Zero-hours Contracts in a Frictional Labor Market

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Abstract

We develop an equilibrium search and matching model to evaluate the pros and cons of zero-hours contracts (ZHC), namely a labor contract where employers are not obliged to provide any minimum working hours, and workers can decline any workload. Our model emphasizes three channels through which ZHC affect labour-market equilibrium outcomes. First, a job-creation effect, as firms endowed with more volatile technologies can enter the market and/or are able to post more vacancies using these flexible contracts. Second, a substitution effect, whereby jobs that are otherwise viable under regular employment contracts become advertised as ZHC. Third,a participation effect, as workers who prefer flexible work schedules join the labor market to take advantage of ZHC. We calibrate our model to UK data and policies to assess the impact of ZHC on equilibrium allocation and welfare through each of these channels. Finally, we analyze sorting between different types of workers and firms using either type of contracts.[1]

Keywords: Zero-hours contracts; Working hours; Gig economy

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1 Introduction

The past few years have seen growing interest about the incidence of the so-called *gig economy* across both sides of the Atlantic (see Krueger [2018]). However, research on why these new labor relationships have emerged or how they affect workers' welfare and firms' profits is only at an early stage. In addition, detailed data on these contracts has only recently become available (see Katz and Krueger [2019] and the references cited at the end of this section for an overview of the existing literature).

This paper aims to fill part of this gap. In particular, we analyze the labour-market effects of the use of a specific atypical work arrangement which has become popular in the UK. This is the so-called "zero-hours" contract (ZHC, hereafter). After documenting stylized facts about ZHC in that country, we provide a theoretical framework to help understand their welfare effects on employers and workers in a market where these contracts are in competition with "regular" contracts. The distinguishing features of our modelling setup are that both workers and firms are heterogeneous –firms face more or less volatile demand and workers are more or less attached to the labor market– all jobs pay the same (minimum) wage, and employed workers may quit to other jobs. In this context trade-offs arise between contract types for different agents, leading to sorting patterns and welfare comparisons of interest to policy makers.

ZHC have been the subject of a heated controversy in the British media and political arena (see Adams et al. [2015] and Adams and Prassi, 2018). The debate is centered around two contrasting views: while employers (and some workers) point to the benefits of having flexible labor contracts in the face of fluctuating demand conditions, trade unions and other commentators have expressed strong concerns about potential exploitation of workers due to significant monopsony power in online labour market platforms (see Dube et al. [2018]). Moreover, Blanchflower (2019) argues that the expansion of ZHC and similar flexible contracts after the Great Recession has led to underemployment in the economy, rendering conventional measures of slack, like unemployment rates, less useful in explaining wage and inflation growth.

ZHC may provide a flexible transition from full-time work to retirement, allow to get some earnings while in education, or play the role of stepping stones towards more stable jobs. In effect, according to Datta et al. [2019], 40% of workers under these contracts were satisfied with the number of hours they work, while 44% would rather work more hours, and the remaining 16% would rather prefer to work less hours.[2]

In this respect it should be noticed that ZHC are akin to other work arrangements (e.g. those labeled 'reservist', 'on call', and 'if and when' contracts; see Dickens [1997]), some of which date back to the ninetieth century where workers hired under piece-rate contracts were not guaranteed any amount of fixed work on a daily or weekly basis, e.g. in industries involving dock labor. Likewise, ZHCs are not an exclusive feature of the UK labor market. Similar contracts can be found in Australia, Canada, Finland and Ireland, though they differ in legal status and levels of regulation.[3]

Our model highlights three channels through which ZHCs affect the equilibrium of the labor market. First, we identify a *job-creation* effect, as firms in more volatile technologies can enter the labor market and/or post more ZHC vacancies than when these contracts do not exist. Second, there is a *substitution* effect, whereby jobs that would be viable under conventional regular contracts are advertised as ZHC. Third, there is a *participation* effect, as an increasing number of workers preferring flexible work schedules enter the labor market

[2]A nice illustration of this phenomenon has been the offer made by McDonald in 2016 to 115,000 of its UK employees to move to regular fixed contracts, with a minimum number of guaranteed hours every week. This move has taken place after staff in its restaurants complained they were struggling to get loans and mortgages because they were not guaranteed employment each week. However, the company reported that about 80% of these workers chose to remain on flexible ZHCs. https://www.theguardian.com/business/2017/apr/25/mcdonalds-contracts-uk-zero-hours-workers

[3]Similar on-call contracts exist in European countries like the Scandinavian ones, Cyprus, and Malta. Furthermore, they are also used, albeit subject to a much heavier regulations in Germany, Italy and the Netherlands. They are either explicitly forbidden or not used in the remaining EU countries. In the US, on call working arrangements are also growing in importance. Despite the absence of federal regulation, several states operate 'show-up pay' laws, where employers are required to pay workers for a minimum number of hours, if they have been called to work, though coverage varies across these states and a number of exemptions exist (see Datta et al. [2019]).

to take advantage of ZHC. In addition, there is the issue of how different types of workers *sort* across firms offering different types of labor contracts.

We calibrate our model to UK data and policies to assess the impact of ZHCs on equilibrium allocations and welfare through each of the previous channels. In particular, were ZHC banned our simulations point to an increase of 0.9 pp. in the unemployment rate of the UK low-pay labor market, an increase in the share of regular contracts in the labor force of this labor market of 4.2 pp. and a reduction in its LFP of 2.6 pp. Additionally, we evaluate how the model outcomes respond to changes in labor market institutions, like e.g.a rise in the statutory minimum wages, a cap on working hours for all contracts, and regulation of overtime work, and the taper rate. The main finding, in line with the empirical results of Datta et al. (2019) is that a rise in the minimum wage increases the share of ZHC in such a labor maket. Overall, our goal is to evaluate the predicted welfare impact of the presence of ZHC in terms of unemployment rate and employment composition along both firm and worker heterogeneity.

Related Literature

A recent body of literature examines the consequences of flexibility in work arrangements on consumption and labor supply. For example, Koustas [2018] focuses on the large rise in rideshare employment during 2012-2016 in the US, where the number of active rideshare drivers now exceeds taxi drivers and chauffeurs. The main finding is that rideshare drivers tend to be more borrowing constrained than taxi drivers before starting as drivers. However, after a household begins ridesharing, total spending (net of auto expenses) rises by 3-5% and the excess sensitivity of spending to main payroll income falls by over 80%. Thus, flexible labor supply acts as an *insurance device*. His estimates suggest that households are willing to pay around $ 1,800 per year for flexible work.

This last figure is in line with the experimental results for a US national call centre reported by Mas and Pallais [2017] where the average worker is willing to give up 8% of wages for the option to work from home. Besides, workers are also prepared to pay 20% to avoid a schedule set by an employer on short notice.

Another paper dealing these issues, this time focusing on the US retail sector, is Frazier [2017] which aims to understand the effect of regulations restricting variation in hours. The setup is an equilibrium directed search model of hours and wages, where a job offer is a combination of a wage and a distribution of hours from one of two sectors. In the first sector the employer is allowed to adjust hours in response to a productivity shock, while in the other sector hours are fixed. Search frictions in the economy generate imperfect sorting between workers and firms. Here the key trade-off between the two contract types are the wage level and the hours flexibility, whereby wage differences act as a compensating differential for unwanted hours flexibility. More recently, we have come across another paper by Scarfe [2019] which uses a similar model to ours in order to explain the effects of casual work in Australia. In her model, however, workers are risk neutral, wages are Nash bargained (albeit in a restrictive sense), job creation is different and the micro-foundations of the firm's choices are different. Moreover, in contrast to our results, her calibrated general equilibrium effects of a ban on casual work are massive since workers do not rank contracts.

As regards ZHC in the UK, to the best of our knowledge, the only (non descriptive) paper is Datta et al. [2019], which documents how the 2016 rise in the UK minimum wage resulted in an increase in the use of ZHCs in the UK social care sector, and in low wage sectors in general.

Our specific contribution to this literature is threefold. First, we model incentives in both sides of the labor market to operate with ZHC, where both firms and workers are heterogeneous in their relative valuation of ZHC compared to regular contracts. Second, in contrast to Frazier [2017], we assume random search and allow for job-to-job mobility in exchange for our simplifying assumption of a common hourly wage for all workers . This type of worker turnover will be key in the firms' choice of contract type since less desirable contracts will experience higher quit rates which will depress firms' profits. Finally, our structural approach will complement Datta et al. [2019]'s findings on the impact of a rise in minimum wage and disect the mechanism through which all agents in the labor market respond to this rise.

The rest of the paper is structured as follows. Section 2 describes the regulatory framework of ZHCs in the UK. Section 3 provides the main stylized facts about these contracts, using information from the UK LFS. Section 4 lays out the model we use to characterize the evolution of ZHC and regular contracts in a frictional labor-market setup; the model is calibrated to the UK. Section 5 evaluates the labor market effects of ZHC, and their response to several policy changes. Finally, Section 6 concludes.

2 Regulatory framework

This section reviews the legal status of individuals on ZHC in the UK, as well as their entitlement to welfare under these contracts.

Workers' rights As will be explained below, ZHC typically give staff a 'worker' employment status, which lies between the categories of "employee"and "self-employed". This status will confer such individuals with the following employment rights:[4]

- Right not to be discriminated against under the Equality Act 2010;
- Right to receive pro-rata holiday pay and other working time rights (Working Time Regulations 1998);
- Right to receive Statutory Sick Pay (so long as they have met the Lower Earnings Limit);

[4]There is some controversy between trade unions and employers associations about whether individuals on ZHC are workers or employees. While the Trade Unions Congress (TUC, 2018) considers that most of them are workers, the Chartered Institute of Personnel and Development (CIPD, 2013) states that, in a survey carried out by this institute, two-thirds of interviewed employers reported that they classified those individuals as employees.

- Automatic enrolment for pensions;
- Protection from unlawful deductions from wages;
- Right to receive the hourly National Minimum Wage or National Living Wage.[5]

These rights will also depend on the individual employment contract. [6] Since May 2015 exclusivity clauses in ZHC, which stop someone from taking on another job, have been banned. Employers cannot enforce the clause, and since January 2016, workers have been able to claim compensation at an employment court if they are punished or dismissed for looking for work elsewhere.

Whereas in the UK workers under ZHC are not obliged to provide any minimum working hours, in Ireland individuals are contractually obliged to be available for work if called by employers. By contrast, "self-employed" individuals have no employment rights besides certain discrimination rights. At the other end of the spectrum "employees" have the whole range of employment rights including unfair dismissal and redundancy and family rights, such as paid maternity leave.

The distinction between the status of "worker" and that of "employee" has been subject to court litigation recently. A well-known case is whether companies like Uber or Deliveroo should hire under employment contracts or freelance work. To the extent that some of these firms use contractors rather than employees, they do not fall into the above definition of ZHC. The most important difference between these two categories of workers is that employers must offer "employees" work in exchange for pay, and "employees" are required to do the work, whereas "workers" can turn work down, depending on their *availability.*

However, whether an individual is considered to be an "employee" or a "worker" will depend not just on what it is the offered contract, but what happens day to day. While a

[5]In the UK there are several minimum wages in place. From April 2016 there are three rates for youth (16-17, 18-20, and a special one for apprentices), another one for adults (20-24), and finally the new NLW (25+) which was updated in April 2018 to £7.83 an hour.

[6]However, in contrast to employees, workers can be unfairly dismissed and do not receive a statutory redundancy payment

contract might say that there is no obligation to work, if the individual is 'punished' for not accepting all the offered hours offered, or consistently work a set number of hours, then a tribunal might decide that she is actually an "employee".

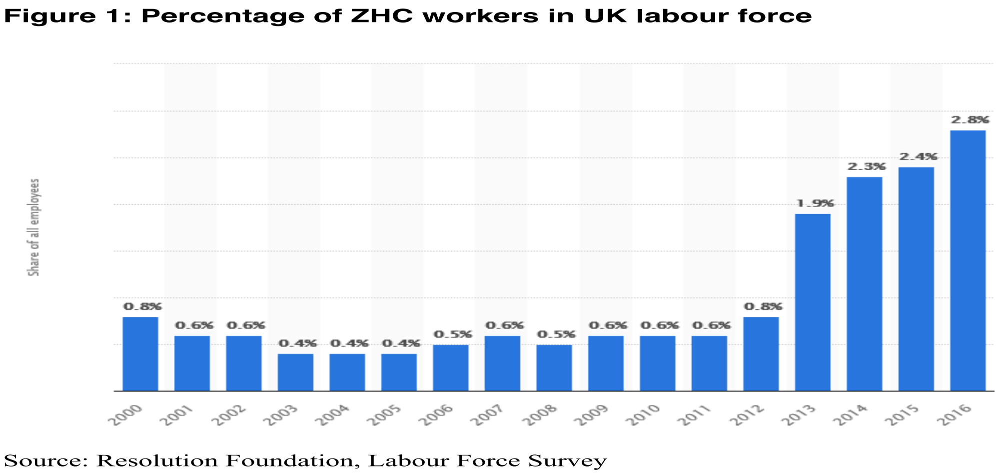
Entitlement to welfare Since workers under ZHC are often low-wage earners, they are entitled to means-tested benefits and tax credits. In the past, the benefits one could claim depended on whether individuals worked more than 16 hours in a week, as in the case of Income Support or Jobseekers' Allowance (JSA). When working 16 hours a week or more, they could also claim the Working Tax Credit, Child Benefit and Housing Benefit if they needed help with the rent and had savings less than Â£16,000.

However, in 2013 Universal Credit (UC) replaced all of these income support schemes with a taper rate of 65% (63% since 2018) implemented from a typical monthly work allowance of (net of taxes) £490 for single workers. With a current hourly NMW of £7.38 (20-24) and NLW of £7.83 (25 and above), plus an estimated average hours of work under ZHC of 25 hours in a week (see Resolution Foundation), the monthly wage of a ZHC workers would be between £738 and £783. Since the maximum monthly income support under UC are £252 (for workers under 25) and £318 (over 25), someone working 100 hours in a month would receive £898 (=252+490+0.63(738-490)) if aged under 25 and £993 (=318+490+0.63(783-490)) if aged 25 and over.

3 Stylized facts about ZHC

The number of ZHCs in the UK has surged fivefold since the beginning of the 2010s, although there are signs of having reached a plateau in the last few years. As depicted in Figure 1, in 2016 there were slightly above 900 thousand workers under ZHC, which represents about 2.8% of all employees in the UK labor force (0.8% in 2012). Likewise, a survey of businesses (ONS, 2018) estimates that there were around 1.8 million ZHC at the end of 2017, representing around 6% of all employment contracts.

Figure 1. Share of ZHC in UK labor force



In this section, we present some stylized facts about ZHC drawn from the UK LFS.[7] This dataset has the advantage of covering a large number of individuals in each cross-section, which is important for our purposes since ZHC represent a fairly small share of the labor market. Moreover, the UK LFS has a modest longitudinal dimension (since it only follows individuals over 5 quarters) that will be analyzed in the latter part of this section.

We start by examining a recent cross-section dataset of the LFS. We use here the survey carried out in the second quarter of 2018 and restrict our attention to individuals of working age, 18 to 65. This leaves us with 54,544 individuals, out of whom 76.2% are in employment, 2.8% are unemployed according to the ILO definition and 21% are inactive.

Every other quarter, the LFS includes a question relating to the contractual nature of employment of the respondent. In our sample, 716 individuals declare having a ZHC contract of employment. This represents 1.3% of all individuals surveyed in our sample and 2.2% of those being employed. All individuals on ZHC report being employed. The breakdown of answers across all types of alternative contracts is reported in Table 1. It is clear from these

[7]Unlike the business survey, where there may be several ZHC for each job, the LFS counts people rather than contracts. One individual may also hold contracts with several different employers. The LFS only counts people who report to have ZHC in their main job. Hence, if the ZHC is held in a secondary job, they will not be counted. Yet, the additional job is counted in the business survey.

Table 1. Contract types

Type of agreed working arrangements	Z	R	Total
Does not apply	0.00	0.40	0.39
flexitime	3.49	10.82	10.66
annualised hours cont	0.28	4.91	4.81
term time working	3.21	4.19	4.17
jobsharing	0.14	0.33	0.32
9-day fortnight	0.00	0.27	0.26
4.5-day week	0.00	0.56	0.55
zero hours contract	92.88	0.00	2.02
on-call working	0.00	1.73	1.69
none of these	0.00	76.80	75.13
Total	100.00	100.00	100.00

figures that all other types of contracts are included in what we will call regular contracts and we should bear in mind that 23% of these refer to contracts where weekly hours may vary, i.e. "flexitime", "annualised hours contracts" and "term-time working".

The mean age of employees in ZHC is markedly younger than in other contracts: 38.8 years versus 42.9 years old. In order to get a more precise view of the use of ZHC over the lifecyle, we display in Table 2 the shares of ZHC in employment in 3-year age bands between 18 and 65. This shows an increased prevalence of these contracts at both ends of the working life: 10.6% of employed 18-20 year-olds are in ZHC, as are over 3% of those aged under 27 and over 62; by contrast, only around 1.5% of prime-age workers (from 30 to 55) hold these contracts. Thus, we observe that a greater share of ZHC in employment coincides with age ranges when labour force participation LFP is low.

Furthermore, female employees are more likely to hold a ZHC than a regular contract, as they represent 55.5% of ZHC employment vs. 49.4% of regular employment. Table 3 shows the distribution of education across non-employment, regular employment and ZHC. Perhaps unexpectedly these distributions only exhibit modest differences: 25% of ZHC employees hold a degree or equivalent vs. 35% of employees in regular contracts, and 17% of ZHC employees hold no or "other" qualifications vs. 13% of employees in regular contracts.

Table 2. Distribution of labour contracts by age

age bands	Z	R	Total
1	10.55	89.45	100.00
2	5.29	94.71	100.00
3	3.69	96.31	100.00
4	2.10	97.90	100.00
5	1.62	98.38	100.00
6	1.49	98.51	100.00
7	1.42	98.58	100.00
8	1.25	98.75	100.00
9	1.22	98.78	100.00
10	1.79	98.21	100.00
11	1.52	98.48	100.00
12	1.19	98.81	100.00
13	1.78	98.22	100.00
14	1.93	98.07	100.00
15	2.58	97.42	100.00
16	3.16	96.84	100.00
Total	2.18	97.82	100.00

Table 3. Distribution of education by labor contract

Highest qualification	Not employed	Z	R	Total
Degree or equivalent	23.39	24.86	35.21	30.38
Higher education	8.29	10.20	9.38	8.96
GCE A level or equiva	23.57	27.23	22.05	22.72
GCSE grades A*-C or e	21.42	19.55	19.03	19.99
Other qualification	9.60	11.45	7.69	8.50
No qualification	13.72	6.70	6.63	9.45
Total	100.00	100.00	100.00	100.00

Table 4. Distribution of tenure by labor contract

Length of time with current employer	Z	R
Less than 3 months	5.74	2.63
3 months, less that 6	5.74	3.77
6 months, less than 1	13.52	7.75
1 year, less than 2	21.52	11.22
2 years, less than 5	31.15	19.04
5 years, less than 10	12.91	16.85
10 years, less than 2	7.17	24.42
20 years or more	2.25	14.32
Total	100.00	100.00

Table 4 shows the distribution of tenure with the current employer of employees in either type of contract. Rather surprisingly, nearly half of ZHC employees report tenures longer than 2 years, contrasting with the popular image of ZHC precarious contracts. Tenures are on average shorter in ZHC contracts than in regular contracts, but probably less so than expected: 22% of employees in ZHC have been with their current employer for more than 5 years vs. 54% or employees in regular contracts; 9.2% of ZHC employees were recruited in the last 3 months vs. 3.4% of employees in regular contracts.

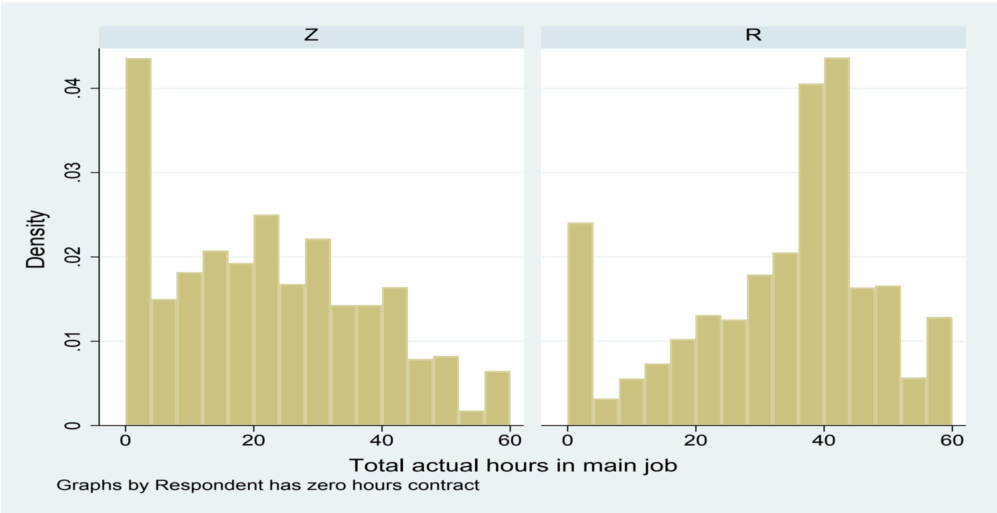
In our dataset, the only measure of hours that does not suffer from a large fraction of missing data is the "total actual hours in the main job". There is no variable indicating whether the survey respondent is on holiday in the relevant week, so we report in Table 5 and Figures 2 and 3 distributions of hours with and without assuming that 10% of respondents are on holiday at any given point in time. Two features of these distributions are as expected: ZHC employees work on average fewer hours, and the cross-sectional variance of these hours is greater than in regular contracts. There is, however, another feature which is more surprising: the variance of hours in regular contracts is still substantial. On the other hand, when asked "why pay usually varies", only 0.8% of respondents in regular contracts say that the number of hours and days of work vary, whereas 8.4% of those in ZHC do so.

Turning to the breakdown of ZHC employment by industry, we observe in Table A-1

Table 5. Mean and variance of actual hours worked

	mean	std dev	N
All			
Z	21.5	15.9	700
R	32.3	15.7	31,643
Excluding holidays			
Z	23.8	15.0	631
R	35.8	12.2	28,479

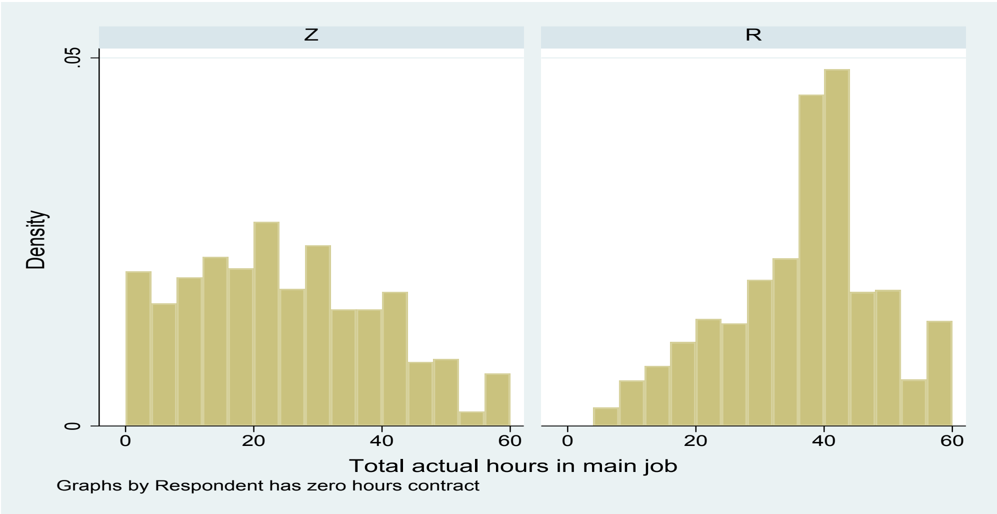
Figure 2. Distribution of actual hours worked



that "Arts and Entertainment" (19% of employment), "Accommodation and Food" (14%) and "Admin and Support Services" (7%) are the industries where ZHC are more prevalent. The sectors of "Health and Social Work" and of "Wholesale, Retail and Repair of Vehicles" represent large shares of ZHC employment (20% and 13% respectively) even though the use of these contracts within these industries is average (6.8% and 2.8% respectively).

Table A-2 shows the distribution of occupations in both types of contracts. Here the differences are substantial: only 1.8% (resp. 13.5%) of ZHC employees are in higher (resp. lower) managerial and professional occupations, vs 16.9% (resp. 28.2%) of other employees. On the other hand, 57.7% of ZHC employees are in semi-routine or routine occupations or have never worked before (which we will call "lower occupations" hereafter), while the corresponding figure among regular employees is 23.5%. Table 6 shows the distribution

Figure 3. Distribution of actual hours worked - excluding holidays



of education across occupations in both types of contracts. This gives limited evidence of over-qualification in routine and semi-routine occupations where 25.6% of ZHC holders have higher education or more vs. only 15.7% in regular contracts.

Unfortunately, our dataset has too few non-missing observations on pay in ZHC to derive meaningful descriptive statistics. Since our model focuses on the minimum-wage segment of the labor market and gives no role to wage dispersion, we will use a subset of the data relating to those occupations where the minimum wage tends to prevail. As a result, in our theoretical framework and empirical evaluation, we will restrict our attention to the labor market in lower- occupations which cover around 1.6 m. workers in the UK. Within this sub-labor market, ZHC represent 6.6% of employment. The descriptive statistics related to this sub-market are reported in the Appendix and show a similar qualitative picture.

Among unemployed respondents, 66.8% report a previous job in the "lower occupation" sub-market. We examine the distribution of the duration of unemployment for these individuals. As can be seen in Table 7, 33% of this group have been unemployed for under 3 months and 19% for over 2 years.

Finally, as mentioned above, individuals in the UK LFS are followed over 5 consecutive quarters and 20% of them are replaced from the sample every quarter. This longitudinal

Table 6. Cross-tabulation of occupation and education

Z Employment							
NS-SEC major group	Degree	Higher ed	A lev	GCSE	Other	No qual	Total
Higher managerial and	69.23	7.69	15.38	7.69	0.00	0.00	100.00
Lower managerial and	53.61	19.59	16.49	7.22	2.06	1.03	100.00
Intermediate occupati	30.99	14.08	23.94	11.27	16.90	2.82	100.00
Small employers and o	17.74	9.68	20.97	30.65	9.68	11.29	100.00
Lower supervisory and	23.33	5.00	38.33	15.00	6.67	11.67	100.00
Semi-routine occupati	17.32	6.15	24.58	29.61	14.53	7.82	100.00
Routine occupations	18.12	10.14	18.12	18.84	23.19	11.59	100.00
Never worked, unemplo	14.58	9.38	57.29	17.71	0.00	1.04	100.00
Total	24.86	10.20	27.23	19.55	11.45	6.70	100.00
R Employment							
NS-SEC major group	Degree	Higher ed	A lev	GCSE	Other	No qual	Total
Higher managerial and	66.97	8.33	12.61	8.09	2.32	1.67	100.00
Lower managerial and	52.02	12.23	17.00	12.61	3.30	2.84	100.00
Intermediate occupati	26.31	9.88	29.17	25.36	5.17	4.10	100.00
Small employers and o	21.03	9.30	27.87	21.15	10.58	10.07	100.00
Lower supervisory and	11.34	9.76	35.16	23.69	12.13	7.91	100.00
Semi-routine occupati	11.74	7.55	23.67	30.72	13.78	12.54	100.00
Routine occupations	6.27	4.46	20.29	27.98	21.34	19.67	100.00
Never worked, unemplo	25.13	7.41	41.67	19.18	3.70	2.91	100.00
Total	35.21	9.38	22.05	19.03	7.69	6.63	100.00

Table 7. Distribution of unemployment duration in previous lower occupation

Duration	Percent
Less than 3 months	31.05
3 months,less that 6	12.64
6 months, less than 12	15.60
1 year, less than 2	15.60
2 years, less than 3	6.86
3 years, less than 4	4.37
4 years, less than 5	3.59
5 years or more	10.30
Total	100.00

Table 8. Transition rates between contract types and employment status

	NE	Z	R	Total
NE	66.78	3.42	29.80	100.00
Z	8.02	86.57	5.41	100.00
R	4.50	0.35	95.15	100.00

dimension can be useful to provide a better understanding of the composition of ZHC employment and its main differences with regular employment and to shed light on the dynamics of employment in these contracts. Since one wave of the longitudinal dataset relates to 20% of a cross-section and ZHC are a small fraction of employment, a problem, however, is that we do not have enough observations in a single wave to draw useful information. As result, we have pooled the 8 most recent waves of the longitudinal LFS, from October-December 2015-6 to July-September 2017-8 in order to gather enough observations on ZHC workers. We will assume in the following that the labor market was stable over this period in the dimensions that we describe. We obtain information on 32,117 respondents, of whom 679 report being employed in a ZHC in at least one interview and 250 are observed employed in a ZHC in two consecutive semesters.[8]

Table 8 shows the transition matrix between three labor market states –non-employed, employed in a ZHC (hereafter denoted Z in short) and employed in a regular contract (denoted R). Several interesting facts emerge from this matrix. First, 10% of exits (=3.42/33.22) from non-employment are to Z contracts. Second, the rate of loss of employment over two quarters is almost twice as large in Z than in R (8.02.8% vs 4.50%). Third, the rate of continuous employment in the same contract type is larger in R than in Z contracts (95.15% vs. 86.57%). Fourth, this last figure seems in line with the distribution of tenure with the same employer that we described above, where 80% of Z employees remained with the same employer for over 6 months.

To gain an insight into the types of individuals in terms of their labor force attachment

[8]To be precise, each individual is only asked this question twice (two quarters apart) over their 5 quarters in the LFS.

Table 9. Labor market trajectories

	NE	ZZ	RR	ZR	RZ	Total
Entrant	3.74	0.40	0.02	0.51	0.00	1.51
EE	2.48	88.00	95.99	90.40	87.45	58.44
EU	1.12	0.80	0.39	1.01	0.87	0.69
EI	4.91	3.60	1.32	2.02	4.33	2.80
UE	1.67	2.40	0.46	2.53	1.73	0.98
UU	1.95	0.00	0.03	0.00	0.00	0.79
UI	1.35	0.00	0.00	0.00	0.00	0.54
IE	5.16	4.00	1.00	2.53	3.03	2.71
IU	2.06	0.40	0.01	0.00	0.00	0.83
II	66.72	0.00	0.07	1.01	0.87	26.73
Retiree	8.85	0.40	0.72	0.00	1.73	3.97
Total	100.00	100.00	100.00	100.00	100.00	100.00

who are employed in each type of contract, we display in Table 9 the composition in terms of their labor market history over their 5 quarters in the sample of four sub-groups: those reporting Z (resp. R) employment in two consecutive semesters and those switching from Z to R (resp. R to Z) employment in two consecutive semesters. Comparison of the four columns suggest that workers who are at some point employed under a Z contract tend to be less attached to employment or the labor force as they exhibit higher transition rates to and from these states. Note that the column "NE" refers to individuals who report not being employed in the two interviews when the contract type question is asked. This does not rule out that they could be employed in any of the other three quarters of their presence in the survey.

Table A-3 shows the distribution of tenure with the current employer for the four sub-groups defined above. As expected, the group of individuals reporting R employment in two consecutive semesters exhibit the longest average tenure and the two groups reporting having switched from R to Z employment or vice-versa exhibit the shortest average tenures. Surprisingly though, over 85% of each of these groups report tenures longer than 6 months, even though they report changing contracts. These "contract switchers" represent over a half of individuals who ever report being in Z employment in this dataset, so this is a very relevant

Table 10. Distribution of individual hours processes

	mean	std. dev.
ZZ	19.21	7.87
RR	31.00	8.16
ZR	22.55	7.84
RZ	23.21	8.00

phenomenon. An alternative explanation is intermittent mis-classification in contract type.

Desired job mobility varies substantially across groups: 4% of those continuously employed under R contracts report "looking for a different or additional paid job", whereas 12% or those under Z contracts do so. Among contract switchers, 14% of those reporting a switch from Z to R report looking for a different job vs. only 10% of individuals switching the other way do so.

In a similar vein, 19% of those in continuous Z employment report wishing to "work longer hours at current basic rate of pay", contrasting with only 6.6% of those in continuous R employment.

An advantage of having longitudinal data on individual hours is that we can gauge whether the variability of hours commented above is specific to the average individual history of hours worked or just reflects the variance of constant individual hours sequences. We show in Table 10 the averages of means and standard deviations of individual hours sequences. These sequences each comprise 5 quarterly observations. The mean weekly hours of individuals employed in ZHC continuously is 3.5 hours lower than those of individuals changing contracts either way, which are 4 hours lower than the mean hours of individuals in continuous R employment. The coefficient of variation of individual hours processes is 1.5 larger in the group of employees continuously in ZHC than in the group of employees in continuous R employment.

Table A-4 reports the occupational breakdown for the four groups defined above. This breakdown is quite similar across the three groups who report Z employment in one of the two semesters. They are most represented in "Caring, Leisure And Other Service" "Elementary

Occupations", which are also the two occupations with the highest shares in these three groups. The group of individuals continuously employed in R contracts includes greater shares in higher occupations "Managers, Directors And Senior Officials" and "Professional Occupations"

As before, we have computed all the above descriptive statistics for a subset of our longitudinal data restricted to lower occupations likely to pay around the minimum wage. These are shown in Appendix **??**. All results are qualitatively similar to those reported above.

4 Model

The objective of our model is to analyze the incentives of heterogeneous workers and firms to post/accept contracts of either type (i.e. ZHC or regular). In addition, we provide an understanding of the equilibrium stocks and flows between employment in either contract type and unemployment.

In our framework, time t is discrete and the economy is populated by heterogeneous workers and firms who have a common discount factor $\beta \in (0, 1)$. Our focus is on the labour market segment of low-paid occupations, we assume that all matches pay the minimum wage, denoted w. Firms choose what type of job to create at the point of advertising vacancies. They are not allowed to change the nature of the contract beyond this point. Search is random and the contact rates for unemployed workers and for vacant jobs are λ_u and λ_f respectively. When employed, workers under Z contracts may choose to search on-the-job. If they do their relative search intensity is x and their contact rate is $\lambda_e = x.\lambda_u$. Job destruction is exogenous and depends on the contract type: δ_Z and δ_R.[9]

[9]This difference in job destruction rates will be endogenized in a future version of the model.

4.1 Workers

Workers can be either unemployed or employed. In unemployment, they receive unemployment benefits b, while in employment they work for h hours. These hours are guaranteed and constant in R contracts, $h = \bar{h}$, whereas they are variable in Z contracts: h is drawn from a distribution $G(.)$, which is job-specific (this will be described shortly). When earning labour income $w \cdot h$, workers lose their unemployment benefit at a taper rate τ, so that their total income is:[10]

$$\text{inc}\,(h) = \max\left\{wh, b + (w - \tau)\,h\right\} \tag{1}$$

Workers are available for work for a hours. If they work more than a hours, they incur a linear dis-utility cost equal to $\alpha.\max\{h - a, 0\}$.

Preferences are homogeneous and the cost parameter α is identical for all workers. However the distribution of availability a is type specific, with cdf $\Gamma_i(\cdot)$. Finally, it is assumed that some workers quit to unemployment at rate q_i (see below).

There is no saving/borrowing and workers consume all their income. They derive utility from consumption (equal to income) according to a CRRA function. Instantaneous utility is thus given by:

$$u\,(h, a) = \frac{\text{inc}\,(h)^{1-\eta} - 1}{1 - \eta} - \alpha.\max\{h - a, 0\} \tag{2}$$

We assume that shocks to a and h are more frequent than firm's and worker's decisions (which are taken once per model period). The assumption of higher frequency of shocks is adopted to allow a role for the different volatility of shocks to desired and available hours without giving the current level of hours too large a role. Thus, decisions by firms and workers are taken with respect to expectations of flow utility/profit over a longer period

[10] We assume that there are no other sources of income for this segment of the labour market.

than that of shocks (e.g. a quarter for decision making and bi-weekly for the realisation of shocks in our calibration exercise; for more details, see further below). Calling n the number of shocks per model period, and assuming that the flow utility is anticipated at the beginning of each model period, they have to be expressed in terms of expectations (E). Using the subscript $lmw \in \{U, Z, R\}$ to denote the worker's labour-market state, ϕ denotes the flow utility in each state, which is given by:

$$\phi_{lmw} = n.E_{lmw}\left(u\left(h, a\right)\right) \tag{3}$$

where $h = 0$ in unemployment.

We conjecture that there are two types of workers (denoted i) with different distributions of shocks to a, $\Gamma_i(.)$, such that:

$$\begin{cases} U < W_Z < W_R & \text{for type 1} \\ W_R < U < W_Z & \text{for type 2} \end{cases}$$

where we label the asset values of being: (i) unemployed as U, (ii) employed under a Z contract as W_Z, and (iii) employed under an R contract as W_R. In addition, type-2 workers quit into unemployment with probability q whereas type-1 workers never do so. Due to being less attached workers they may suffer changes in their personal lives making them drop either R or Z contracts.

Clearly R contracts offer an stable income flow but more constraints on hours. The trade-off depends on the shape of the distributions $\Gamma_i(a)$ and $G(h)$. On the one hand, type-1 workers accept all job offers and search on-the-job when employed in a Z contract with search intensity , since they would prefer an R contract. On the other hand, type-2 workers only accept job offers under Z contracts and do not search on-the-job. If Z contracts were to be banned, notice that type-2 workers would remain unemployed. It is noteworthy that, despite not modelling the extensive margin decision of participating in the labor market, we could consider the latter case akin to being inactive. As a result, through this type of workers, we capture the *participation* effect of Z contracts.

4.2 Firms

Firms are risk-neutral and their measure is endogenously determined in the model. They face shocks to product demand and adjust labour demand (i.e. working hours) to maximize profits. If adjustments to hours are costless, optimal hours are $\widetilde{h}$. The distribution of shocks to labour demand, which is firm-specific, translates into a distribution of $\widetilde{h}$ denoted $H(.)$. When a fixed number of hours is offered, it is assumed that the firm incurs a quadratic cost of being away from $\widetilde{h}$, captured by $c\left[(h-\widetilde{h})^2\right]$. The micro-foundations of this specifications are provided in Appendix C. The instantaneous payoff function, π, can be therefore be expressed as:

$$\pi(h,\widetilde{h}) = (p-w)h - c\left[(h-\widetilde{h})^2\right] \tag{4}$$

Firms posting vacancies under Z contracts (which do not guarantee a fixed level of hours, in which case $h=\widetilde{h}$) avoid the quadratic cost term, so that their flow payoff is just the first term in the RHS of (4). Alternatively, firms which post an R contract guaranteeing $\bar{h}$ hours of work, so that $h=\bar{h}$, incur the quadratic cost in (4). Shocks to $\widetilde{h}$ occur each sub-period (as shocks to a for workers). At the beginning of the period, the firm anticipates the flow payoffs σ_{lmf} for each labour market state $lmf \in \{V, Z, R\}$ it faces over the whole period:

$$\begin{aligned}
\sigma_V &= -n.k \\
\sigma_Z &= n.(p-w).E(\widetilde{h}) \\
\sigma_R &= n.\left[(p-w).\bar{h} - E\left(c\left[\left(\bar{h}-\widetilde{h}\right)^2\right]\right)\right]
\end{aligned} \tag{5}$$

Exogenous job destruction shocks hit jobs with probability δ_Z and δ_R,respectively.

Denoting the asset values of a vacancy of either contract type V_Z and V_R and of a filled job under a R contract as J_R and a filled job under a Z contract as J_Z,

We conjecture that there are three firm types (denoted j) with different distributions of shocks to $\widetilde{h}$, $H_j(.)$ such that:

$$\begin{cases} V_R^c < 0 < V_Z^c & \text{for type } c \\ 0 < V_R^s < V_Z^s & \text{for type } s \\ 0 < V_Z^r < V_R^r & \text{for type } r \end{cases}$$

The three categories of firms exhibit the following characteristics. First, when Z contracts become legal, type c-firms would predominantly *create* these jobs while, when abolished, they would abstain from creating any jobs. Thus, type c-firms allows us to capture the *job-creation* effect of allowing for Z contracts. Second, type s-firms would *switch* to R contracts if Z contracts are banned. Hence, this type of firms allows us to capture the *substitution* effect of Z contracts. Finally, firms of type r would *remain* offering R contracts irrespective of whether Z contracts are legal or banned.

In equilibrium there are stocks $e_{i,j}$ of matches filled with workers of type i, $i = 1, 2$ and firms of type j, $j = c, s, r$. The type-specific stocks of unemployed are denoted u_1 and u_2 while vacancy stocks for each type of vacancy are denoted v_j, $j = c, s, r$. The total stocks of unemployed and vacant jobs are u and v respectively.

4.3 Asset values

Workers:

Denote W_i^k the value to a worker of type i of being employed in a contract k. For workers of type 1, asset values are:

$$.W_1^Z = \phi_1^Z + \beta\left[(1-\delta_Z)\left(\lambda_e\frac{v_r}{v}W_1^R + \left(1-\lambda_e\frac{v_r}{v}\right)W_1^Z\right) + \delta_Z U_1\right] \tag{6}$$

$$W_1^R = \phi_1^R + \beta\left[(1-\delta_R)W_1^R + \delta_R U_1\right] \tag{7}$$

$$U_1 = \phi^U + \beta\left[\lambda_u\left(\frac{v_r}{v}W_1^R + \frac{v_c+v_s}{v}W_1^Z\right) + (1-\lambda_u)U_1\right]. \tag{8}$$

These workers accept all job offers but carry on searching on the job when they are employed in a Z contract. On the other hand, for workers of type 2, the asset values are:

$$W_2^Z = \phi_2^Z + \beta\left[(1-\delta_Z)(1-q_2)W_2^Z + (\delta_Z + (1-\delta_Z)q)U_2\right] \tag{9}$$

$$W_2^R = \phi_2^R + \beta\left[(1-\delta_Z)(1-q_{\text{"}})W_2^R + (\delta_R + (1-\delta_R)q)U_2\right] \tag{10}$$

$$U_2 = \phi^U + \beta\left[\lambda_u\frac{v_c+v_s}{v}W_2^Z + \left(1-\lambda_u\frac{v_c+v_s}{v}\right)U_2\right]. \tag{11}$$

These workers only accept offers from firms offering Z contracts and do not search on the job while employed since they have no expected gains to do so. Sometimes they quit into unemployment (at rate q).

Firms:

Let J_i^k be the asset value of a firm matched to a worker of type i under contract k, and V^k the value of advertising a vacant job with contract k. Given the workers' behavior described above, the firms' asset values under a Z contract are as follows:

$$J_1^Z = \sigma^Z + \beta(1-\delta_Z)\left[\left(1-\lambda_e\frac{v_r}{v}\right)J_1^Z + \lambda_e\frac{v_r}{v}V_Z\right] + \beta\delta_Z\ V^Z \tag{12}$$

$$J_2^Z = \sigma^Z + \beta(1-\delta_Z)\left[(1-q_2)J_2^Z + q_2.V^Z\right] + \beta\delta_Z\ V^Z \tag{13}$$

$$V^Z = \sigma^V + \beta\left[\lambda_f\frac{u}{u+x(e_{1,c}+e_{1,s})}\left(\frac{u_1}{u}J_1^Z + \frac{u_2}{u}J_2^Z\right) + \left(1-\lambda_f\frac{u}{u+x(e_{1,c}+e_{1,s})}\right)V^Z\right].. \tag{14}$$

Since the expressions for these values do not depend on the firm type, we have omitted the j

index referring to firm type to ease notation. Vacant jobs and filled matches under contract R have the following values for the firms:

$$J_1^R = \sigma^R + \beta (1 - \delta_R) J_1^R + \beta \delta_Z \; V^R \tag{15}$$

$$J_2^R = 0 \tag{16}$$

$$V^R = \sigma^V + \beta \left[\lambda_f \frac{u_1 + x (e_{1,c} + e_{1,s})}{u + x (e_{1,c} + e_{1,s})} J_1^R + \left(1 - \lambda_f \frac{u_1 + x (e_{1,c} + e_{1,s})}{u + x (e_{1,c} + e_{1,s})} \right) V^R \right]. \tag{17}$$

These contracts attract more stable workers of type 1 (*sorting* effect) who never search on-the-job. Z contracts do not incur costs of having to guarantee sub-optimal hours of work but experience a higher turnover. Note that we make a distinction between firms replacing workers have quit by re-advertising a vacancy of the same type, in which case the value is V_k and firms destroying the job, in which case the value is zero (see job creation below).

4.4 Matching and job creation

The labor market tightness is denoted θ. Workers and firms meet via random search and types are private information. Workers may decline a job offer. The number of contacts per unit of time is given by a standard Cobb-Douglas matching function with constant returns to scale and match efficiency parameter M, such that tightness, the job filling rate, and the job finding rate of the unemployed and type-1 workers under Z contracts who search on the job, given by:

$$\theta = = \frac{v}{u + x (e_{1,c} + e_{1,s})} \tag{18}$$

$$\lambda_f = M \theta^{-\kappa} \tag{19}$$

$$\lambda_u = M \theta^{1-\kappa} \tag{20}$$

$$\lambda_e = x . \lambda_u . \tag{21}$$

where κ is the matching elasticity with respect to unemployment, x is the search intensity of employed workers .

Besides the flow cost of opening a vacancy σ_V, it is also assumed that there is a lump-sum cost K of creating a job. Once this cost is incurred, firms draw their type with probability γ_j, $j = c, s, r$, and decide whether to post a vacancy or not, and what type of contract to advertise. When posting a vacancy, the firm decides on the type of contract $\{R, Z\}$ they will offer. Potential entrepreneurs enter the market until all rents are exhausted, i.e.

$$K = \gamma_c.V_Z^c + \gamma_s.V_Z^s + \gamma_r.V_R^r, \tag{22}$$

4.5 Laws of motion

The steady-state employment stocks in Z contracts are derived from the following laws of motion for $j = c, s$:

$$e'_{1,j} = \left(1 - \lambda_e \frac{v_r}{v}\right)(1 - \delta_Z)\, e_{1,j} + \lambda_u \frac{v_j}{v} u_1 \tag{23}$$

$$e'_{2,j} = (1 - q)(1 - \delta_Z)\, e_{2,j} + \lambda_u \frac{v_j}{v} u_2. \tag{24}$$

and for employment stocks in R contracts, we have:

$$e'_{1,r} = (1 - \delta_R)\, e_{1,r} + \lambda_e \frac{v_r}{v}(1 - \delta_Z)(e_{1,c} + e_{1,s}) + \lambda_u \frac{v_r}{v} u_1 \tag{25}$$

$$e'_{2,r} = 0. \tag{26}$$

The laws of motion for unemployment stocks are:

$$u'_1 = \delta_R e_{1,r} + \delta_Z (e_{1,c} + e_{1,s}) + (1 - \lambda_u)\, u_1 \tag{27}$$

$$u'_2 = ((1 - \delta_Z)\, q + \delta_Z)(e_{2,c} + e_{2,s}) + \left(1 - \lambda_u \frac{v_c + v_s}{v}\right) u_2, \tag{28}$$

and for the stocks of vacant jobs of firm types c and r advertising Z contracts:

$$v_j' = \left[\lambda_e \frac{v_r}{v} (1-\delta_Z) e_{1,j} + q(1-\delta_Z) e_{2,j} + \left(1 - \lambda_f \frac{u}{u + x(e_{1,c} + e_{1,s})}\right) v_j\right] + \left(\delta_Z \sum_i (e_{i,c} + e_{i,s}) + \delta_R e_{2,r}\right) \gamma_j, \tag{29}$$

while for vacant jobs of type r:

$$v_r' = \left(1 - \lambda_f \frac{u_1 + x(e_{1,c} + e_{1,s})}{u + x(e_{1,c} + e_{1,s})}\right) v_r + \left(\delta_Z \sum_i (e_{i,c} + e_{i,s}) + \delta_R e_{2,r}\right) \gamma_r. \tag{30}$$

4.6 Equilibrium

We can now define an equilibrium in this segment of the labor market as:

A stationary equilibrium is a list of asset values W_{xi}, U_i, J_{xj}, and choice of contract $x(i,j)$; a stationary distribution of workers e_{xi} and vacancies v_{xj}; and labor-market tightness θ such that:

1. (Workers optimize): Given θ , the vacancies v_j, and the quit rates q_i the asset values W_{xi} and U_i solve the Bellman equations in (6).

2. (Firms optimize): Given θ and the quit rates q_i, the asset values J_x solve the Bellman equations (14) and (17).

3. (Free-entry condition): Given $e_{i,j}$, u_i and W_i, U_i, J_x, the stocks of vacancies posted by type-j firms v_j solves (22).

4. (Time-invariant distribution): Given θ and the distribution of worker and firm types, the cross-sectional distributions $e_{i,j}$, u_i, v_j are time-invariant.

5 Calibration (work in progress)

In this section, we calibrate our model, evaluate its ability to capture relevant features of the U.K. low-paid labor market highlighted in Section 3, and discuss several other model outcomes. Low-paid employment in the UK affects 5 million workers in the UK as of 2018 with an unemployment rate of about 12 percent. We aim to match in the data the following 23 targets: (i) distribution of labour-market states across (U, Z, R) (2 moments); (ii) transition matrices among (U, Z, R) (6 moments); (iii) distributions of unemployment duration (3 moments) and job tenure in Z and R contracts (8 moments), and (iv) mean and standard deviation of hours of work in Z and R contracts (4 moments).

5.1 Parameter values

The model period is set to one quarter, whereas the random variables a and $\widetilde{h}$ are assumed to be drawn every fortnight. The minimum wage w is set equal to 1, whereas the UI replacement rate b=0.65, the taper rate τ=0.63, and the guaranteed hours under R contracts $\bar{h}$=6 per day. The parameters used to fit the data are shown in Table 11.

Table 11. Calibrated parameters

λ_u	0.41
q_2	0.50
$\frac{v_c+v_s}{v}$	0.16
x	0.16
δ_R	0.045
δ_Z	0.000

With these parameter values, the distribution of worker types across the three labour market states is displayed in Table 12. As can be seen, a large majority of workers under Z and R contracts are type-1 (i.e, labor-market attached workers). Notice that the fact that only 1.11 percent of workers under Z contracts are type-2 (unattached) responds to the fact that the share of attached workers is very large in the population (i.e. $\omega_1 = 0.99$).

Table 12. Distribution of worker types

	Type 1	Type 2
Unemployment	0.854	0.147
Z employment	0.989	0.011
R employment	1.000	0

5.2 Model fit

Table 13 compares the mobility of workers among the different labour market states (U,Z,R) both in the data and the model confirming that the fit of the model is very good.

Table 13. Worker mobility fit

	Data	Model
Transition matrices	$\begin{bmatrix} 0.668 & 0.034 & 0.298 \\ 0.080 & 0.866 & 0.054 \\ 0.045 & 0.004 & 0.951 \end{bmatrix}$	$\begin{bmatrix} 0.663 & 0.039 & 0.298 \\ 0.080 & 0.866 & 0.054 \\ 0.045 & 0 & 0.955 \end{bmatrix}$
Ergodic distributions	$\begin{bmatrix} 0.124 & 0.053 & 0.823 \end{bmatrix}$	$\begin{bmatrix} 0.121 & 0.035 & 0.844 \end{bmatrix}$
Stocks	$\begin{bmatrix} 0.136 & 0.048 & 0.815 \end{bmatrix}$	$\begin{bmatrix} 0.121 & 0.035 & 0.844 \end{bmatrix}$

Figure 4 in turn shows the actual (red) and simulated (blue) distributions of employment tenure for worker under Z (upper panel) and R (middle panel) contracts, and unemployment duration (lower panel). The fit is again satisfactory. Note that we need heterogeneity in exit rates from both unemployment and Z employment in order to mimic the shape of the duration/tenure distribution in these two states. In this respect, the fact that type-1 and type-2 workers have different hazard rates of exit from both Z employment and unemployment is key to ensure the simulations perform well.

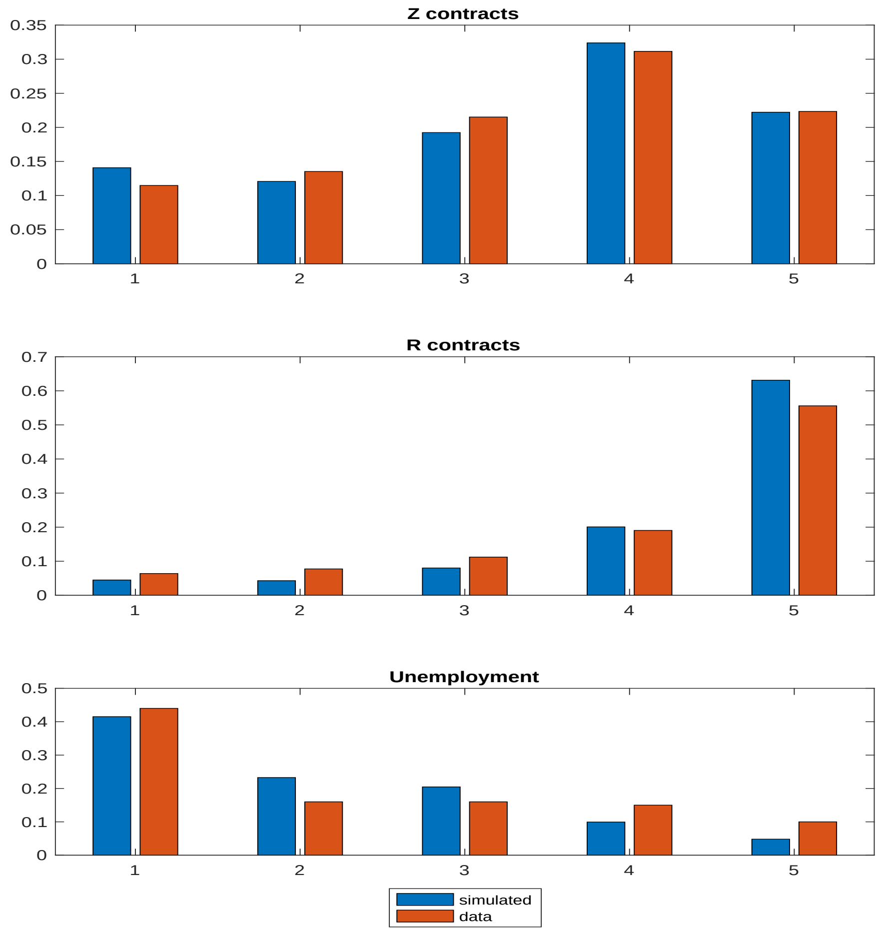


Figure 4. Fit of duration/tenures distributions

5.3 Counterfactual policy simulation

Given that these parameter values yield a good fit of the data, we proceed to simulating the impact of a counterfactual policy consisting of a ban on Z contracts. Since we only identify the share of firms of type r, we carry out simulations under three alternative assumptions regarding the fraction of firm types c in the underlying distribution of firm types. Results are reported in Table 15.

Table 14. Impact of banning Z contracts

	Baseline	Assumption on fc		
		0	0.05	0.10
Share of U in L	0.124	0.152	0.151	0.151
Share of Z jobs in L	0.053	0.0	0.0	0.0
Share of R jobs in L	0.823	0.848	0.849	0.849
Percentage change in tightness				
		-0.77	-1.31	-1.82
Destinations of Z workers/jobs				
Fraction going to U		0.70	0.70	0.69
Fraction going to R		0.30	0.30	0.31
Implied firm shares				
fc		0.0	0.05	0.06
fs		0.06	0.02	0.00
fr		0.94	0.94	0.94

For example, when $f_c = 0.05$ (second column on the right panel of Table 15), a ban of Z contracts would increase the unemployment rate in the low-pay segment of the labor market by **2.7 pp.** (=15.1%-12.4%). This implies that 48% of the former Z workers would move to U, while the remaining 52% shift to jobs offering R contracts. As can be seen in the other columns of Table 15, these transition rates are fairly robust to the other considered values of f_c. As a result, defining the case of no Z contracts as the benchmark, their approval would imply a triple effect: (i) a *Job creation* effect of **5.3 pp.**, (ii) a *Substitution* effect (i.e, the fraction of R contracts that become Z contracts) of **3.1%.** (=1-82.3/84.9); and (iii) a *Participation* effect (i.e. the share of the labour force who become employed under either type of contract) of **2.7 pp.** (=(5.3% -2.6%)).

Next, using the utility function in (2) and the income definition in (1), we compute the welfare change due to a ban of Z contracts. Aggregate welfare decreases by 0.46% when the coefficient of risk aversion η is equal to 2. Not surprisingly, as workers become more risk averse, such a policy becomes less detrimental. In particular, we find that, for $\eta = 4$, welfare does not change and, above this cutoff value of risk aversion, it increases .

5.4 Qualitative impact of a rise in the minimum wage

Next, we follow Datta et al. [2019] in examining the impact of changing the minimum wage change on ZHC. In line with these authors we consider a rise of 7.5 percent, which corresponds to the increase in the National Living Wage (NLW) for workers aged 25 in the UK which has taken place since its introduction in April 2016. Before presenting results, however, we provide the basic insight of the link between changes in the minimum wage and the share of Z contracts according to our model.

A firm will prefer to open a vacancy under a Z contract than under an R contract whenever $V_Z > V_R$, which, with the asset values derived in section 4.3 and our calibrated parameters translates as the following condition on flow profits:

$$\sigma_Z - \sigma_R > 0.063.(\sigma_Z + \sigma_V) \tag{31}$$

As seen in (5) above, $[\sigma_Z - \sigma_R]$ is an increasing function of the variance of the distribution of orders to the firm, while σ_Z is an increasing function of the mean of that distribution minus the wage. As a result, a rise in the minimum wage will decrease σ_Z but not affect $[\sigma_Z - \sigma_R]$, therefore making the above condition less stringent. Consequently, more firms will choose to open vacancies under Z contracts.

Table 15 reports the results of the above-mentioned exercise. As can be observed, a rise of the minimum wage of 7.5 percent raises the share of workers under Z contracts in the low-pay segment of the labor market by almost 2 pp., with a decline in the share of R employees by 2.3 pp since the unemployment gap goes up by 0.3 pp. As regards firm types, the higher values of fc and fs reflect that more entry firms will offer Z contracts and that some firms will substitute R with Z contracts. Therefore, we obtain the qualitative finding that an increase in the minimum wage will increase the share of Z contracts in the economy, in line with

Datta et al. [2019]'s findings.[11]

Table 15. Impact of a Minimum Wage rise

	Baseline	Calibrated fc
Share of U in L	0.124	0.127
Share of Z jobs in L	0.053	0.072
Share of R in L	0.823	0.801
Implied vacancy shares		
fc	0.00	0.08
fs	0.16	0.18
fs	0.84	0.76

6 Conclusions

In this paper we provide a theoretical setup in which to discuss the effects of flexible contracts on labor market outcomes. In particular we focus on zero-hours contracts (ZHC) which became quite popular in the UK since 2013 or so. Under these contracts, neither employers nor workers commit themselves to offer/accept any given number of working hours. Both may prefer these contracts because of their flexibility; however, there may be workers that, due to risk aversion, prefer more stable working-hour schedules provided by what we coin regular contracts. With random matching, this may create high working turnover in ZHC which, in the presence of vacancy-opening costs, may lead firms in some instances to replace them with regular contracts .

Among these effects, we analyze how would the UK low-pay segment of the labor market respond to a ban on ZHC. We find the unemployment rate (around 12.4 percent in this segment) would go up by about 2.7 pp., the fraction of workers under Z contracts in the labor force would fall by 5.3 pp. and the participation rate would be reduced by 2.7 pp.

[11] In the next draft we will provide simulation results on the effects of the other policies discussed in the foreword of this section, as well as welfare changes

This policy would imply a reduction in aggregate welfare of -0.46% when the coefficient of risk aversion is equal to 2, whereas welfare would increase when this parameter is above 4. In addition, we document the effects of a 7.5% rise in the minimum wage (as that happening in the UK in the UK) on Z contracts. It is shown that such a policy rises the the share of Z contracts as firms bet on them to decrease labor costs when working hours are low. In next drafts of the paper, we plan to report the sorting patterns of workers with different preferences and firms with different vacancy costs under both sets of policies.

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A More descriptive statistics

Industry section	Z	R	Total
A Agriculture, fores	0.42	1.02	1.01
B Mining and quarryi	0.14	0.43	0.42
C Manufacturing	4.49	9.32	9.21
D Electricity, gas,	0.00	0.68	0.66
E Water supply, sewe	0.14	0.75	0.73
F Construction	3.09	7.08	6.99
G Wholesale, retail,	9.13	12.89	12.81
H Transport and stor	5.62	5.13	5.14
I Accommodation and	21.35	4.38	4.75
J Information and co	1.12	3.95	3.89
K Financial and insu	0.42	3.97	3.89
L Real estate activi	0.56	1.11	1.10
M Prof, scientific,	2.67	7.57	7.46
N Admin and support	8.85	4.68	4.77
O Public admin and d	1.97	6.97	6.86
P Education	9.69	10.82	10.80
Q Health and social	20.22	13.81	13.95
R Arts, entertainmen	7.44	2.40	2.51
S Other service acti	2.39	2.66	2.65
T Households as empl	0.28	0.23	0.23
U Extraterritorial o	0.00	0.15	0.14
Total	100.00	100.00	100.00

Table A-1. Distribution of contracts across industries

NS-SEC major group	Z	R	Total
Higher managerial and	1.82	16.91	16.58
Lower managerial and	13.55	28.21	27.89
Intermediate occupati	9.92	13.72	13.64
Small employers and o	8.66	10.47	10.43
Lower supervisory and	8.38	7.08	7.10
Semi-routine occupati	25.00	12.32	12.60
Routine occupations	19.27	8.94	9.16
Never worked, unemplo	13.41	2.35	2.59
Total	100.00	100.00	100.00

Table A-2. Distribution of contracts across occupations

	ZZ	RR	ZR	RZ	Total
Less than 3 months	4.22	1.55	6.32	6.45	1.69
3 months, less that 6	2.95	2.07	8.42	6.45	2.20
6 months, less than 1	6.75	4.35	13.68	9.68	4.54
1 year, less than 2	19.41	9.45	21.58	17.05	9.78
2 years, less than 5	39.66	18.89	25.79	23.96	19.28
5 years, less than 10	13.92	17.71	10.00	20.74	17.62
10 years, less than 2	9.28	27.15	8.95	11.06	26.56
20 years or more	3.80	18.82	5.26	4.61	18.33
Total	100.00	100.00	100.00	100.00	100.00

Table A-3. Distribution of tenure across contract-stayers and contract-switchers

Major occupation group	ZZ	RR	ZR	RZ	Total
Managers, Directors And Senior Officials	0.10	99.05	0.33	0.52	100.00
Professional Occupations	0.76	97.93	0.55	0.76	100.00
Associate Professional And Technical	0.52	98.08	0.59	0.81	100.00
Administrative And Secretarial	0.94	97.80	0.61	0.66	100.00
Skilled Trades Occupations	0.76	97.45	0.70	1.08	100.00
Caring, Leisure And Other Services	3.76	91.62	2.43	2.19	100.00
Sales And Customer Service	0.86	96.90	1.46	0.77	100.00
Process, Plant And Machine Operatives	1.96	94.82	1.16	2.05	100.00
Elementary Occupations	3.27	91.24	2.53	2.96	100.00
Total	1.23	96.65	0.98	1.15	100.00

Table A-4. Distribution of occupations across contract-stayers and contract-switchers

B Derivation of the profit function

Each period, an individual firm receive orders q^o (price is fixed). When the employee works for h hours, the firm produces $q = ph$ units, where p is productivity, and incurs labour costs wh. If the firm produces less than its orders, i.e. $q < q^o$, it incurs a convex reputation cost of $c^-(q - q^o)^2$. If the firm wants to sell more than its orders, i.e. $q > q^o$, it needs to spend on marketing to sell the new orders. Again, these costs are convex: $c^+(q - q^o)^2$.

For simplicity we assume $c^- = c^+ = c$ and the profit function is:

$$\pi(h, h^o) = (p - w)h - c.(h^o - h)^2,$$

where $h^o = q^o$. If the firm chooses hours freely, optimal hours are $\widetilde{h} = h^o + \frac{p-w}{2c}$ and optimal profit is $\widetilde{\pi} = (p - w).h^o + \frac{(p-w)^2}{4c}$. The actual profit that the firm makes when it has to produce for h hours is: $\pi = \widetilde{\pi} - c.(h - h^o)^2$. The distribution of orders q^o that the firm receives, which is firm-specific, is denoted $H(.)$.