of transitions between involuntary part-time work and full-time employment occur at the same employer. The converse transitions also occur overwhelming at the same employer.

Fact 3.3 Subsection 2.2 is devoted specifically to establishing this fact.

2.2 U.S. Institutions and Policies

In this section we argue that involuntary part-time workers are covered by public income insurance in a restrictive set of circumstances, and in practice benefit little from the programs for which they are potentially eligible. This assessment follows from analyzing eligibility rules and data on take-up rates and amounts paid to involuntary part-time workers under Partial Unemployment Insurance, Short-time Compensation Schemes and the Earned Income Tax Credit.[5]

Partial Unemployment Insurance. All U.S. states offer some form of partial unemployment insurance (UI) benefits. This program is part of the state's UI system and aims to provide income insurance to individuals who are either part-time employed but looking for a full-time job, or individuals in short-time work. The basic eligibility requirements are the same as those for (full-time) UI: workers must search and be available for full-time work, have accumulated enough employment in the past and be unemployed (partially or fully) at the time of the claim due to no fault of their own. Additional requirements vary by state. In most states, eligible individuals must work less than a full-time workweek and earn below their weekly benefit amount (WBA) plus some disregard amount. The WBA is the amount of weekly unemployment benefits the individual is entitled to if she is fully unemployed. The partially unemployed worker's benefits are calculated differently in each state, but usually correspond to the difference between the WBA and the labour income earned in excess of the disregard level.[6]

While the description above may suggest that partial UI is an effective insurance mechanism for individuals who undergo spells of involuntary part-time work, in practice this does not seem to be the case. To illustrate this, we estimate the UI amounts (in dollars) paid monthly per unemployed and involuntary part-time worker (reported in Figure 1). The dashed line denotes paid per unemployed and it averages 315 dollars over the sample period. The solid line depicts the UI amount paid per involuntary part-time worker, which is much lower: the average over the period is 18 dollars. It is also clear that its cyclical component is considerably less salient compared to the dashed line. These observations suggest that, albeit indirectly, the coverage provided by partial UI is limited (both in normal times and during economic downturns) and that involuntary part-time workers receive little income from this program.

Short-Time Compensation schemes. A number of states in the U.S. run short-time compensation (STC) schemes (also known as work-sharing plans). Under this program workers whose

[5] Our analysis spans the period from January 1986 onwards. We were unable to find any information about claims for short-time compensation schemes before 1986. Additional details are provided in Section A.3 of the online appendix.

[6] See US-DOL [2015a] for further details.

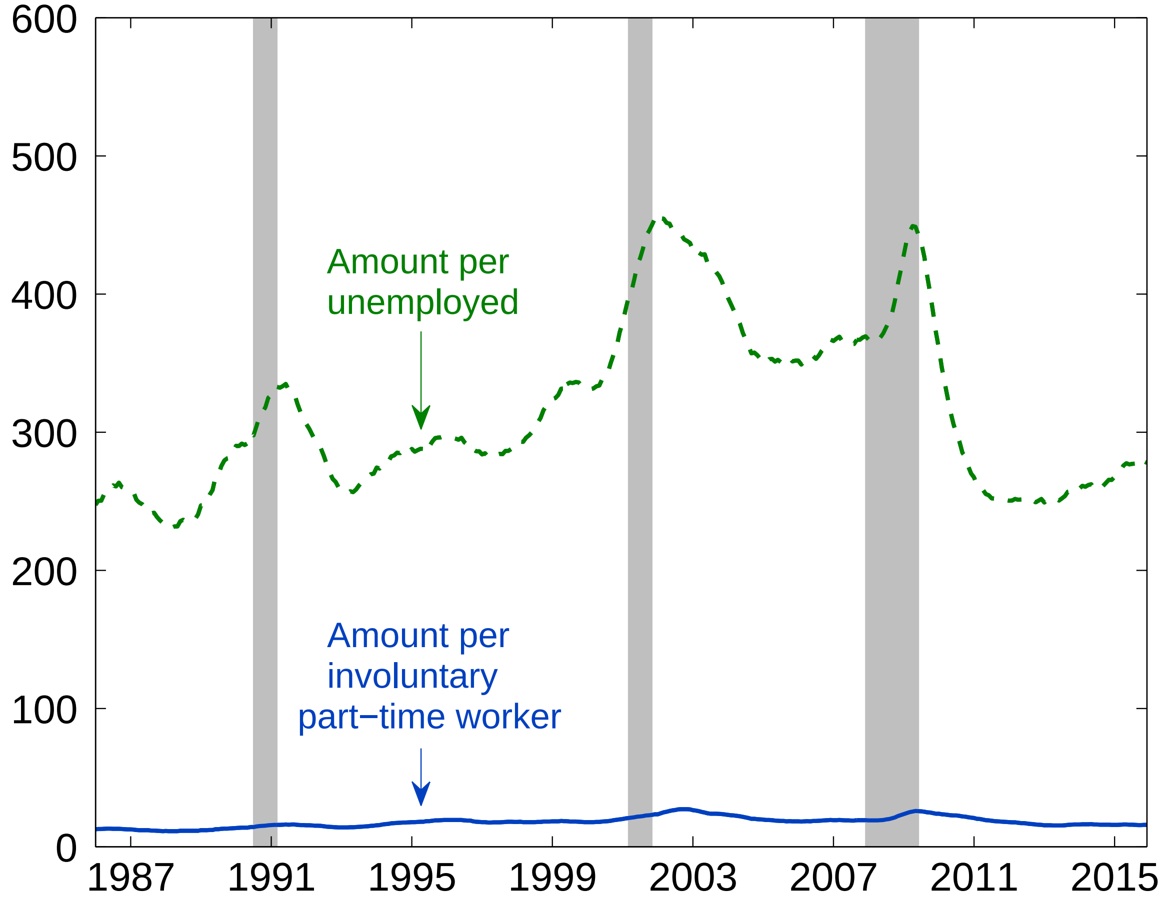

Figure 1. UI amounts paid per involuntary part-time worker and per unemployed

Notes: Authors' calculations based on data on amounts paid in UI (in constant 2009 U.S. dollars) from the Department of Labor Employment and Training Administration, and CPS data. Seasonally adjusted and MA-filtered data. Gray-shaded areas indicate NBER recession periods.

employers obtain approval from the UI agency to implement a work-sharing plan are entitled to UI benefits. The amount of benefits is prorated based on the reduction in hours. Thus, while partial UI formulas are based on workers' earnings, STC rules are based on hours worked. STC schemes may be used for workers whose hours have been reduced by between 10% and a maximum determined by state law, which has to be below 60%. The maximum duration for benefit reception is between six and twelve months, and they have a similar effect on employers' tax rates as unemployment benefits paid to laid-off workers.[7]

In practice, the scope of income insurance provided by STC schemes in the U.S. context is quite limited. We ground this statement on the ratio of the number of STC claims to the number of involuntary part-time workers, which we estimate for the 17 states that have run STC programs. As shown in Figure 2, this ratio is remarkably low, at 0.01 on average over the sample period. To provide a basis for comparison, we compute the ratio of UI claims to the number of unemployed individuals in states with STC schemes. Table 1 shows that, even in states with low take-up rates, the ratio of UI claims to the number of unemployed individuals is much higher than the ratio in Figure 2. In fact,

[7] According to Abraham and Houseman [2014], some states impose surcharges on employers, and even prohibit employers with negative balances in their unemployment insurance accounts from implementing a short-time compensation plan. See US-DOL [2015b] for complementary information.

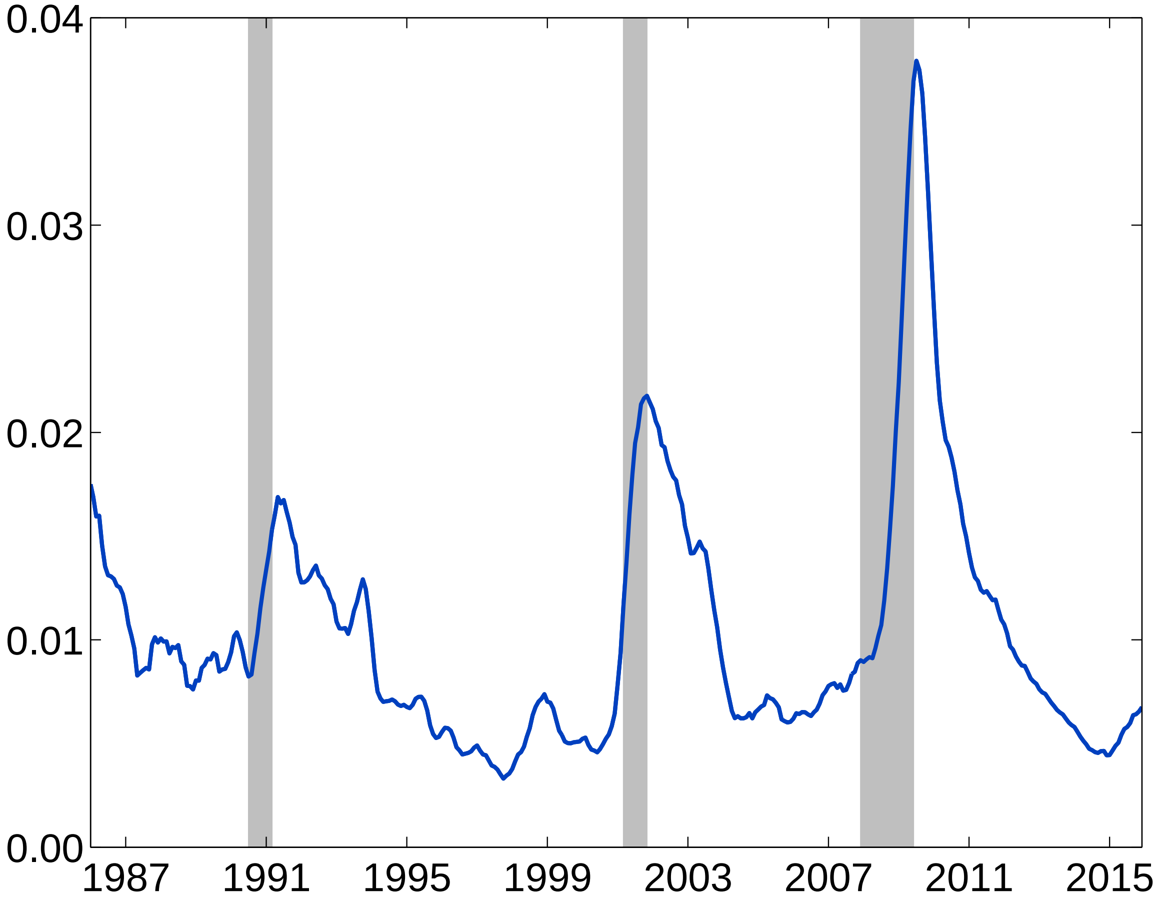

Figure 2. Fraction of STC claims among involuntary part-time workers in selected states

Notes: Authors' calculations based on monthly STC claim data from the Department of Labor Employment and Training Administration, and CPS data. Seasonally adjusted and MA-filtered data. Gray-shaded areas indicate NBER recession periods.

the average ratio of UI claims to the number of unemployed workers in those 17 states is 0.34. It is worth noting that those 17 states account for 44% of the working-age population on average over the sample period.

Table 1. Ratio of UI claims to unemployed

Arizona	0.23	Kansas	0.32	Oregon	0.42
Arkansas	0.39	Maryland	0.32	Rhode Island	0.48
California	0.38	Massachusetts	0.50	Texas	0.23
Connecticut	0.48	Minnesota	0.38	Vermont	0.49
Florida	0.23	Missouri	0.33	Washington	0.40
Iowa	0.37	New York	0.39		

The Earned Income Tax Credit. The Earned Income Tax Credit (EITC) is an in-work benefit program that provides income support to individuals based on their income and their family's structure and income (see Nichols and Rothstein [2016] and references therein). Eligibility is determined by the presence of qualifying children in the household, positive labour earnings below a certain threshold (for example, 50,000 dollars per year for a family with two children) and a maximum threshold of non-labour income (which is lower than the labour income threshold). For future reference, it is also

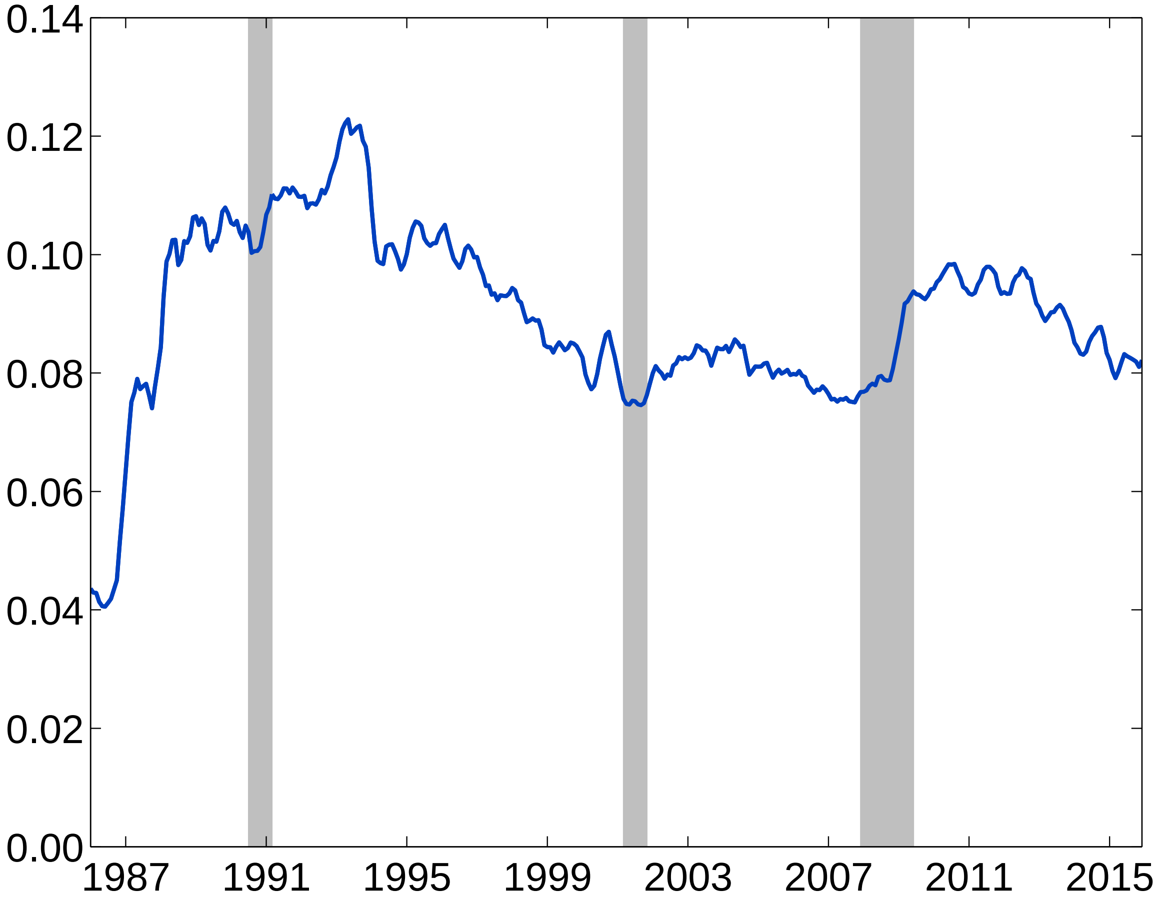

Figure 3. Fraction of involuntary part-time workers potentially eligible for EITC

Notes: Authors' calculations based on EITC parameters from the Congressional Research Service and monthly data from the CPS combined with data from the March CPS. Seasonally adjusted and MA-filtered data. Gray-shaded areas indicate NBER recession periods.

useful to note that single parents with no children are unlikely to receive any or very small amounts, and families without children receive much lower benefits (Nichols and Rothstein [2016]).

After constructing estimates of the eligible for EITC based on family structure and income (reported in Figure 3), we find that the fraction of involuntary part-time workers who are potentially eligible is only 0.08 on average. Due to differences in demographic characteristics, the corresponding number for the whole labour force (not shown) is slightly higher at 0.11. Both figures are consistent with the actual coverage of the EITC. As is the case with partial UI and STC schemes, it is thus unlikely that involuntary part-time workers benefit from partial income insurance by the EITC.

3 Model

We develop a framework that has two pillars: an incomplete-market model and a job-search model. The former is commonly used to assess the implications of imperfect insurance against the risk of unemployment (see e.g. Hansen and İmrohoroğlu [1992] and Abdulkadiroğlu et al. [2002]).[8] The addition of job search to that model is similar to the one proposed by Acemoglu and Shimer [2000].

[8]Unlike the cited articles, which analyze the optimal provision of unemployment benefits, we abstract from moral hazard related to workers' quit decisions.

In the resulting framework, we are only interested in the worker's decision problem. Hence, we keep all prices (interest rates, wages, etc.) exogenous and fixed. In addition to facing incomplete insurance markets, workers cannot receive insurance through, e.g., efficient wage contracts.

3.1 Environment

Preferences. The worker is risk-averse and infinitely-lived. Her momentary utility function depends on consumption and leisure. She maximizes:

$$\mathbb{E}_0 \sum_{t=0}^{+\infty} \beta^t \frac{\left(c_t \left(\bar{h} - h_t\right)^{\eta}\right)^{1-\sigma} - 1}{1-\sigma}. \tag{1}$$

$\mathbb{E}_0$ denotes the expectation operator conditional on information at time 0, β the subjective discount factor, σ the coefficient of relative risk aversion, η the relative value of leisure and $\bar{h}$ the time endowment. The worker chooses consumption c_t and the amount of time allocated to market activities h_t. Therefore leisure time is the remainder $\bar{h} - h_t$.

Hours, wages and search. The worker is either employed or unemployed. There are two types of jobs: part-time (P) and full-time (F), both of which consist of an exogenous bundle of wages and hours of work (w_i, h_i), with $i \in \{P, F\}$ indicating the job type. Notice that we do not assume that part-time work is involuntary. Rather, the involuntary nature of part-time work will be implied by our choice of parameter values.[9]

The worker can search both on and off the job. h hours of search effort generate a work opportunity with probability λh. She selects hours of search effort in the interval $\left[0, \bar{h}\right]$, when unemployed, and in the interval $\left[0, \bar{h} - h_i\right]$, when employed, with $i \in \{P, F\}$.[10] A fraction ϕ_P of work opportunities are part-time jobs, and the worker can decide to turn down any job offer.

Exogenous reallocation. In employment (F, P), the worker is subject to exogenous job destruction and reallocation shocks governed by the following transition matrix:

$$\Pi = \begin{bmatrix} \pi_{F,F} & \pi_{F,P} & \pi_{F,U} \\ \pi_{P,F} & \pi_{P,P} & \pi_{P,U} \end{bmatrix}. \tag{2}$$

The probabilities $\pi_{i,j}$ give a lower bound on the transitions between states i and j, since in addition there are endogenous transitions across employment states coming from search and quit decisions.[11]

Insurance. There are two sources of insurance against idiosyncratic labour market risks. First, there is private insurance through a risk-free asset a which the worker can save but cannot borrow.

[9] This is why we denote this state by the letter P instead of I.

[10] We allow the worker to search both during part-time and full-time work, although in the parametrized version of the model the returns to search in full-time employment are offset by the costs of so doing. Thus, the assumption of on-the-job search in full-time employment is innocuous, but the alternative (ruling out job search during full-time work) would generate an unnecessary difference between part-time and full-time employment.

[11] In particular, notice that the matrix Π in equation (2) is *not* the Markov transition matrix describing the trajectory of the worker across labour market states and asset holdings.

The maximization of (1) is thus subject to a sequence of budget constraints:

$$c_t + a_{t+1} \leq (1+r)\,a_t + x_t^d, \quad a_t \geq 0, \tag{3}$$

with a denoting the asset, x^d disposable earnings and r the interest rate, which is exogenous.[12]

Second, there is public insurance against the risk of becoming unemployed: when the job is destroyed by the shocks $\pi_{P,U}$ or $\pi_{F,U}$, the worker can collect unemployment benefits θ_1. These benefits expire with probability ϕ_U and they can be regained only through a spell of employment. If benefits are exhausted, she receives social assistance benefits $\theta_0 < \theta_1$. Finally, the worker cannot quit to receive unemployment benefits. In particular, when a full-time position is transformed into a part-time one (which occurs with probability $\pi_{F,P}$), the worker can only choose between working part-time or moving to social assistance.[13]

3.2 Recursive Formulation

The decision problem of the worker can be formulated in recursive form. Hereafter, W_i denotes the value of being employed in a job $i \in \{P, F\}$; U_1 is the value of being unemployed and collecting unemployment benefits; U_0 is the value of being unemployed and collecting social assistance benefits.

Beginning with the value functions in employment, these solve:

$$\begin{aligned} W_i(a) \;=\; \max_{a',h} \Bigg\{ & \frac{\left(c\left(\bar{h} - h_i - h\right)^{\eta}\right)^{1-\sigma} - 1}{1-\sigma} + \beta\left(\lambda h \left(\phi_P \max\left\{\overline{W}_i(a'), W_P(a')\right\}\right.\right. \\ & \left.\left. + (1-\phi_P)\max\left\{\overline{W}_i(a'), W_F(a')\right\}\right) + (1-\lambda h)\,\overline{W}_i(a')\right) \Bigg\} \end{aligned} \tag{4}$$

subject to

$$\begin{aligned} c + a' &\leq (1+r)\,a + w_i \\ a' &\geq 0 \\ h &\in \left[0, \bar{h} - h_i\right] \end{aligned}$$

where $\overline{W}_i(a) \equiv \pi_{i,F}\max\{W_F(a), U_0(a)\} + \pi_{i,P}\max\{W_P(a), U_0(a)\} + \pi_{i,U}U_1(a)$ is the value of being employed in a job $i \in \{P, F\}$ by the end of the model period.

[12]For any set value of the interest rate r, our calibration results in a value for the subjective discount rate much higher than r, so that the worker remains close to the borrowing limit. Even if we were interested in the general equilibrium of the model, it is unlikely that an endogenous interest rate would change the main results. The equilibrium interest rate would be closer to the subjective discount rate, but wealth-poor agents (on whom we focus on in the experiments) rely predominantly on labour income, and thus they are little affected by a reduction in the cost of precautionary savings.

[13]This assumption explains why the worker sometimes undertakes part-time work: our parameter values imply that uninsured unemployment is never preferred to part-time work. In addition, the lifetime utility of a worker is always higher in full-time than in part-time employment, which justifies interpreting the latter as involuntary.

In unemployment, we index the value functions by $j \in \{0,1\}$ to write the Bellman equations as:

$$U_j(a) = \max_{a',h} \left\{ \frac{\left(c\left(\bar{h}-h\right)^{\eta}\right)^{1-\sigma}-1}{1-\sigma} + \beta\left(\lambda h\left(\phi_P \max\left\{\overline{U}_j\left(a'\right), W_P\left(a'\right)\right\}\right.\right.\right. \tag{5}$$

$$\left.\left. + \left(1-\phi_P\right)\max\left\{\overline{U}_j\left(a'\right), W_F\left(a'\right)\right\}\right) + \left(1-\lambda h\right)\overline{U}_j\left(a'\right)\right)\Bigg\}$$

subject to

$$\begin{aligned} c + a' &\leq (1+r)a + \theta_j \\ a' &\geq 0 \\ h &\in \left[0, \bar{h}\right] \end{aligned}$$

with $\overline{U}_1(a) \equiv (1-\phi_U)U_1(a) + \phi_U U_0(a)$ and $\overline{U}_0(a) \equiv U_0(a)$ giving the end-of-period value functions of the worker during unemployment.

The above set of Bellman equations delivers three types of decisions. First, there are decision rules for asset holdings $\widetilde{a}^P(a)$, $\widetilde{a}^F(a)$ associated with equations (4), and $\widetilde{a}_0^U(a)$, $\widetilde{a}_1^U(a)$ associated with equations (5) (notice that both (4) and (5) describe two equations). Second, there are decision rules for search effort $\widetilde{h}^P(a)$, $\widetilde{h}^F(a)$ associated with equations (4), and $\widetilde{h}_0^U(a)$, $\widetilde{h}_1^U(a)$ associated with equations (5). Finally, there are work decisions associated with the comparison of value functions in employment and unemployment. That is,

$$\varepsilon_{i,j}(a) = \mathbb{1}\left\{W_i(a) > U_j(a)\right\} \tag{6}$$

for all $i \in \{P,F\}$ and $j \in \{0,1\}$, and

$$\varepsilon_{F,P}(a) = \mathbb{1}\left\{W_F(a) > W_P(a)\right\} \tag{7}$$

($\mathbb{1}\{.\}$ is the indicator function). Notice that in (6) and (7) there is no uncertainty about labour market status if the worker decides not to accept the job opportunity, since we assume that job destruction and exhaustion of benefits occur before the end of the model period. This is consistent with the formulation of equations (4) and (5) since, at the beginning of the period, the worker is uncertain about her outside option if she receives a job offer.

4 Parametrization

We draw on standard parameters in the literature, auxiliary information on U.S. institutions and on our own calculations based on CPS data to select parameter values. For reasons that we explain below, we calibrate the parameters β, λ, ϕ_P jointly to match three data moments. The other parameters are set externally. Table 2 summarizes our parameter choices. Throughout the analysis we interpret a period as one month.

4.1 Parameters Set Externally

Utility function. We choose $\sigma = 2.0$, which is within the range of empirically plausible estimates of the coefficient of relative risk aversion (see Heathcote et al. [2009]).[14] For the relative value of leisure, η, we explored a range of values from low to high. For reasons explained below, we use an intermediate value of $\eta = 0.50$ as our benchmark. We discuss results based on $\eta = 0.25$ and $\eta = 0.75$ in Subsection 4.3 and in the online appendix.

Interest rate. The interest rate is set to 3.5 percent on an annual basis. This is in line with long-run averages of the real return on U.S. 10-year treasury note and is a standard value used in models of precautionary savings (see e.g. Gourinchas and Parker [2002]).

Earnings and hours of work. The model allows for two normalizations: the time endowment $\overline{h}$ and full-time earnings w_F. We set both parameter values to 1.0. We use CPS data on hours and earnings to pin down values for h_F, h_P and w_P. For hours, we find that individuals in full-time (involuntary part-time) employment report 42 hours (24 hours) per week (Panel a. of Table 4, online appendix).[15] Assuming that an individual has $7 \times 14 = 98$ hours of substitutable time per week, we set $h_F = 0.429$ and $h_P = 0.245$.

To pin down a value for w_P, we estimate a part-time wage penalty, the reduction in hourly wages attributable to part-time work.[16] Using data come from the Outgoing Rotation Groups of the CPS, we find that the part-time wage penalty is generally around 15% (Panel b. of Table 4, online appendix). We set $w_P = 0.485$ such that ${}^{w_P}\!/_{h_P} = 0.85\,{}^{w_F}\!/_{h_F}$.

Unemployment insurance. We use figures for the U.S. labour market reported in OECD [2007] to parametrize unemployment insurance and social assistance benefits. The average replacement ratios for these benefits are 45 and 5 percent, respectively, which dictates $\theta_1 = 0.45$ and $\theta_0 = 0.05$. ϕ is set to 0.167 to make the worker exhaust unemployment benefits after 26 weeks, in line with U.S. policies.

Transition probabilities. To pin down values for the matrix Π, we use labour market data for prime-age workers who are non-married and without children. These individuals are typically not eligible for EITC (cf. Subsection 2.2), which makes them a relevant empirical counterpart to the worker in our theoretical framework. Specifically, we use data as follows: (i) $\pi_{F,P}$ is set to the transition probability from full-time employment to involuntary part-time work, (ii) $\pi_{P,F}$ is set to the transition probability from involuntary part-time work to full-time employment *at the same employer* and (iii) $\pi_{F,U}$ ($\pi_{P,U}$) is set to the transition probability from full-time employment (involuntary part-time work) to unemployment. We provide details regarding the measurement of transition probabilities in the online appendix. Since the probabilities in each row of Π must add up to one, we obtain:

$$\Pi = \begin{bmatrix} 0.975 & 0.011 & 0.014 \\ 0.261 & 0.651 & 0.089 \end{bmatrix} \tag{8}$$

[14]The results are qualitatively similar when we change the coefficient of risk aversion; see, for instance, Table 8 in the online appendix where we report results based on $\sigma = 1.0$ and $\sigma = 3.0$.

[15]The results are very similar when we set values for h_F and h_P such that $h_P = h_F \times {}^1\!/_2$.

[16]We do not attach any causal interpretation to our estimates, since though standard our specification raises valid concerns of endogeneity bias.

Table 2. Parameter values (one model period is one month)

Parameter		**Value**	**Source**
Set externally:			
Relative risk-aversion	σ	2.0	Literature
Relative value of leisure	η	0.5	Literature
Interest rate	r	0.003	3.5 percent annual interest rate
Time endowment	$\overline{h}$	1.0	Normalization
Part-time hours of work	h_P	0.245	Workweek length of 24 hours*
Full-time hours of work	h_F	0.429	Workweek length of 42 hours*
Part-time earnings	w_P	0.485	Part-time wage penalty of 15 percent*
Full-time earnings	w_F	1.00	Normalization
Social assistance benefits	θ_0	0.05	OECD [2007]
Unemployment benefits	θ_1	0.45	OECD [2007]
Probability of exhausting benefits	ϕ_U	0.167	Benefit period of 26 weeks
Reallocation shocks:			Estimated transition probabilities*
	$\pi_{P,F}$	0.261	$I \to F$ at the same employer
	$\pi_{F,P}$	0.011	$F \to I$
	$\pi_{F,U}$	0.014	$F \to U$
	$\pi_{P,U}$	0.089	$I \to U$
Set internally:			
Subjective discount factor	β	0.9883	Median wealth to annual ratio of 0.5
Returns to search effort	λ	0.378	Transition probability $U \to E$*
Fraction of part-time jobs	ϕ_P	0.222	Transition probability $U \to I$*

Notes: * - Based on CPS data. E: Employment. F: Full-time employment. I: Involuntary part-time employment. U: Unemployment. See the online appendix for details about the data.

4.2 Parameters Set Internally

To pin down values for the remaining parameters, namely β, λ, ϕ_P, our starting point is the following equation (where a is omitted to simplify the notation):

$$\frac{\eta c^{1-\sigma}}{\left(\overline{h}-h\right)^{1-\eta(1-\sigma)}} = \beta\lambda\left[\phi_P \max\left\{W_P - \overline{U}_j, 0\right\} + (1-\phi_P)\max\left\{W_F - \overline{U}_j, 0\right\}\right]. \tag{9}$$

In this equation, W_i is the value of employment in $i \in \{P, F\}$, and $\overline{U}_j$ is the value of being unemployed with unemployment income θ_j, with $j \in \{0, 1\}$, by the end of the model period. The right-hand side gives the expected returns to search effort in unemployment, and the left-hand side the marginal utility with respect to hours, h. The interior solution for search effort must satisfy this first-order condition. In particular, equation (9) highlights that β, λ, ϕ_P jointly determine the returns to search effort for a given set of values of the parameters selected in the previous section.[17]

[17] Of course, in principle all the parameters of the model can affect search effort since the lifetime values W_i and U_j are solved jointly with the policy functions, which include search effort. We emphasize equation (9) to explain why, after choosing values for the remaining parameters, it is relevant to calibrate β, λ, ϕ_P jointly.

Guided by this structural equation, we use three moments of the time-invariant distribution of the model to calibrate β, λ and ϕ_P. Notice that, due to the ergodic properties of Markov processes, we can interpret this distribution as the fraction of time that the worker spends in the different states of the model (labour market states and asset holdings).

Discount factor. We calibrate β such that the median ratio of wealth compared to annual income is 0.50. Over time the worker accumulates assets and sometimes runs down her financial wealth. We require that her median asset levels are worth one half of her annual income.[18]

Job availability parameters. We calibrate λ and ϕ_P to match an average (monthly) transition rate from unemployment to employment of 25.2%, and an average transition rate from uninsured unemployment to part-time work of 5.64%. The first target is the job-finding rate computed in our data, i.e. the monthly transition probability to employment among the prime-aged unemployed who are not married and without children. To be precise, transition probabilities from unemployment to full-time and part-time employment are 15.8% and 9.38%, respectively, which adds up to the target of 25.2%.[19] The other target, also computed from our data, is the observed transition probability from unemployment to involuntary part-time work ($U \to I$). We use it as a target for transitions out of uninsured unemployment because, in our framework, this makes the worker resemble the unemployed who would take on a part-time job because they cannot find a full-time position.

4.3 Features of the Model

Our calibration procedure yields: $\beta = 0.9883$, $\lambda = 0.3781$, $\phi_P = 0.2218$. Several features of the calibrated model give us confidence that we can use it to draw quantitative inferences. First, part-time work in the model is involuntary in that the value of full-time employment, W_F, is higher than the value of part-time employment, W_P, for the range of assets held by the worker over time. This outcome results from a combination of the disutility of work, lower earnings in part-time employment and the fact the worker is too impatient to accumulate enough assets to prefer part-time over full-time work. Second, the model predicts that the worker runs down her assets during spells of part-time employment. In models with precautionary savings, dissaving is typically associated with unemployment. Our framework also has this property, which is illustrated in Figure 4, and justifies the comparison we draw between part-time work and unemployment.

The third, and perhaps more important reason why this framework is suitable for our purposes, is that it captures the risk of unemployment well. Indeed, Table 3 below shows that the drops in consumption experienced on losing a full-time job are similar to those observed in the data. For instance, when the relative value of leisure, η, is equal to 0.5, the predicted drop in insured unemployment is 8%, and the corresponding number in uninsured unemployment is 25%. Both numbers are remarkably close to those reported by Gruber [1997]: he reports a 6-8% decrease in the first case and a 22% decrease in the second scenario.

[18] The ratio of wealth to annual income we select is slightly higher than in standard calibrations of incomplete-market models. This is motivated by the fact that our model does not allow borrowing.

[19] See the online appendix. The job-finding rate in our data is low compared to usual estimates for the U.S. because the sample period covers 20 years that include the Great Recession and the ensuing sluggish recovery. In a previous version of this study, we excluded the Great Recession to target a higher job-finding rate. The results from the numerical experiments were not substantially different from those presented in Section 5.

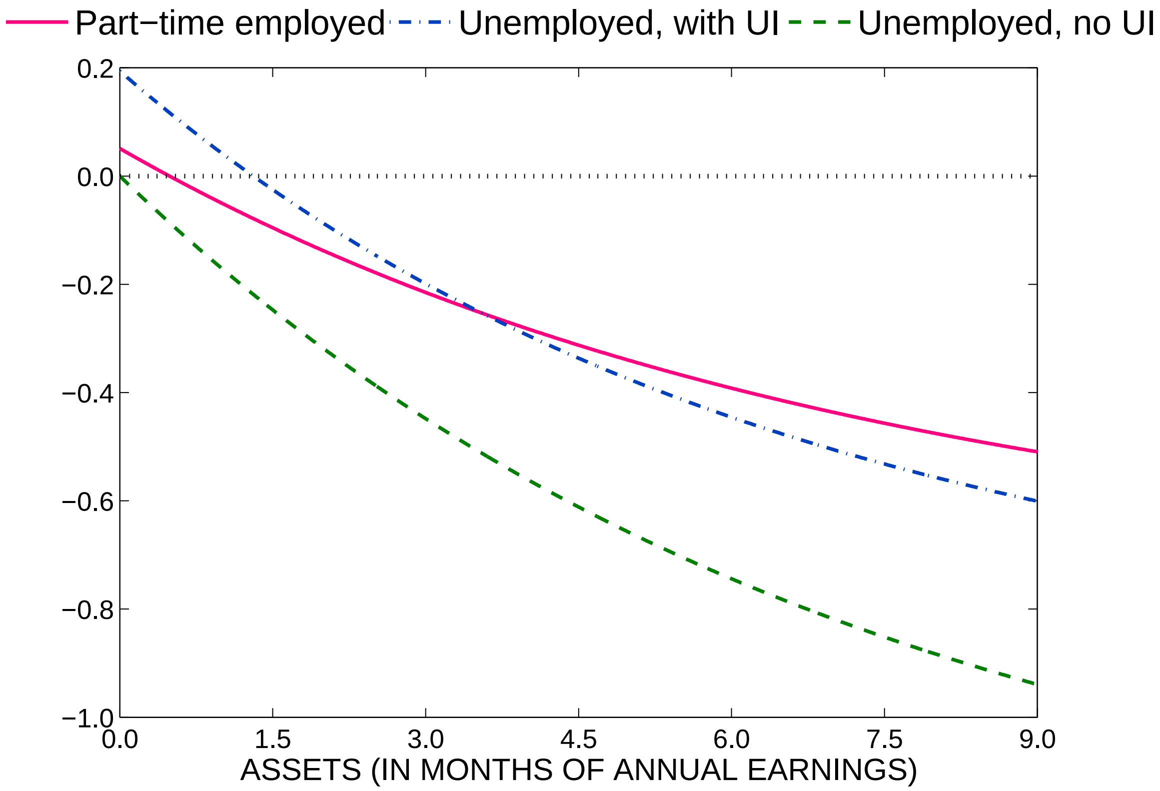

Figure 4. Net savings decisions of the worker

Notes: The solid line is the policy function for net savings in part-time employment, $\tilde{a}^P(a) - a$. The dashed-dotted (dashed) line is the policy function for net savings decisions in insured (uninsured) unemployment $\tilde{a}_1^U(a) - a$ ($\tilde{a}_0^U(a) - a$).

Table 3. Consumption drop following (full-time) job loss

	$\eta = 0.25$	$\eta = 0.50$	$\eta = 0.75$
Part-time employment	-5.08	-5.93	-6.66
Insured unemployment	-6.01	-7.96	-10.73
Uninsured unemployment	-24.06	-25.20	-28.00

Notes: An entry in the table is the change (reported in percent) in consumption after losing employment in a full-time position, when wealth at the time of displacement amounts to one quarter of annual earnings.

Notice that we obtain the figures in Table 3 by looking at the behaviour of the worker when her wealth at the time of job loss amounts to one quarter of annual earnings. We motivate this choice by studying empirically the amount of household wealth which is held in liquid assets, i.e. assets that can be liquidated on short notice and at a small transaction cost. In the online appendix we report that, in data from the Panel Study of Income Dynamics, liquid assets typically amount to one quarter of annual earnings.[20] This is the value that we use for our baseline results in the next section. In Section C.2 of the online appendix, we discuss how these results change when we vary the amount of wealth

[20]We follow the literature on precautionary savings (e.g., Carroll and Samwick [1998]) to establish this fact. The result is not new and it is not surprising either: it is well known that household wealth is mostly held in illiquid assets (see Kaplan and Violante [2014]).

held by the worker at the time of job loss.

5 Numerical Experiments

This section contains our quantitative results. In Subsection 5.1 we calculate the difference between the short-run welfare losses of displacement shocks from full-time employment to involuntary part-time work vs. unemployment, and decompose it into several components. In Subsection 5.2 we calculate the welfare losses of cyclical fluctuations in involuntary part-time risk.

We have checked that our main conclusions are robust to using different preference parameters and/or changing the assets held by individuals at the time of job displacement. The sensitivity analysis is provided in Section C.2 of the online appendix.

5.1 Short-run welfare costs of involuntary part-time work and unemployment

We use the calibrated model to answer the following questions: how much worse off is a full-time worker if she is displaced to unemployment instead of involuntary part-time work, and why?

Let $\mathscr{U}_{1,t}$ ($\mathscr{U}_{4,t}$) be a statistic measuring the welfare effect of involuntary part-time work (unemployment) t periods after displacement from full-time employment; we will explain momentarily how these statistics are calculated. To understand the source of differences between the two labour market risks, we consider a set of intermediary changes that make involuntary part-time work resemble unemployment incrementally. We decompose the difference according to the equation below:

$$\underbrace{\mathscr{U}_{1,t}-\mathscr{U}_{4,t}}_{\triangle\text{ total}} = \underbrace{\mathscr{U}_{1,t}-\mathscr{U}_{2,t}}_{\triangle\text{ labour earnings}} + \underbrace{\mathscr{U}_{2,t}-\mathscr{U}_{3,t}}_{\triangle\text{ access to full-time}} + \underbrace{\mathscr{U}_{3,t}-\mathscr{U}_{4,t}}_{\triangle\text{ hours constraint}} . \tag{10}$$

That is, we attribute the total difference between spells of involuntary part-time work and unemployment to: a gap in labour earnings, a differential access to full-time work (which occurs only through search effort when unemployed), and a constraint in hours allocated to market activities.

The experiment protocol is the following. Instead of just one worker, now we envision cohorts of workers whose preferences and behavior are identical to that of the worker described so far. We study four cohorts of full-time workers, which we put respectively in the following states in the first period of observation:[21] [22]

1. part-time employment (the control group);
2. part-time employment earning benefits θ_j (with j fixed to either 0 or 1 to indicate if the comparison is to uninsured or insured unemployment);

[21] In the calculations of 2, 3 and 4, we re-compute optimal decisions after changing the parameters of the model. Therefore, the agents always take into account changes to the economic environment, which they interpret as permanent changes. We obtain qualitatively similar results if we keep the policy functions unchanged from the baseline calibration and introduce an unexpected, one-off change in earnings, hours and transitions from part-time employment to full-time employment.

[22] After changing the value of $\pi_{P,F}$ in step 3, we re-scale $\pi_{P,P}$ using $\pi_{P,P} = 1.0 - \pi_{P,F} - \pi_{P,U}$, so that the value of $\pi_{P,U}$ remains unchanged throughout the experiments.

3. part-time employment earning benefits θ_j and whose working hours h_P are used to search for a full-time job (viz. we replace $\pi_{P,F}$ by $\lambda(1-\phi_P)h_P$);

4. unemployment.

All cohorts are followed for several periods and we keep track of their outcomes. Then, we use the model-generated data to compute the *treatment effect* of displacement from state 1 to state 2, state 3 and finally state 4.[23] The outcome variable is cross-sectional utility, which we express in terms of percentage change in consumption.

Measurement. The experiments rely on the comparison of cross-sectional utility across several cohorts of workers. These workers have identical preferences and they are homogeneous in assets at the time of the displacement shock. We follow them over a short period of time (our focus is on the first three quarters after displacement), and since there is only one full-time job, the model generates little dispersion in labour market trajectories and asset holdings within each cohort. Therefore we treat each cohort in any period as a representative worker. This allows us to present the results of the experiments using a small set of numbers, rather than reporting the treatment effects for all possible trajectories following the displacement shock.

Consider for instance the comparison of cohorts in states 1 and 2, t periods after the shock. We measure cross-sectional utility, $\mathscr{U}_{k,t}$, in each cohort $k \in \{1,2\}$. Let $C_{k,t}$ and $H_{k,t}$ denote consumption and leisure, respectively, of the representative worker ($\mathscr{U}_{k,t} = \mathscr{U}\left(C_{k,t}, H_{k,t}\right)$). The treatment effect $\vartheta^t_{1,2}$ we report satisfies:

$$\mathscr{U}\left(\left(1+\vartheta^t_{1,2}\right)C_{1,t}, H_{1,t}\right) = \mathscr{U}\left(C_{2,t}, H_{2,t}\right). \tag{11}$$

For the class of utility function considered, this gives:

$$1+\vartheta^t_{1,2} = \left[\frac{\mathscr{U}_{2,t}+\frac{1}{1-\sigma}}{\mathscr{U}_{1,t}+\frac{1}{1-\sigma}}\right]^{\frac{1}{1-\sigma}}. \tag{12}$$

Next, consider the cohorts in states 1, 2 and 3. Since $\vartheta^t_{2,3}$ satisfies an equation similar to (12), we can show that:

$$\left(1+\vartheta^t_{1,2}\right)\left(1+\vartheta^t_{2,3}\right) = 1+\vartheta^t_{1,3}. \tag{13}$$

Therefore, $\vartheta^t_{1,3} \approx \vartheta^t_{1,2} + \vartheta^t_{2,3}$ is valid as a first-order approximation of this equation. Using this result, we can write:

$$\vartheta^t_{1,4} \approx \sum_{k=1}^{3} \vartheta^t_{k,k+1}. \tag{14}$$

This last equation provides a simple way to operationalize the decomposition presented in equation (10). In practice, the approximation is highly accurate, which can be gauged by comparing column 4

[23] Notice that the treatment effects depend on wealth at the time of displacement. In line with the discussion in Subsection 4.3 (and data on asset holdings presented in the online appendix), we use cohorts of workers whose asset holdings on losing their full-time job amount to one quarter of annual earnings.

to the sum of columns 1 to 3 in Table 4 below.

Before studying the results, we comment on another comparison between involuntary part-time work and unemployment, namely that based on lifetime values. This comparison provides an informative and yet quite distinct assessment of the welfare effects of involuntary part-time work: it informs us about the effects of permanently replacing the labour market features of the latter state by those of unemployment. Our emphasis on cross-sectional utility is motivated by the view that liquidity constraints are almost surely important in practice and that, as a result, individuals may not be able to smooth out short-run income fluctuations well. In fact, liquidity constraints are commonly invoked to justify public insurance programs such as those reviewed in Section 2.

Results. The main results are displayed in Table 4. An entry in each panel of the table is the treatment effect of reducing labour earnings in part-time employment (column 1), changing the role of hours h_P from work to search (column 2), removing the constraint on hours worked (column 3), and finally the cumulated sum of these effects (column 4). The effects are reported as averages over each quarter (up to the third quarter) following the displacement shock.

Table 4. Welfare costs of involuntary part-time work vs. unemployment

1. Comparison with: Insured unemployment

	$\triangle$ labour earnings (1)	$\triangle$ access to full-time (2)	$\triangle$ hours constraint (3)	$\triangle$ total (4)
1st quarter	-2.016	-6.386	0.768	-7.633
2nd quarter	-1.007	-0.534	0.170	-1.371
3rd quarter	-0.803	-0.316	0.070	-1.049

2. Comparison with: Uninsured unemployment

	$\triangle$ labor earnings (1)	$\triangle$ access to full-time (2)	$\triangle$ hours constraint (3)	$\triangle$ total (4)
1st quarter	-14.92	-8.597	0.227	-23.29
2nd quarter	-1.591	-1.537	0.413	-2.714
3rd quarter	-1.021	-0.689	0.252	-1.458

Notes: An entry in the table is the change (reported in percent) in quarterly consumption. The upper (lower) panel of the table compares part-time employment with insured (uninsured) unemployment, when wealth at the time of displacement amounts to one quarter of annual earnings.

Consider first the number displayed in column 4 of the first row in panel 1. If workers were reallocated to insured unemployment instead of part-time work, their consumption during the first quarter would need to be raised by 7.63% to compensate them. The number is larger in uninsured unemployment (panel 2), as their consumption would need to be increased by 23.3%. Both numbers are plausible given the observed drop in consumption during unemployment (cf. Subsection 4.3). These effects vanish as we move to the second and third quarters after displacement. This is due to the fast dynamics of the U.S. labour market, which informs our calibration: after one quarter, the majority of workers from the control group have returned to full-time work, and a large fraction of workers from the treated group have also returned to full-time employment.

Next, when analyzing columns 1, 2 and 3, we note that 'access to full-time employment' (column 2) plays an important role in all instances. To understand this finding, note that $\lambda(1-\phi_P)h_P = 0.378 \times (1.0-0.222) \times 0.245 = 0.072$ is the (exogenous) transition probability to full-time work that the worker would face during part-time employment if her hours h_P were used for the purpose of search instead of work. This ought to be compared with the probability $\pi_{P,F} = 0.261$, which is almost four times larger. We interpret the discrepancy between $\pi_{P,F}$ and the transition rate to full-time work implied by h_P as the premium in access to full-time work faced by involuntary part-time workers. As shown in Table 4, it has important welfare implications: removing the premium associated to $\pi_{P,F}$ amounts to a loss of 6-9% in consumption during the first quarter of a spell of involuntary part-time employment. In Section 6 we elaborate further the interpretation of this result, which is a robust prediction of our analysis.

The results displayed in columns 1 and 3 are somewhat more mechanical. The negative effects of reducing earnings in part-time employment to equate them to benefits θ_j are larger when we consider uninsured unemployment. The effects of removing the constraint on hours supplied to the labour market are positive, not negligible during the first quarter and they vanish quickly.[24]

5.2 Welfare costs of cyclical fluctuations in involuntary part-time risk

A complementary question to the one addressed in the previous experiment is the following: how large are the welfare costs of fluctuations in consumption propelled by the cyclicality in involuntary part-time risk? To answer it, we follow the standard practice in the literature (see Krusell et al. [2009]) and introduce cyclical fluctuations in our framework by means of a latent, aggregate state variable, namely

$$z \in \{z_b, z_g\}. \tag{15}$$

So, the economy is either in a bad (z_b) or in a good state (z_g). As in Krusell et al. [2016] we assume that z is governed by a symmetric Markov process with parameter ρ_z, and we use: $\rho_z = 0.975$. We let the business cycle affect matrix Π (cf. equation (2)) as follows: $\pi_{F,P}(z) = \bar{\pi}_{F,P}(1+\varepsilon_{F,P})$ ($= \bar{\pi}_{F,P}(1-\varepsilon_{F,P})$) if $z = z_b$ (if $z = z_g$), and $\pi_{P,F}(z) = \bar{\pi}_{P,F}(1-\varepsilon_{P,F})$ ($= \bar{\pi}_{P,F}(1+\varepsilon_{P,F})$) if $z = z_b$ (if $z = z_g$). The variables denoted with an upper bar ($\bar{\cdot}$) refer to the baseline values reported in Table 2. According to this construct, the business cycle consists of cyclical changes in $\pi_{F,P}$ and $\pi_{P,F}$, the variance of which is controlled by the parameters $\varepsilon_{F,P}$ and $\varepsilon_{P,F}$.

The experiment is as follows. First, we solve the model using: $\varepsilon_{F,P} = 0$ and $\varepsilon_{P,F} = 0.05$ to reproduce 'normal' times.[25] We then recalculate value functions for different combinations of $\varepsilon_{F,P}$ and $\varepsilon_{P,F}$ that reproduce the cyclical deviations in $\pi_{F,P}$ and $\pi_{P,F}$ observed in the data at business-cycle

[24] In the comparison to unemployment, we ignore the fact that, according to labour market statistics, individuals must provide a minimum search effort to be classified as unemployed workers. Therefore, it is possible that the experiments overstate the effects of relaxing the constraint on hours allocated to the labour market.

[25] We allow for low cyclical variations in $\pi_{P,F}$ even in normal times because of the high correlation between $I \rightarrow F$ transitions and the job-finding rate, which is a very cyclical variable.

frequencies. Finally, we tabulate the change in lifetime consumption triggered by these deviations relative to normal times.[26]

Table 5. Welfare effects of an increase in the cyclical risk of involuntary part-time work

Deviations around:	**1.** $\bar{\pi}_{F,P} = 0.011$		**2.** $\bar{\pi}_{F,P} = 0.022$	
	$\varepsilon_{F,P} = 0.20$	$\varepsilon_{F,P} = 0.40$	$\varepsilon_{F,P} = 0.20$	$\varepsilon_{F,P} = 0.40$
$\bar{\pi}_{P,F} = 0.261$	(1)	(2)	(3)	(4)
$\varepsilon_{P,F} = 0.05$	[-0.012, -0.011]	[-0.020, -0.018]	[-0.017, -0.015]	[-0.017, -0.016]
$\varepsilon_{P,F} = 0.10$	[-0.038, -0.034]	[-0.060, -0.054]	[-0.060, -0.055]	[-0.085, -0.078]
$\varepsilon_{P,F} = 0.15$	[-0.070, -0.065]	[-0.107, -0.095]	[-0.115, -0.105]	[-0.166, -0.151]

NOTE: An entry in the table is the range of welfare effects computed at different levels of asset holdings. The welfare effects measure the percentage change in lifetime consumption of an increase in the cyclical risk of involuntary part-time employment. The left (right) panel of the table shows the effects of deviations around the monthly transition probability $\bar{\pi}_{F,P} = 0.011$ ($\bar{\pi}_{F,P} = 0.022$).

The results are displayed in Table 5. Since the welfare figures are computed over the whole range of assets held by the worker over time, in the table we report their lower and upper bounds. We consider the effects of deviations around a steady-state value of $\bar{\pi}_{F,P}$ of 1% in Panel 1, and a steady-state value of 2% in Panel 2. Indeed, these seem to capture the U.S. labour market experience respectively before and after the Great Recession.

The main findings are twofold. First, the negative correlation between $\pi_{P,F}$ and $\pi_{F,P}$ is quantitatively important to generate welfare losses from involuntary part-time work. In recessions, the probability of working part-time involuntarily rises, but the welfare implications would be negligible if the probability of returning to full-time work were to remain unaltered. This finding echoes the result that 'access to full-time employment' is paramount to understand the welfare effects of involuntary part-time work. Second, though fluctuations in involuntary part-time work entail welfare losses, they are much lower than the losses from business-cycle fluctuations in unemployment tabulated in the literature – which are in the vicinity of 1% in consumption equivalents (see Krusell et al. [2009]). In the most extreme scenario in Table 5, the effect amounts to one-sixth of a percentage point of lifetime consumption (Panel 2, $\varepsilon_{F,P} = 0.15$, $\varepsilon_{P,F} = 0.40$). This corroborates the conclusion based on the baseline model, that the welfare costs of involuntary part-time work are low relative to those of unemployment.

6 Concluding Remarks

In this paper, we analyze the short-run welfare implications of spells of involuntary part-time work. The contribution is twofold. First, we provide empirical evidence on the (limited) availability and extent of public insurance against this labour market risk. Second, we use this evidence and other facts on involuntary part-time work to inform an incomplete-market, job-search model featuring spells of

[26] Section C.1 of the online appendix provides the complete background information for this experiment.

involuntary part-time work and unemployment. Our main finding is that spells of involuntary part-time work entail lower welfare losses compared to unemployment spells, and that this difference is largely accounted for by the higher probability of returning to full-time work enjoyed by part-time workers. Relatedly, when we consider aggregate shocks, we find that the welfare losses associated with cyclical fluctuations in involuntary part-time risk are considerably smaller relative to those entailed by fluctuations in unemployment risk.

In our welfare calculations, the key difference between unemployment and involuntary part-time work is the high probability of workers in the latter state to return to full-time employment. While the unemployed need to exert search effort to generate full-time employment offers, involuntary part-time workers face a positive probability to return to full-time employment without making any such effort. This feature is motivated by the observation that the vast majority of transitions between part-time and full-time work occur at the same employer (fact 3.2 in Section 2). We interpret it as capturing an alternative reallocation channel compared to job search. In other words, if involuntary part-time workers used the same search technology to return to full-time work as the unemployed, they would move less quickly (and/or they would need to exert higher search effort to maintain a high transition rate) and would suffer larger decreases in consumption.

While for the purpose of our analysis it is useful to isolate these two reallocation channels, we think that the distinction may not be so clear cut in actual employment relationships. On the one hand, it is conceivable that involuntary part-time work is used by employers as a worker discipline device. If that is the case, then the high transition rate from involuntary part-time work to full-time employment would in turn be the product of higher work effort. On the other hand, as documented by Fujita and Moscarini [2015], a non-trivial share of unemployed workers in the U.S. labour market are recalled by their previous employer. This phenomenon suggests that employers and workers are able to temporarily suspend the employment relationship and save on future search efforts. Both mechanisms suggest that our estimates give an upper bound for the welfare value of the premium in access to full-time work enjoyed by part-time workers. Future research could refine our estimates by exploring empirically and theoretically these alternative reallocation channels.

Finally, we want to emphasize that our conclusions on the welfare costs of involuntary part-time work relative to unemployment are based on *existing policies*. Given the much higher costs associated with unemployment that we estimate, this suggests no immediate change to existing policies is warranted. However, if (as the recent literature suggests) involuntary part-time risk has indeed permanently increased and can continue to rise in the future, understanding the key trade-offs faced in the optimal provision of public insurance against this risk seems an important endeavour. A key ingredient of that analysis, we think, is a better understanding of the trade-off faced by employers between reallocation to part-time work and lay-offs. This would allow one to consider the general equilibrium effects of current policies and, by extension, their impact on macroeconomic aggregates like employment, consumption and productivity.

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Online Appendix for:
The Welfare Effects of Involuntary Part-time Work

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Appendix A contains details on the motivating empirical evidence presented in Subsection 2.1 of the paper. Appendix B provides the information used to select the parameters of the model. Appendix C complements Section 5 of the paper, which analyzes the numerical experiments.

A Empirical Evidence

To gather the empirical evidence on involuntary part-time work discussed in Subsection 2.1, we use data from the monthly files of the Current Population Survey (CPS). There was a major overhaul of the CPS in 1994, which affects the measurement of part-time employment drastically. Therefore we restrict ourselves to CPS data from January 1994 onwards.

A.1 Characteristics of Involuntary Part-time Workers

In Table 1, we describe involuntary part-time workers in terms of their population characteristics. By comparing them to voluntary part-time workers (column 3 vs. column 2), we find a number of noticeable differences. For instance, while part-time work is strongly skewed toward women, involuntary part-time employment is much closer to parity (55.3% of involuntary part-timers are female workers). In addition, involuntary part-time workers are more likely to fall within the 25–54 age bracket. There are also significant differences between involuntary and voluntary part-time workers with respect to educational attainment, which is lower among involuntary part-time workers.

To get some perspective, in columns 4 and 5 of Table 1 we describe the population characteristics of unemployed workers. We distinguish between unattached workers (those who are new-entrants or re-entrants to the workforce) and attached workers (the remainder of the unemployed population). The composition of the pool of involuntary part-timers is strikingly similar to that of attached unemployed workers. In short, these individuals are more likely to be men in their prime age (which coincides with stronger labour force attachment), with lower-than-average employment opportunities (lower education levels), and less likely to be married.

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Table 1. Cross-sectional characteristics of part-time work and unemployment

	Labour force	Part-time work Voluntary	Part-time work Involuntary	Unemployment Unattached	Unemployment Attached
	(1)	(2)	(3)	(4)	(5)
(a) Gender					
Men	53.5	29.8	44.7	45.9	62.4
Women	46.5	70.2	55.3	54.1	37.0
(b) Age					
16 to 24 years	15.6	36.9	29.7	54.4	21.0
25 to 54 years	71.4	49.6	60.9	41.0	68.0
55 to 64 years	12.9	13.5	9.4	4.9	10.3
(c) Education					
Less than high-school	11.9	18.3	21.5	35.6	18.7
High-school graduates	30.1	24.3	37.7	29.2	38.7
Some college	24.4	31.7	22.7	22.0	23.0
College or higher education	29.0	21.8	14.5	11.2	14.8
(d) Marital status					
Married	56.1	46.3	36.3	23.1	40.7
Widowed; divorced; separated	14.1	9.3	16.6	10.8	17.4
Single	29.7	44.5	47.1	66.5	40.3

Notes: Authors' calculations based on CPS data for the period 1994m01–2015m12. All entries are reported in percent.

A.2 Dynamics of Involuntary Part-time Work

To inform our characterization of the dynamics of involuntary part-time work, we use linked CPS data to estimate transition probabilities. We classify workers in five labour market states: full-time work (F), part-time work, voluntary (V) or not (I), unemployment (U) and non-participation (N). We follow the estimation protocol presented in Borowczyk-Martins and Lalé [2016b]. In particular, we implement a correction for transitions between voluntary (V) and involuntary (I) part-time work, and transitions between non-participation (N) and unemployment (U), both of which appear spuriously common in the raw data. As per the estimation protocol, the time series that we obtain control for seasonality, margin-error problems and time-aggregation bias.

In order to maximize consistency between data and the assumptions of our model, we estimate transition probabilities for prime-age workers who are non-married and are without children.

Transition probabilities

Table 2 reports sample averages of inflow and outflow transition probabilities for involuntary part-time work (left panel) and unemployment (right panel).[1] For completion, in this table we report transitions between I, V, N in the left panel, and U, V, N in the right panel, although these do not have a counterpart in the model. The point is to explain how we calculate the total monthly inflow and outflow probabilities displayed in the last row of Table 2.

[1] The inflow transition probability from i to j at time t, denoted $q(i \to j)$, is the ratio of the gross flow of workers moving from i to j at time t divided by the number of workers in j at time t. The outflow transition probability from i to j at time t, denoted $p(i \to j)$, is the ratio of the gross flow of workers moving from i to j at time t divided by the number of workers in i at time $t-1$.

Table 2. Sample averages of monthly transition probabilities

Involuntary part-time work				Unemployment			
Inflows		Outflows		Inflows		Outflows	
$q(F \to I)$	29.6	$p(I \to F)$	28.9	$q(F \to U)$	18.3	$p(U \to F)$	15.8
$q(V \to I)$	16.7	$p(I \to V)$	15.1	$q(V \to U)$	3.63	$p(U \to V)$	3.74
$q(U \to I)$	12.4	$p(I \to U)$	8.85	$q(I \to U)$	3.97	$p(U \to I)$	5.64
$q(N \to I)$	4.65	$p(I \to N)$	3.58	$q(N \to U)$	9.11	$p(U \to N)$	7.88
$\sum_{i \neq I} q(i \to I)$	63.3	$\sum_{j \neq I} p(I \to j)$	56.4	$\sum_{i \neq U} q(i \to U)$	35.0	$\sum_{j \neq U} p(U \to j)$	33.1

Notes: Authors' calculations based on CPS data for the period 1994m01–2015m12. The sample includes all individuals aged 25 to 54 who are non-married and are without children. All entries in the table are reported in percent.

The high levels of transition probabilities at the bottom of Table 2 underscore one of our claims, that involuntary part-time work and unemployment are both transitory labour market states. For instance, when looking at involuntary part-time workers, we observe that roughly two thirds (63.3%) of these workers were in a different labour market state (F, V, U or N) in the previous month. It is noticeable that, during this period, the inflow and outflow transition probabilities (respectively at 35.0% and 33.1%) of unemployment are low compared to historical U.S. averages. As a result, the dynamics of involuntary part-time work look by comparison extremely fast.

The second fact worthy of attention in Table 2 is that involuntary part-time work and unemployment are both highly connected to full-time employment. For example, 29.6% of all involuntary part-time workers were employed full-time in the previous month, and 28.9% will enter full-time employment next month. The corresponding figures for unemployment are 18.3% and 15.8%. In relative terms, transitions from (into) full-time employment account for *half* of the inflows (outflows) of both involuntary part-time work and unemployment.

Within-employer transitions

An important fact concerning the source of transitions between involuntary part-time and full-time employment is that they take place overwhelmingly at the same employer. Table 3 illustrates this point with statistics on the share of transitions occurring at the same employer.

Table 3. Transitions between full-time and involuntary part-time work

Share of transitions at the same employer			
$F \to I$	93.5	$I \to F$	90.4

Notes: Authors' calculations based on CPS data for the period 1994m01–2015m12. The sample includes all individuals aged 25 to 54 who are non-married and are without children. All entries in the table are reported in percent.

We observe that, on average, 90.4% of transitions from involuntary part-time work to full-time employment ($I \to F$) occur without a change in employer. This pattern underscores our findings regarding the premium enjoyed by part-time workers in returning to full-time work. We elaborate further on this result in Section 6 of the paper.

A.3 U.S. Institutions and Policies

We use data from various sources in order to offer empirical evidence about the U.S. public programs that may provide some degree of insurance to involuntary part-time workers. For partial UI and STC schemes, we use data provided by the Employment and Training Administration of the U.S. Department of Labor (DOLETA). For the EITC, we use data from the Congressional Research Service. We combine these data with state-specific time series of involuntary part-time employment for the overlapping period, which we construct using the methodology presented in Borowczyk-Martins and Lalé [2016b]. We now provide details on our empirical work.

Partial Unemployment Insurance. To assess the coverage of partial UI, we collect state-level data published by the DOLETA (available at `http://oui.doleta.gov/unemploy/`) on the amount of benefits effectively paid in partial and full unemployment insurance. The amount paid in partial unemployment insurance is the total value of benefits paid to individuals who earn above the state's disregard level. We link these data to time series of stocks of unemployed and involuntary part-time workers to obtain estimates of the monthly UI payments per unemployed worker and involuntary part-time worker. The final time series, displayed in Figure 1 of the paper, are expressed in constant 2009 U.S. dollars based on the Personal Consumption Expenditures Price Index.

Let us comment briefly on our somewhat surprising finding, that the UI amount paid per involuntary part-time worker is very low. Our conjecture is that workers who are experiencing short-time work at their employer (the bulk of involuntary part-time workers) have little incentives to claim partial UI. In this regard, Le Barbanchon [2016]'s case-study of the utilization of partial UI in the states of Idaho, Louisiana, Missouri and New Mexico during the late 1970s and early 1980s offers interesting insights. The author finds that eligibility of individuals who are experiencing short-time work at their employer is conditional on the presentation of an employer-certified reduction in hours worked. It is conceivable that, on top of this requirement, short-time workers face additional hurdles (e.g., at the UI agency, etc.) which prevent them from effectively claiming partial UI benefits.

Short-Time Compensation schemes. The data on the number of STC claims come from the DOLETA (`http://www.dol.gov/`). The data are available on a weekly basis, beginning on January 4, 1986. We merge the number of STC claims to the number of involuntary part-time workers in the 17 states with STC programs during the past thirty years (Arizona, Arkansas, California, Connecticut, Florida, Iowa, Kansas, Maryland, Massachusetts, Minnesota, Missouri, New York, Oregon, Rhode Island, Texas, Vermont, Washington). The resulting time series is shown in Figure 2 of the paper. Its low level dovetails with the small take-up rates reported by Abraham and Houseman [2014]. In their account of this policy, the authors also report small take-up rates even in industries where work-sharing programs are supposedly more prevalent (typically, the manufacturing sector).

In Table 1 of the same section, we report the number of UI claims divided by the number of unemployed workers in states with STC schemes. We downloaded the data on UI claims from `http:`

//www.workforcesecurity.doleta.gov/unemploy/finance.asp. Data on unemployment at the state level come from the Local Area Unemployment Statistics of the Bureau of Labor Statistics available at http://www.bls.gov/lau/.

The Earned Income Tax Credit. To assess the EITC's coverage we combine three data sources. The first source of data is from the Congressional Research Service (www.crs.gov), which provides information on the maximum phase-out income level of the EITC in each year for childless adults, families with one child, families with two children and families with three or more children. For example, in 2015, the maximum phase-out income level for families with two or more children is 44,454 U.S. dollars. The second data source are the annual demographic supplement files of the Current Population Survey (March CPS). We use information on total household income and money received from energy subsidies and food stamps. Then, in each group circumscribed by family structure and marital status, we estimate the fraction of households with income below the maximum phase-out income level of the corresponding year. This fraction provides us with an estimate of potential eligibility for the EITC based on the family structure and marital status of individuals. Although quite simple, this approach enables us to accurately predict the number of EITC recipients in each year since 1980: the overall R-square of the regression of the actual vs. the predicted time series is 93%. Finally, these estimates are matched to data on involuntary part-time workers from the monthly CPS using the same partition by family structure and marital status. The final estimates of potential EITC eligibility among involuntary part-time workers are plotted in Figure 3 of the paper.

B Parameter Choices

In this subsection, we present the empirical basis to ground the choice of parameter values in Section 4 of the paper. We begin with the evidence on hours and earnings, which are used to set several parameter values externally. Then we describe the data moments that discipline the model's calibration.

B.1 Hours Worked and Earnings

To gather evidence on hours worked and earnings, we pool data from the Outgoing Rotation Groups of the CPS for the period 2001m12–2007m11. We focus on this window because it spans a long period of time between the two recessions covered by our dataset.

Hours worked. Panel a. of Table 4 reports average and median hours worked in full-time, in overall part-time and in involuntary part-time employment. The gap in hours worked is close to 50 percent when we compare full-time with overall part-time employment, and is reduced when we only consider involuntary part-time work. The parameter values for h_P and h_F are chosen so as to match the values of median hours worked in full-time and involuntary part-time work shown in Table 4. In a previous version of the model, we selected values for h_P and h_F under the assumption that the gap in hours is exactly 50 percent; the results were similar to those obtained under the current parametrization.

Earnings. Our choice of parameter values for w_P and w_F is meant to include a part-time wage penalty, in line with a well-established literature on this topic (see footnote 2 below). Estimating the

Table 4. Hours and earnings in overall part-time and involuntary part-time work

a. Hours	Male workers			Female workers		
	Full-time	Part-time		Full-time	Part-time	
		Overall	Involuntary		Overall	Involuntary
Mean	43.7	21.6	24.0	41.4	21.4	23.6
Median	40.0	20.0	25.0	40.0	20.0	25.0

b. Earnings gap	Male workers			Female workers		
	(1)	(2)	(3)	(4)	(5)	(6)
Overall part-time	-0.608	-0.288	-0.201	-0.323	-0.179	-0.112
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Involuntary part-time	-0.519	-0.274	-0.185	-0.397	-0.230	-0.134
	(0.006)	(0.006)	(0.005)	(0.004)	(0.004)	(0.004)
Worker-level controls	N	Y	Y	N	Y	Y
Job-level controls	N	N	Y	N	N	Y

Notes: Authors' calculations based on CPS data, pooled outgoing rotation groups for the period 2001m12–2007m11. Panel a: Average and median hours worked in full-time, in overall part-time and in involuntary part-time employment. Panel b: Each entry is from a separate OLS regression of the log hourly earnings against a dummy for overall part-time work (first row) or involuntary part-time work (second row), and further controls at the worker-level (N/Y) and job-level (N/Y). Standard errors in parentheses.

wage penalty associated with involuntary part-time work is beyond the scope of our analysis. We nevertheless report results based on our own calculations, and that are very well-aligned with the findings from the literature.

Our variable of interest is (the log of) hourly earnings (including usual amounts of overtime, tips, commissions, and bonuses) trimmed at the bottom and top 1 percent of the distribution. We run several OLS regressions to estimate the wage penalty of overall part-time work as well as the penalty of involuntary part-time work. As can be observed in panel b. of Table 4, there is a significant and large earnings penalty in the raw data (columns 1 and 4): -60.8% (-32.3%) in overall part-time, -51.9% (-39.7%) in involuntary part-time for men (women). In line with the existing literature, we also find that individual controls account for a large share of the observed differential, and that including job characteristics further reduces the difference in earnings. After accounting for (observed) individual and job characteristics (columns 3 and 6), the part-time penalty is between -20.1% and -18.5% for men, and between -13.4% and -11.2% for women, very similar to estimates reported in the literature.[2] In the calibrated model, we take the part-time wage penalty to be -15%, a figure well within the range of the estimates presented in Table 4.

B.2 Asset Holdings

We use data from the Panel Study of Income Dynamics (PSID) to compare asset holdings and earnings. These comparisons help us choose a calibration target for the discount factor, β, and determine

[2] Similar results are found in specifications that are arguably more immune to endogeneity biases; see Hirsch [2005] who uses the panel structure of the CPS, and Aaronson and French [2004] who use administrative data.

the relevant range of asset holdings used to conduct our numerical experiments.

Data. The data come from the supplemental wealth files to the PSID for the years 1984, 1989, 1994 and for every two years from 1999 to 2007. These files contain information on eight broad wealth categories at the family level. Those include: (i) the value of checking and savings accounts, money market funds, certificates of deposit, savings bonds, Treasury bills and other individual retirement accounts (IRAs; IRAs are asked separately beginning in 1999), (ii) the value of shares of stock in publicly-held corporations, mutual funds or investment trusts, including stocks in IRAs, (iii) the value of other investments in trusts or estates, bond funds, life insurance policies and special collections, (iv) the value of debts other than mortgages, such as credit cards, student loans, medical or legal bills, personal loans, (v) the net value of real estate other than the main home, (vi) the net value of vehicles or other assets "on wheels", (vii) the value of home equity, calculated as home value minus remaining mortgage and (viii) the net value of farm or business assets. We follow the study of precautionary savings by Carroll and Samwick [1998] and sum components (i), (ii) and (iii) to construct a variable measuring *liquid* asset holdings.[3]

The wealth files can be matched to the core file of the PSID, which provides socio-demographic and income data at the family level. We restrict the sample to observations from the non-poverty subsample of the PSID, with households heads aged 25 to 54 and with at least 12 years of schooling. The objective of these restrictions is to obtain a sample that is representative of a large population while being sufficiently homogeneous to resemble our framework, which features no *ex ante* heterogeneity.

Analysis. Table 5 reports the mean value of three variables: liquid assets, annual earnings, and the ratio of liquid assets to annual earnings. Notice that the third row shows the mean of this ratio, which is different from taking the ratio of the mean of the first two variables.

Table 5. Asset holdings compared with annual earnings

	(1)	(2)	(3)
Average wealth (liquid assets), in 2000 U.S. dollars	15,920	15,306	13,058
Average annual earnings, in 2000 U.S. dollars	53,303	53,535	53,764
Ratio of wealth to annual earnings	0.29	0.27	0.22

Notes: Authors' calculations based on PSID data on households (non-poverty subsample) with head aged 25 to 55 years old and with at least 12 years of schooling. In column 2 (resp 3), the sample is trimmed at the 1st and 99th (resp. 5th and 95th) percentiles of the variable measuring the ratio of wealth to annual earnings.

The picture conveyed by Table 5 is readily described. When looking at liquid assets, we find that these amount to around a quarter of households' annual earnings. This average value is not too sensitive to the ratios observed at the two ends of the spectrum. As noted in the main text (see for instance Subsection 4.3), the figure is not unexpected in light of what the literature on precautionary savings documents. Table 5 motivates our focus on the trajectory of a worker who holds one quarter of annual earnings in savings to smooth out the shock of being separated from a full-time position.

[3] We focus on these categories since less liquid assets do not resemble the asset that the agent accumulates in our model. It seems likely that assets that cannot be liquidated without incurring a high transaction costs are less relevant to smooth out a temporary shocks to labour earnings.

In the calibration, the target used for β is a median asset level worth one half of the annual income of the worker. This value is higher than the wealth-to-income ratio computed in our data when we use liquid asset holdings. In fact, in the data the ratios are dragged down by a fraction of households with *negative* levels of wealth. Our model cannot speak to this feature because we preclude borrowing in order to economize on the number of parameters. Meanwhile, our calibration target implies a very high subjective discount rate: 15.2% on an annual basis. This is in line with the high subjective discount rates used in standard incomplete-market models in order to 'push' a fraction of agents towards the borrowing limit.

B.3 Transition Probabilities

For completeness, we explain how we calculate the data moments on labour market transitions that are used in the calibration. Based on Table 2, we compute the job-finding rate as the sum of transition probabilities $p(U \to F)$, $p(U \to V)$ and $p(U \to I)$. The latter component is the other data moment that we target in the calibration. We interpret it as a measurement of transitions from uninsured unemployment into involuntary part-time work.

C Numerical Experiments

This appendix complements Section 5 of the paper in two ways. Firstly, we give additional details on the numerical experiments conducted in Subsection 5.2, where we extend the model to study cyclical fluctuations in involuntary part-time work. The second part of this appendix reports the results from several robustness checks mentioned in the text.

C.1 Welfare costs of cyclical fluctuations in involuntary part-time risk

To recast the analysis of the business cycle within the context of the model, let us recall that we set $\pi_{F,P} = \bar{\pi}_{F,P}(1+\varepsilon_{F,P})$ and $\pi_{P,F} = \bar{\pi}_{P,F}(1-\varepsilon_{P,F})$ during bad times, and $\pi_{F,P} = \bar{\pi}_{F,P}(1-\varepsilon_{F,P})$ and $\pi_{P,F} = \bar{\pi}_{P,F}(1+\varepsilon_{P,F})$ during good times. The economy fluctuates between bad times and good times according to a symmetric Markov process.

Business-cycle patterns

Table 6 displays the empirical evidence that motivates our stylized characterization of short-run fluctuations. As is standard in business-cycle analysis, we study the cyclical component of quarterly time series taken in logs as deviations from a Hodrick-Prescott trend with parameter 10^5. In the table, we focus on $p(I \to F)$, $p(F \to I)$ and $p(U \to E)$.

The first row of Table 6 shows that $p(I \to F)$ and. $p(F \to I)$ deviate from their long-run value by on average 8.2% and 19.7%, respectively. Thus, by using $\varepsilon_{P,F} = 0.10$ and $\varepsilon_{F,P} = 0.20$ in the experiments, we replicate closely the business-cycle behaviour of these transition probabilities. Notice that we also explore the effects of raising $\varepsilon_{P,F}$ and $\varepsilon_{F,P}$ further to respectively 0.15 and 0.40. So doing, we aim at capturing the increased volatility of transition probabilities at the end of the sample period. The second part of Table 6 reports a set of correlation coefficients. They are all statistically significant at the 0.01 level. We observe, first of all, that the correlation between (the cyclical components of) $p(I \to F)$ and the job-finding rate ($p(U \to E)$) is positive and large, at 0.479. We do not introduce business-cycle variations in the job-finding rate (through, e.g., fluctuations in λ), but in our definition of tranquil economic times, we set $\varepsilon_{P,F}$ to 0.05 in order to account for this correlation. Second, we find that the correlation between (the cyclical components of) $p(I \to F)$ and $p(F \to I)$ is -0.358. This motivates our assumption of perfectly negatively correlated stocks, although the actual correlation is much below 1 in absolute value. By forcing a perfect correlation, we give the best chance for a large effect of business-cycle fluctuations.

Table 6. Business cycle moments of transition probabilities

		$p(I \to F)$	$p(F \to I)$	$p(U \to E)$
Std. Dev.		0.082	0.197	0.157
Correlation	$p(I \to F)$	1.0	-0.358	0.479
	$p(F \to I)$	–	1.0	-0.863
	$p(U \to E)$	–	–	1.0

Notes: Authors' calculations based on CPS data for the period 1994m01–2015m12. The time series are quarterly averages of the monthly series taken in logs as deviations from an HP trend with smoothing parameter 10^5.

In Subsection 5.2, we contrast the effects of fluctuations in transition probabilities around two steady-state values: $\bar{\pi}_{F,P} = 0.011$ and $\bar{\pi}_{F,P} = 0.022$. The motivation is straightforward. Over the entire sample period, the monthly transition probability $p(F \to I)$ is 1.12% on average. At the end of the Great Recession (more precisely: during the first two quarters of 2009), $p(F \to I)$ peaked at 2.16%. This transition probability has remained stubbornly high since then (see Borowczyk-Martins and Lalé [2016b]). Thus, we think the experiment is informative in that it explores an extreme scenario where $\bar{\pi}_{F,P}$ remains permanently elevated.

Welfare figures

In the experiment conducted in Subsection 5.2, we compare the lifetime values in full-time employment, when the cyclical risk of involuntary part-time work measured by $\varepsilon_{F,P}$ switches from 0 to a positive value. Let $W_F(a,z)$ (resp. $\widetilde{W}_F(a,z)$) denote the value of full-time work with asset a when the aggregate state of the economy is z and $\varepsilon_{F,P} = 0$ (resp. $\varepsilon_{F,P} > 0$). Given our choice of preferences, the change in lifetime consumption triggered by $\varepsilon_{F,P} > 0$, which we denoted as $\vartheta(a,z)$, satisfies:

$$1 + \vartheta(a,z) = \left[\frac{\widetilde{W}_F(a,z) + \frac{1}{1-\beta}\frac{1}{1-\sigma}}{W_F(a,z) + \frac{1}{1-\beta}\frac{1}{1-\sigma}} \right]^{\frac{1}{1-\sigma}}. \tag{1}$$

For all a, we aggregate $\vartheta(a,z_b)$ and $\vartheta(a,z_g)$ as follows. Since the Markov process for z is symmetric, the worker spend half of her time in $z = z_b$ and the other half in $z = z_g$. Therefore, we let

$$\vartheta(a) \equiv \frac{1}{2}\vartheta(a,z_b) + \frac{1}{2}\vartheta(a,z_g) \tag{2}$$

measure the welfare effect at the asset level a. Finally, in Table 5 of the paper, we report the *range* of values $\vartheta(a)$ computed over the support for asset holdings. This avoids aggregating the values $\vartheta(a)$ using some cross-sectional distribution of asset holdings. Moreover, it gives a good approximation of the average welfare effect since the range of computed values turns out to be quite narrow.

C.2 Sensitivity Analysis

Preference parameters. In table 7 we show the analogue of the results reported in Table 4 of the paper using different values for the relative utility of leisure, η. We report results based on a lower and higher relative value of leisure, namely $\eta = 0.25$ and $\eta = 0.75$. The calibration procedure for $\eta = 0.25$ yields: $\beta = 0.9905$, $\lambda = 0.3508$, $\phi_P = 0.1906$. For $\eta = 0.75$, the calibration procedure yields: $\beta = 0.9880$, $\lambda = 0.4328$, $\phi_P = 0.2218$.

With a lower value ($\eta = 0.25$) the gap in workers' welfare between involuntary part-time work and unemployment decreases, both for insured and uninsured unemployment (respectively from -7.633 to -4.567, and from -23.29 to -21.66). Inspection of the columns in each panel shows that all three components contribute to make unemployment relatively less costly than in the baseline scenario. With $\eta = 0.75$, the effect is the opposite (the value of the utility compensation increases). Our main finding, viz. the greater quantitative importance of 'access to full-time employment' in accounting for the welfare difference between involuntary part-time and insured unemployment, is still true in either of the two alternative parametrizations.

Table 7. Sensitivity analysis: The role of the utility of leisure

	1. Comparison with: Insured unemployment							
	a. $\eta = 0.25$				**b.** $\eta = 0.75$			
	△ labour earnings (1a)	△ access to full-time (2a)	△ hours constraint (3a)	△ total (4a)	△ labour earnings (1b)	△ access to full-time (2b)	△ hours constraint (3b)	△ total (4b)
1st quarter	-1.759	-3.038	0.230	-4.567	-2.527	-6.777	0.442	-8.862
2nd quarter	-1.238	-0.383	0.064	-1.557	-1.354	-0.530	0.146	-1.738
3rd quarter	-0.920	-0.314	0.065	-1.169	-1.084	-0.411	0.107	-1.387
	2. Comparison with: Uninsured unemployment							
	a. $\eta = 0.25$				**b.** $\eta = 0.75$			
	△ labour earnings (1a)	△ access to full-time (2a)	△ hours constraint (3a)	△ total (4a)	△ labour earnings (1b)	△ access to full-time (2b)	△ hours constraint (3b)	△ total (4b)
1st quarter	-15.57	-6.373	0.279	-21.66	-17.90	-8.527	0.211	-26.21
2nd quarter	-1.400	-0.963	0.230	-2.132	-1.985	-1.654	0.531	-3.108
3rd quarter	-1.040	-0.614	0.210	-1.443	-1.178	-0.674	0.306	-1.545

Notes: An entry in the table is the change (reported in percent) in quarterly consumption. The upper (resp. lower) panel of the table compares part-time employment with insured (resp. uninsured) unemployment, when wealth at the time of displacement amounts to one quarter of annual earnings. Columns 1a to 4a (resp. 1b to 4b) report results based on a low (resp. high) utility of leisure.

Table 8 is the analogue of Table 5 in the paper, except that the coefficient of relative risk aversion is changed to either $\sigma = 1.0$ or $\sigma = 3.0$. In Table 8, we use the baseline specification for η, i.e. $\eta = 0.50$. For $\sigma = 1.0$, the calibrated parameters are $\beta = 0.9963$, $\lambda = 0.5187$, and $\phi_P = 0.1749$, while under $\sigma = 3.0$ the calibrated parameters are $\beta = 0.9715$, $\lambda = 0.4484$, and $\phi_P = 0.2218$. The results are remarkably consistent with the baseline specification: the order of magnitude of the welfare figures is unchanged, and hence these remain far below the costs of business cycle fluctuations in unemployment typically found in the literature. It is worth noting that varying the parameter σ leads to large changes in the subjective discount factor, β, as per the calibration procedure (recall that σ is also the inverse of the elasticity of intertemporal substitution). These changes could in turn explain the invariance of the results.

Table 8. Sensitivity analysis: The role of relative risk aversion

		1. $\sigma = 1.0$		
Deviations around:	**a.** $\bar{\pi}_{F,P} = 0.011$		**b.** $\bar{\pi}_{F,P} = 0.022$	
	$\varepsilon_{F,P} = 0.20$	$\varepsilon_{F,P} = 0.40$	$\varepsilon_{F,P} = 0.20$	$\varepsilon_{F,P} = 0.40$
$\bar{\pi}_{P,F} = 0.261$	(1)	(2)	(3)	(4)
$\varepsilon_{P,F} = 0.05$	[-0.009, -0.008]	[-0.015, -0.014]	[-0.013, -0.012]	[-0.014, -0.012]
$\varepsilon_{P,F} = 0.10$	[-0.026, -0.025]	[-0.042, -0.040]	[-0.043, -0.042]	[-0.063, -0.059]
$\varepsilon_{P,F} = 0.15$	[-0.047, -0.046]	[-0.074, -0.072]	[-0.081, -0.079]	[-0.119, -0.115]
		2. $\sigma = 3.0$		
Deviations around:	**a.** $\bar{\pi}_{F,P} = 0.011$		**b.** $\bar{\pi}_{F,P} = 0.022$	
	$\varepsilon_{F,P} = 0.20$	$\varepsilon_{F,P} = 0.40$	$\varepsilon_{F,P} = 0.20$	$\varepsilon_{F,P} = 0.40$
$\bar{\pi}_{P,F} = 0.261$	(1)	(2)	(3)	(4)
$\varepsilon_{P,F} = 0.05$	[-0.012, -0.011]	[-0.018, -0.014]	[-0.015, -0.012]	[-0.014, -0.000]
$\varepsilon_{P,F} = 0.10$	[-0.036, -0.033]	[-0.055, -0.052]	[-0.054, -0.051]	[-0.077, -0.062]
$\varepsilon_{P,F} = 0.15$	[-0.066, -0.062]	[-0.100, -0.094]	[-0.103, -0.098]	[-0.150, -0.134]

Notes: An entry in the table is the range of welfare effects computed at different levels of asset holdings. The welfare effects measure the percentage change in lifetime consumption of an increase in the cyclical risk of involuntary part-time employment. The top and bottom left (resp. right) panel of the table shows the effects of deviations around the monthly transition probability $\bar{\pi}_{F,P} = 0.011$ (resp. $\bar{\pi}_{F,P} = 0.022$). The top (resp bottom) panel is based on the model calibrated with $\sigma = 1.0$ (resp. $\sigma = 3.0$).

Other robustness checks. Table 9 reports the results from changing the asset levels of individuals at the time of job displacement. The features worth pointing out are as follows. First, in the comparison with insured unemployment, the relative value of total utility compensation changes little with the level of initial wealth. Second, the contribution of the various components is also robust to changing initial wealth. Third, in the comparison with uninsured unemployment, the level of initial wealth plays a more important role in changing both the levels and contribution of the different components. In particular, the effects of 'labour earnings' becomes more potent when assets are lower. In all instances, 'access to full-time employment' remains a major contributor to the short-run welfare difference between involuntary part-time work and unemployment.

A previous version of the paper contained results based on slightly different estimates for the transition matrix Π and other calibration targets for λ and ϕ_P. The results were qualitatively similar

Table 9. Sensitivity analysis: The role of asset holdings at the time of displacement

1. Comparison with: Insured unemployment

	a. $a=1$ month of earnings				**b.** $a=6$ months of earnings			
	$\triangle$ labour earnings (1a)	$\triangle$ access to full-time (2a)	$\triangle$ hours constraint (3a)	$\triangle$ total (4a)	$\triangle$ labour earnings (1b)	$\triangle$ access to full-time (2b)	$\triangle$ hours constraint (3b)	$\triangle$ total (4b)
1st quarter	-1.886	-6.472	0.639	-7.719	-1.476	-4.399	0.790	-5.088
2nd quarter	-0.948	-0.595	0.197	-1.346	-0.506	-0.282	0.205	-0.584
3rd quarter	-0.627	-0.313	0.105	-0.835	-0.264	-0.066	0.046	-0.284

2. Comparison with: Uninsured unemployment

	a. $a=1$ month of earnings				**b.** $a=6$ months of earnings			
	$\triangle$ labour earnings (1a)	$\triangle$ access to full-time (2a)	$\triangle$ hours constraint (3a)	$\triangle$ total (4a)	$\triangle$ labour earnings (1b)	$\triangle$ access to full-time (2b)	$\triangle$ hours constraint (3b)	$\triangle$ total (4b)
1st quarter	-22.57	-6.562	0.013	-29.12	-12.09	-6.875	0.203	-18.76
2nd quarter	-2.579	-2.019	0.492	-4.106	-1.143	-0.811	0.214	-1.739
3rd quarter	-1.794	-1.268	0.459	-2.603	-0.788	-0.452	0.146	-1.094

Notes: An entry in the table is the change (reported in percent) in quarterly consumption. The upper (resp. lower) panel of the table compares part-time employment with insured (resp. uninsured) unemployment, when wealth at the time of displacement amounts to one quarter of annual earnings. Columns 1a to 4a (resp. 1b to 4b) report results based on initial assets amounting to 1 month (resp. 6 months) of annual earnings.

to those reported in the paper. We refer the reader to Tables 8, 9, and C2 to C4 in Borowczyk-Martins and Lalé [2016a] for robustness checks with respect to Π, λ and ϕ_P.

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