Zero-hours Contracts in a Frictional Labor Market

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Introduction

- The rise of **alternative work arrangements**, largely sparked by the digitization of the economy, has raised growing concerns about their employment and welfare effects
- Zero-hours contracts (ZHCs) have been under the spotlight, particularly in the U.K., where they have become the focus of a heated debate in the media and political arena
  - ZHCs: contracts where employers are not obliged to provide any minimum working hours, and workers are not obliged to accept any work offered
- In this paper, we develop **a structural model of ZHCs** to assess the impact of these labor contracts on equilibrium allocation and welfare

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  - **Substitution**: some jobs that would be otherwise viable under regular contracts become advertised as ZHCs
  - **Participation**: individuals who prefer flexible work schedules join the labor market to take advantage of ZHCs

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  - **Participation**: individuals who prefer flexible work schedules join the labor market to take advantage of ZHCs
- Calibrate / estimate the structural parameters of the model, and make inference about the heterogeneous types of workers and firms in the U.K. low-wage labor market
- Analyze and quantify the effects of a min. wage raise [not today] and of a **ban on ZHCs**

Key results

(1) All three channels play quantitatively important roles and interact with each other
$\Rightarrow$ Job creation effects of ZHCs are largest and reinforced by labor force participation

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(3) Welfare effects are not obvious, as both unemployment and regular employment increase
⇒ Full impact of a ban on ZHCs is a welfare loss by about 0.9-1.1% in CEV
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(4) **[Not today]** Structural estimates of the willingness to pay (MWP) for shorter working shifts
⇒ Wide dispersion in MWPs. The least attached workers on ZHCs would require *at least* £10.9 (= 1.45 times the hourly minimum wage) to accept working one extra hour

▸ Related lit.

Roadmap of presentation

The model

Calibration and inference on workers' and firms' types [Not today]

Policy experiments

Conclusion

The model

The model

- Time is discrete. Think of a model time period as 2 weeks
  ⇒ Rapidly changing business conditions, independent across periods

- Economy is populated by **heterogeneous workers** i and **heterogeneous firms** j

- All agents discount the future at rate ρ

- Focus on minimum-wage labor market. No wage dispersion. All jobs pay w
  ⇒ No bargaining. Abstract from compensating differential in wages

Workers' types

- N: a worker's asset value of being not employed
- W_Z and W_R: worker's asset values of being employed under resp. Z and R contracts

$$\begin{cases} N < W_Z < W_R & \text{for type 1} \\ W_R < N < W_Z & \text{for type 2} \\ W_Z < N < W_R & \text{for type 3} \\ N < W_R < W_Z & \text{for type 4} \end{cases} \tag{1}$$

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- Rankings must hold in equilibrium: N, W_Z, W_R are equilibrium objects!

Firms' types

- V_Z and V_R: Firms' asset values of advertising a vacant position as either a Z or R contract
- Under free entry, value of a firm being inactive is 0. Firms can be of one of three types:

$$\begin{cases} V_R < 0 < V_Z & \text{for type } c \\ 0 < V_R < V_Z & \text{for type } s \\ 0 < V_Z < V_R & \text{for type } r. \end{cases} \tag{2}$$

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Notice that:

- Without ZHCs, type-c firms would abstain from creating any jobs $\Rightarrow$ **Job creation effect**
- Type-s firms advertise Z contracts but would be viable as R contracts $\Rightarrow$ **Substitution effect**
- Job creation is somewhat of a misnomer, given that there is free entry of firms

Workers' preferences

- No saving/borrowing, workers consume all their income
- When not employed, workers receive unemployment benefits b
- When working h hours and earning labor income wh, workers lose their unemployment benefit at a taper rate τ:

$$\text{inc}(h) = \max\{wh, b + (1-\tau)wh\} \tag{3}$$

- The intra-period utility function is given by:

$$u^i(h,a) = \frac{\text{inc}(h)^{1-\eta} - 1}{1-\eta} - \alpha_i \max\{h-a, 0\}. \tag{4}$$

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α_i is heterogeneous, even potentially across workers of same type i

Production technology

- $\widetilde{h}$ denotes the number of **working hours that would meet the demand that a firm faces** at a given point in time
- Deviations between actual hours h and $\widetilde{h}$ are costly (reputation costs, marketing expenses)
- Firms' instantaneous profit function is:

$$\pi\left(h,\widetilde{h}\right) = (p-w)h - \frac{\phi}{2}\left(h-\widetilde{h}\right)^2 \tag{5}$$

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- $\widetilde{h}$ is **stochastic** and is drawn from a distribution $H_j(.)$ which is heterogeneous across firms
- Think of ZHCs as contracts that enable firms to set $h=\widetilde{h}$. In R contracts, $h=\bar{h}$

Search frictions

- **Search is random**, labor market tightness θ pins down the contact rate between job seekers and vacancies
- When employed workers choose to **search on the job**. Their relative search intensity is x_i
- Exogenous job destruction shock hits firms with probability δ, making firm leave the market
- When a worker quits into another job, the firm remains and re-advertises its job
- Firms **choose the contract type at the point of advertising**, under full commitment

Policy experiments

Ban on ZHCs: Equilibrium allocation

Table: Equilibrium (re)allocation effects of a ban on Z contracts

	Baseline	**Share of type-c among Z jobs**				
		0.00	**0.25**	**0.50**	**0.75**	**1.00**
Employment rate (in %)	90.8	86.0	85.9	85.7	85.6	85.4
		-4.79	*-4.93*	*-5.08*	*-5.23*	*-5.40*
Unemployment rate (in %)	9.2	11.2	11.4	11.5	11.7	11.8
		2.03	*2.17*	*2.33*	*2.48*	*2.65*
Duration of R vacancies (in weeks)	10.5	8.0	8.0	7.9	7.8	7.8
		-2.47	*-2.53*	*-2.59*	*-2.66*	*-2.73*
Net output (1 = baseline)	1.00	0.98	0.97	0.97	0.97	0.96

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- Important role for **job creation** even when substitution effects are largest (i.e., when $\gamma_c = 0$)

Ban on ZHCs: Accession to regular employment

Change in regular employment, $\widetilde{e}_R/e_R$, depends on three channels:

$$\frac{\widetilde{e}_R}{e_R} = \underbrace{\frac{\lambda(\widetilde{\theta})}{\lambda(\theta)}}_{\text{job creation}} \times \underbrace{\frac{1}{v_R/v}}_{\text{vacancy competition}} \times \underbrace{\frac{\widetilde{n}_1}{(1-\delta)xe_{1,Z}+n_1}}_{\text{search efficiency}}. \tag{6}$$

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- $\lambda(\widetilde{\theta})/\lambda(\theta) = 71\%$, meaning that lower job creation would reduce regular employment by almost 30% *ceteris paribus*
- Reduction in vacancy competition in isolation from the other effects would increase regular employment by 24%
- Additional search efficiency units for employment following a ban on ZHCs would increase regular employment by 15% *ceteris paribus*

Ban on ZHCs: Welfare impact

- What is the overall impact of the ban on time spent *out* of regular employment?
  - After the policy reform, this duration is given by the duration of unemployment spells
  - Prior to the ban, this is the duration that type-1 workers spent in unemployment as well as in Z waiting to eventually transit to R employment
- Difference is readily measured in our model, as

$$\triangle = \frac{\omega_1}{\lambda(\widetilde{\theta})\widetilde{n}_1} - \frac{\omega_1}{\lambda(\theta)\frac{v_R}{v}\left(x\left(1-\delta\right)e_{1,Z}+n_1\right)} \approx -7 \text{ weeks} \tag{7}$$

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- Even though the unemployment rate increases after a ban on ZHCs, type-1 **workers spend on average more time in regular employment**

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Table: Welfare (in % of CEV) effects of a ban on Z contracts

	Baseline	Share of type-c among Z jobs				
		0.00	**0.25**	**0.50**	**0.75**	**1.00**
At 1st percentile of α	0.00	-0.93	-0.99	-1.06	-1.12	-1.15
At 25th percentile of α	0.00	-0.96	-1.02	-1.08	-1.13	-1.14
At 50th percentile of α	0.00	-0.99	-1.04	-1.09	-1.15	-1.13
At 75th percentile of α	0.00	-1.02	-1.07	-1.11	-1.16	-1.13
At 99th percentile of α	0.00	-1.05	-1.09	-1.13	-1.17	-1.12

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At 75th percentile of α	0.00	-1.02	-1.07	-1.11	-1.16	-1.13
At 99th percentile of α	0.00	-1.05	-1.09	-1.13	-1.17	-1.12

- Still, the consequences of more unemployment is that **welfare decreases by 0.9-1.1%**

Ban on ZHCs: Welfare impact

Table: Welfare (in % of CEV) effects of a ban on Z contracts: The substitution channel

	Baseline	**Share of type-c among Z jobs**				
		0.00	**0.25**	**0.50**	**0.75**	**1.00**
At 1st percentile of α	0.00	0.54	0.54	0.53	0.53	0.52
At 25th percentile of α	0.00	0.45	0.45	0.45	0.44	0.44
At 50th percentile of α	0.00	0.37	0.36	0.36	0.36	0.35
At 75th percentile of α	0.00	0.28	0.28	0.27	0.27	0.27
At 99th percentile of α	0.00	0.20	0.19	0.19	0.19	0.18

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At 25th percentile of α	0.00	0.45	0.45	0.45	0.44	0.44
At 50th percentile of α	0.00	0.37	0.36	0.36	0.36	0.35
At 75th percentile of α	0.00	0.28	0.28	0.27	0.27	0.27
At 99th percentile of α	0.00	0.20	0.19	0.19	0.19	0.18

- Not negligible. May explain the seemingly paradoxical responses to the spread of ZHCs
- Importance of a general equilibrium analysis that accounts for the other forces that come into play (Job creation, Labor force participation)

Conclusion

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Our findings suggest that:

- Most workers employed under ZHCs would prefer having a regular contract
- At the same time, and in line with related studies, there is a substantial willingness to pay for flexible work schedules in some segments of the (potential) labor force
- There are productive opportunities in sectors facing highly volatile demand which may not be viable without the ability to adjust working hours at no cost
- Identifying such segments of economic activity requires the availability of richer data on firms' profitability and workers' time use and preferences

Appendix

Related literature

- Growing literature (mostly empirical) on understanding alternative work arrangements
  - Measuring the trends and characteristics of workers: Abraham et al. [2019, 2021], Katz and Krueger [2019], Collins et al. [2019], Boeri et al. [2020], etc.
  - Mas and Pallais [2017]: Experiment with workers in a U.S. national call center to measure different MWPs:
    - Workers willing to give up 8% of wages for the option to work from home
    - Willing to pay 20% to avoid a schedule set by an employer on short notice
  - Datta et al. [2019] document how the 2016 rise in the U.K. minimum wage has resulted in increased usage of ZHCs in the social care and related low-wage sectors

- Only few attempts to analyze flexible hours contracts in a **structural model**
  - Scarfe [2020]: search-matching model of "casual work" in Australia (where casual work accounts for 10% of the labor force)
  - Frazier [2017]: directed-search model with two types of jobs, one with fixed hours, the other with variable hours. Estimated with data on the U.S. retail sector

Back

Bellman equations

- Workers' asset values depend on their own type i and contract k
- These asset values solve:

$$N^{i} = u_{N} + \frac{1}{1+\rho}\left[\left(1-\lambda\left(\theta\right)\right)N^{i} + \lambda\left(\theta\right)\sum_{k'}\frac{v_{k'}}{v}\max\left\{N^{i}, W_{k'}^{i}\right\}\right], \quad (8)$$

and

$$W_{k}^{i} = u_{k}^{i} + \frac{1}{1+\rho}\left[\delta N^{i} + (1-\delta)\left(\left(1-x_{i}\lambda\left(\theta\right)\right)W_{k}^{i} + x_{i}\lambda\left(\theta\right)\sum_{k'}\frac{v_{k'}}{v}\max\left\{W_{k}^{i}, W_{k'}^{i}\right\}\right)\right] \quad (9)$$

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and

$$W^i_k = u^i_k + \frac{1}{1+\rho}\left[\delta N^i + (1-\delta)\left((1-x_i\lambda(\theta))W^i_k + x_i\lambda(\theta)\sum_{k'}\frac{v_{k'}}{v}\max\left\{W^i_k, W^i_{k'}\right\}\right)\right] \tag{9}$$

- Flow values of employment u^i_k in (9) depend on the equilibrium mix of firm types:

$$u^i_Z = \frac{e_c}{e_Z}\int u^i\left(\tilde{h}, a\right) dG_c\left(\tilde{h}\right) + \frac{e_s}{e_Z}\int u^i\left(\tilde{h}, a\right) dG_s\left(\tilde{h}\right) \text{ and } u^i_R = u^i\left(\bar{h}, a\right) \tag{10}$$

Bellman equations

- Firms of a given type j compare the asset value V_k^j of holding a vacant position advertised as a contract $k = Z, R$
- These depend on $J_{i,k}^j$, which is the asset value of filling the position with a worker of type i
- These asset values solve:

$$V_k^j = -\kappa + \frac{1}{1+\rho}\left[V_k^j + \frac{\lambda(\theta)}{\theta}\sum_i \frac{n_i \mathbb{1}_{\{W_k^i > N^i\}} + \sum_{j'} x_i e_{i,j'} \mathbb{1}_{\left\{W_k^i > W_{k(j')}^i\right\}}}{n + \sum_{i'} x_{i'} e_{i'}}\left(J_{i,k}^j - V_k^j\right)\right] \quad (11)$$

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- Notice the role $\mathbb{1}_{\{.\}}$: The worker's decision to accept the job depends on:
  - The contract k offered by the firm
  - The worker's own current labor market status and preferred employment contract

Bellman equations

- For filled jobs, the asset values solve:

$$J^{j}_{i,k} = \pi^{j}_{k} + \frac{1-\delta}{1+\rho}\left[V^{j}_{k} + \left(1 - x_i\lambda(\theta)\sum_{k'}\frac{v_{k'}}{v}\mathbb{1}_{\{W^{i}_{k'} > W^{i}_{k}\}}\right)\left(J^{j}_{i,k} - V^{j}_{k}\right)\right] \tag{12}$$

- Probability of job continuation depends on the equilibrium offers from other firms (through $v_{k'}/v$) and on workers' preferences over those offers

- The flow values of employing a worker under contract k are:

$$\pi^{j}_{Z} = \int \pi\left(\widetilde{h}, \widetilde{h}\right) dG_j\left(\widetilde{h}\right) \text{ and } \pi^{j}_{R} = \int \pi\left(\bar{h}, \widetilde{h}\right) dG_j\left(\widetilde{h}\right). \tag{13}$$

Job creation

- Firms pay a business creation cost K to enter the market, and then draw their type j from a distribution $(\gamma_j)_{j=c,s,r}$
- In equilibrium, these types must be consistent with firms' ranking of posted contracts
- As a result, under free entry, we have

$$K = \gamma_c . V_Z^c + \gamma_s . V_Z^s + \gamma_r . V_R^r \tag{14}$$

- Market tightness θ, which is the ratio between v and $n + \sum_i x_i e_i$, adjusts to satisfy Eq. (14)

Steady-state equilibrium

A **steady-state equilibrium** is a list of asset values N^i, W^i_k, V^j_k, $J^j_{i,k}$; a stationary distribution of job matches $e_{i,j}$, non-employed workers n_i and vacancies v_j; and labor market tightness θ such that:

1. Given the measures $e_{i,j}$, n_i, v_j, and market tightness θ , the asset values N^i, W^i_k, V^j_k, $J^j_{i,k}$ solve the Bellman equations (8), (9), (11), (12)

2. Given N^i, W^i_k, worker types satisfy the rankings presented in (1); given V^j_k, $J^j_{i,k}$ firm types satisfy the rankings presented in (2)

3. Given V^j_k, where $k = Z, R$ is the contract offered by type-j firms, market tightness θ solves the free entry condition in Equation (14)

4. Given market tightness θ, the measures $e_{i,j}$, n_i, v_j are time-invariant with respect to the law of motion of the economy

Vacancy elasticity of the matching function

- Newly-formed matches ($M_{o,t}$), unemployment claims ($U_{o,t}$) and job vacancies ($V_{o,t}$)
  - Occupations o: ('Administrative', 'Secretarial and related', 'Caring personal service', 'Leisure and other personal service', 'Process, plant and machine', 'Elementary trades, plant and storage related', 'Elementary administration and service')
- Run a linear regression:

$$\log\left(\frac{M_{o,t}}{U_{o,t}}\right) = \alpha_o + \varpi' g(t) + \psi \log\left(\frac{V_{o,t}}{U_{o,t}}\right) + \varepsilon_{o,t}. \tag{15}$$

Table: Vacancy elasticity of the matching function

	Log- job finding ($\log\left(M_{o,t}/U_{o,t}\right)$)			
	(1)	**(2)**	**(3)**	**(4)**
Log- market tightness ($\log\left(V_{o,t}/U_{o,t}\right)$)	0.643***	0.701***	0.586***	0.703***
	(0.027)	(0.041)	(0.025)	(0.034)
R-squared	0.859	0.896	0.802	0.871
Time trend ($g(t)$)		✔		✔
Occupation fixed effect (α_o)			✔	✔

Back

Parameters set externally

- Model period is 2 weeks. $\rho = 0.0015$ to yield an annual discount rate of 4 percent
  [To ease interpretation, several parameter values are expressed in weekly values]

- $w =$£7.50 per hour (U.K. national minimum wage for workers aged 25 and over)

- Cobb-Douglas matching function:

$$m(s,v) = Mv^{\psi}s^{1-\psi}, \tag{16}$$

  where v = vacancies and s = job seekers weighted by their search intensity

- ψ can be an important parameter for the job creation effects predicted by the model. Using U.K. data for the low-pay segment of the labor market, we estimate $\psi = 0.65$

▸ Estimating ψ

First-step calibration parameters

- Set M, θ, δ, x, the ω_i's and γ_r to match data moments on job and worker turnover

Identification (somewhat heuristic):

- Either M or $\theta \rightarrow$ transition out of N, $\gamma_r \rightarrow$ whether N to R as opposed to transition N to Z
- δ, x, the ω_i's $\rightarrow$ transitions out of Z and R, with ω_i's identified by the *distribution of job tenure* within each contract type
- No type-4 workers (virtually no R to Z transitions). Rule out type-3 workers as $\omega_3 \rightarrow 0$
- We obtain the sum $\gamma_c + \gamma_s$, but not γ_c and γ_s separately from each other

First-step calibration parameters

Table: Description of baseline equilibrium

		Model	Data
n	Unemployment rate	9.2	10.1
$e_Z/(e_Z+e_R)$	Employment share of ZHCs	6.5	7.2
$v_Z/(v_Z+v_R)$	Vacancy share of ZHCs	19.4	–
$e_{1,Z}/e_1$	Share of employed type-1 workers in ZHCs	4.8	–
$e_{1,Z}/e_Z$	Share of filled ZHCs employing type-1 workers	66.8	–

- Type-1 workers are key to sustain an equilibrium with ZHC jobs
- ZHCs exert a negative effect on R vacancies by making it more difficult for these vacancies to contact type-1 workers (given that search is random)

First-step calibration parameters

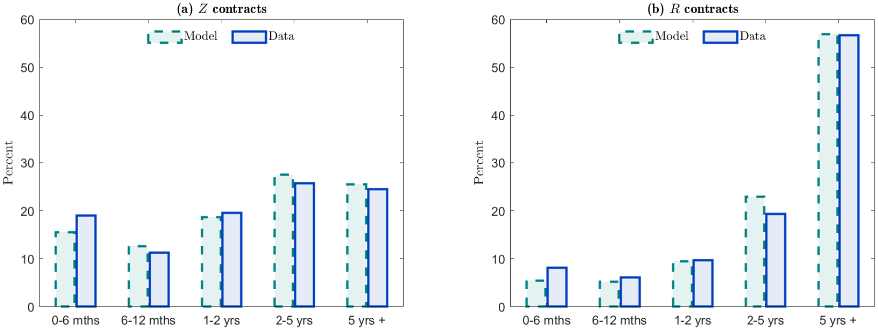

Figure: Model fit: Job tenure by labor contract

Second-step calibration parameters

In the second step, we calibrate p, $\bar{h}$, ϕ, κ, K, and the stochastic distributions $H_j(.)$ for each type j

- $p = 8.25$, assuming that the marginal productivity of low-pay workers is 10% higher than w
- No direct empirical counterpart for ϕ, but (ϕ, κ, K) pinned down by free-entry condition:
  - Expected cost of vacancy posting (i.e. $\kappa\theta/\lambda(\theta)$) of 14% of average quarterly labor earnings (Elsby and Michaels [2013])
  - Startup costs of creating a business, K, at around £4,500
  - For job creation condition to hold, we find $\phi = 0.16$
    $\Rightarrow$ Deviating from $\tilde{h}$ by 5 hours $\downarrow$ firms' weekly accounting profits $((p-w)h)$ by 10%

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- $H_j(.)$'s are Beta distributions over [0, 50], where 50 = maximum weekly hours worked
  - Choose μ_j and σ_j within regions of the parameter space that are consistent with firm types, and given the $\neq$ between R and Z jobs documented in Section 3

Parameter values

Table: Parameter values

(a) Parameters set externally		
ρ	Discount rate of 4 percent per annum	0.0015
ψ	Elasticity of job-filling rate w.r.t. tightness	0.65
w	Minimum hourly wage in £ (U.K. policies)	7.50
(b) First stage calibration parameters		
M	Matching function elasticity	0.1278
θ	Labor market tightness	0.2418
δ	Job destruction probability	0.0047
x	On-the-job search efficiency	0.3524
ω_1	Share of type-1 workers	0.9689
γ_r	Probability of type-r firms upon entry	0.9498
(c) Second stage calibration parameters		
p	Productivity of hours worked	8.25
(μ_c, μ_s, μ_r)	Average of weekly hours by firm type	$(18, 18, 28)$
$(\sigma_c, \sigma_s, \sigma_r)$	St. dev. of weekly hours by firm type	$(6, 3, 2)$
ϕ	Marginal cost of deviating from targeted hours	0.16
κ	Flow cost of vacancy posting, in £ per week	38.0
K	Startup cost of new businesses, in £1,000	4.38

Heterogeneous firms' types

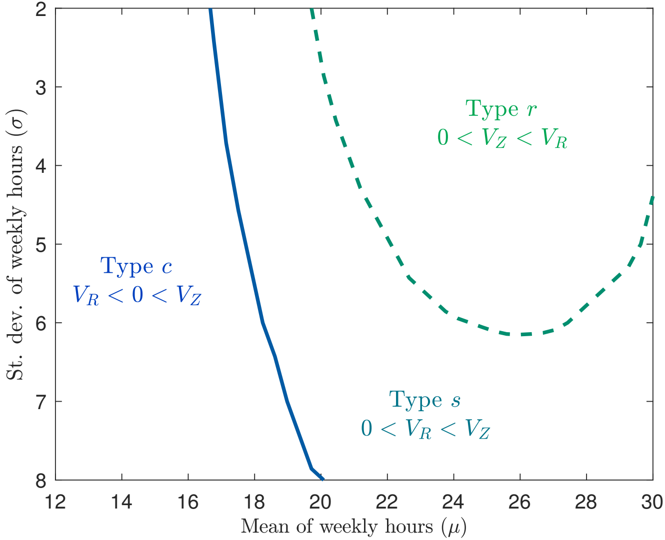

Figure: Firms' types across (some) regions of the parameter space

Heterogeneous workers' types

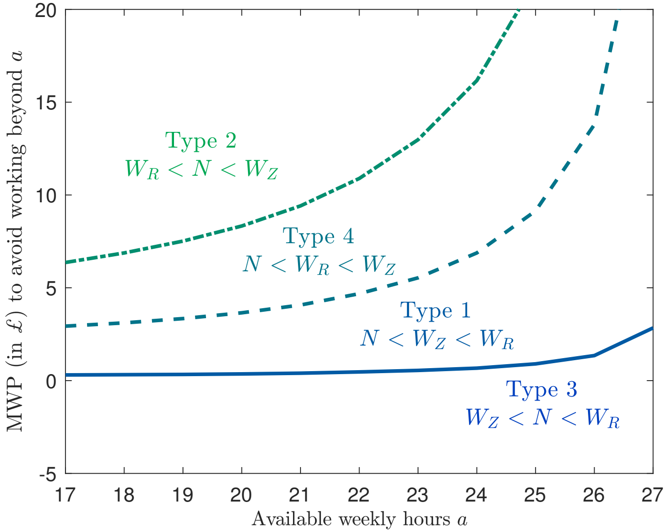

Figure: Workers' types across (some) regions of the parameter space

Heterogeneous workers' types

- Type-1 workers are individuals who do not value short hours much: at $a = 22$ hours would give up £0.5 to £4.6 of consumption (per week) to avoid working one hour beyond a
- Type-2 workers have a higher valuation of short hours. They would be willing to give up *at least* £10.9, or 1.45 times the minimum wage, to avoid working one hour beyond a

Table: Parameter values for welfare assessment

η	Relative risk aversion coefficient	2.0
b	Unemployment benefits in £ per week (U.K. policies)	148.5
τ	Taper rate (U.K. policies)	0.63
a	Available hours per week	22.0