Flexible Work Arrangements in Low Wage Jobs
Evidence from Job Vacancy Data

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Introduction
Motivation

- Technological developments have changed the cost of offering different work arrangements
  - Easier to provide workers with flexible schedules and schedule work on-demand
  - Reduced the need for colocation of workers
- Indeed, by some measures, the structure of work is changing in the labour markets of developed economies
  - Gig Economy (platform mediated work), Zero Hours Contracts (no guarantee of a minimum number of hours), Solo Self-Employment (low income self-employment, potentially with dependence on a single firm)
  - only about 55% of jobs are traditional [permanent, full-time, (9-5)] (Mas & Pallais, 2020)
Motivation

▶ Policy interest in “alternative work arrangements” & flexible jobs
  ▶ Concern about the potential for worker exploitation
  ▶ Reduced role of firms in income smoothing & can be ineligible for support delivered through the employment relationship
  ▶ ...what does this mean for the design and delivery of policy to support low-wage workers?

▶ Yet, job flexibility can also have benefits for firms & workers
  ▶ Work-life balance & the ability to quickly adjust labour supply to domestic “shocks” (although evidence for this is weak)
  ▶ Adjust production to variable demand
Introduction

- Surprisingly little is known about the drivers of firm demand for flexible work arrangements
  - Strong focus of the recent literature has been on worker preferences for flexible jobs
  - Older literature on temporary jobs but unlikely to be ambiguity in ranking of permanent versus temp jobs
- Data and measurement issues have held back empirical research in this area
  - Questions on alternative work arrangements are not asked consistently over time
  - Challenges with how to interpret responses to some questions
  - Zero-hours contracts are under-recorded by the main labour force survey
This Paper

- In this paper, we analyse over 60 million UK job vacancies better to understand firm demand for flexible work arrangements
  - Has there been any change over time in the prevalence of flexible arrangements advertised?
  - What other job characteristics does flexibility correlate with? Does this differ amongst high and low wage postings?
  - Do employers use flexibility as a dimension along which to reduce labour costs?

- Measure flexible work arrangements from job vacancies text
  - Burning Glass Technology: text of 50,240,650 job vacancies in the UK from 2013 onwards
  - Manually annotate 6,500 vacancies to create training data set for supervised machine learning approach
  - Label a number of characteristics including whether salaried/permanent/full time
This Paper

- Considerable heterogeneity in prevalence of flexible work jobs
  - More likely in low paid & non-salaried jobs, and in lower skilled elementary and sales occupations
  - Less likely to be salaried: 61% of non-flexible vacancies specified a salary, while only 35% of flexible vacancies do

- The proportion of flexible vacancies has been growing over time
  - Growing polarisation in offered work arrangements across the wage distribution

- Ongoing work is examining the effect of the shift to the NLW on the characteristics of posted jobs
  - Large (unexpected) announcement to the NMW in July 2015
  - Triple difference-in-differences strategy using variation in exposure within occupations across space & within counties across occupations
Outline of Talk

1. Data & Measurement
2. Variation in Flexible Jobs
3. Impact of NLW
4. COVID & Flexible Jobs
Data
Issues with Extant Data Sets

- Measurement of alternative work arrangements and zero hours contracts challenging for a number of reasons
  - Only asked for the main work arrangement
  - Controversy over the wording of the question resulted in the Office for National Statistics having to apologise for the “risk of an undercount”

- Existing work has therefore focused on bespoke surveys or particular sectors where specialist data exists
  - Datta et al (2019): focus on social care which has good employer-employee data
  - CEP 2018 survey: cannot be used to understand changes over time
  - Adams-Prassl et al (2020): Covid-surveys ask about control of hours (also now used in USoc)
Control of Hours: Adams-Prassl, Boneva, Golin & Rauh

![Bar chart showing the distribution of control of hours.]

- **Fixed**: 67.98%
- **Vary, decided by me**: 16.58%
- **Vary, decided by employer**: 12.96%
- **Vary, on-call worker**: 2.48%

Adams-Prassl, Balgova, Qian, Waters

OECD Seminar
Control of Hours: Adams-Prassl, Boneva, Golin & Rauh

Proportion Earning Less Than £20k

<table>
<thead>
<tr>
<th>Control</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed</td>
<td>0.2</td>
</tr>
<tr>
<td>Vary decided by me</td>
<td>0.4</td>
</tr>
<tr>
<td>Vary decided by employer</td>
<td>0.6</td>
</tr>
<tr>
<td>Vary, on-call worker</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Adams-Prassl, Balgova, Qian, Waters

OECD Seminar
Control of Hours: Adams-Prassl, Boneva, Golin & Rauh

![Bar chart showing the proportion of salaried workers for different control methods of hours.]

- Fixed: 0.8
- Vary, decided by me: 0.6
- Vary, decided by employer: 0.4
- Vary, on-call worker: 0.2

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Job Vacancy Data

- Growing literature using job vacancy data in order to analyse the labour market, some in real-time
  - Demand for skill: Hershbein & Kahn (2018); Deming & Kahn (2018); Clemens, Kahn & Meer (2020)
  - Response of hiring strategies to public policy reform: Duchini et al (2020); Marinescu (2017)
  - Shocks: Javorcik et al (2020); Forsythe et al (2020)

- Our paper is the first to analyse the characteristics of work arrangements from the job vacancy text
Job Vacancy Data

- We measure schedule flexibility on the basis of job vacancy text
  - Burning Glass Technology: text of 50,240,650 job vacancies in the UK from 2014 onwards
  - BGT scrapes 7,500 job boards and company web pages

- Limitations:
  - Not all jobs are advertised online
  - Only what firms state in the advert rather than realised arrangement
  - Not necessarily a neat mapping between characteristics of vacancies & filled jobs: not all vacancies are filled & terms might be negotiated
  - Jobs posted online are disproportionately professional and $\approx 30-40\%$ missing wage info
Classifying Work Arrangements

- Goal is to retrieve all vacancies that describe flexible work arrangements from the set of BGT job adverts.

- Take a supervised machine learning approach that relies on manual annotations
  
  1. Manually label a set of job vacancies for the dimensions of work arrangements of interest;
  
  2. Define the vocabulary and represent each job vacancy in a matrix format;
  
  3. Train a machine learning model to classify work arrangements on the basis of vacancy text;
  
  4. Apply the machine learning model to all 46 million job vacancies.
Schedule Flexibility

▶ Treat flexibility as **schedule flexibility**
  
  ▶ i.e. any arrangement in which the timing of work is not fixed in the contract and has to be agreed at a later date between the employer and the employee.

▶ Difficult to identify control of schedule from vacancy text
  
  ▶ We’ve tried (!!) and may explore unsupervised machine learning techniques in the future

▶ In practice, we categorize a job to be schedule flexible if it mentions shift or rota work without a fixed pattern, offers flexible working, or specifies that work will be organised according to the needs of the business.
Schedule Flexible Jobs

Figure: Salaried Job with Flexible Hours

Income

Hours
Schedule Flexible Jobs

Figure: Non-Salaried Job with Flexible Hours
Manual Annotations

“As this is a Bank position to provide cover as and when we need it, such as for annual leave or sick leave, the hours and days you work will vary.”
Manual Annotations

“They are looking for a dynamic Solicitor, Legal Executive or Licensed Conveyancer to join at this incredibly exciting time to work flexibly/from home.

You will be given the platform to succeed and take care of your clients, whilst benefiting from flexible working from home!

This could suit someone looking to return to work after maternity leave, or someone looking for flexibility around their working hours/wanting to choose their own working hours!”
Manual Annotations

“What we offer:

★ Competitive rates of pay - holiday pay, all out of pocket expenses paid including mileage. You should be able to earn £60-£82 per 6 hour day, based on interviews achieved

★ Ad hoc working - which allows flexibility and choice”
Methodology

- Represent the text of job adverts as a matrix (dropping common words such as “and”, “the”, “job” &c)

- Tokenize at the word level (1-gram) and supplement with common 2- and 3-grams identified in manual annotations

\[
\begin{pmatrix}
1 & 0 & \ldots & 1 \\
1 & 1 & \ldots & 0 \\
0 & 1 & \ldots & 0 \\
\vdots & \vdots & \ddots & \vdots \\
0 & 0 & \ldots & 1
\end{pmatrix}
\]

- So called “bag of words” approach using a binary count vectorizer

- Use of word vectors or the TF-IDF vectoriser did not improve performance
Methodology

- Use a logistic classification model with LASSO regularisation
- Tuning parameter for the LASSO regularisation was determined using a grid search and cross validation
  - Draw five repeated test & train samples from the annotated data
  - Test data is not used for model estimation
  - Accuracy of the model evaluated using the F-score, precision, and recall
Methodology

<table>
<thead>
<tr>
<th>Predicted Label</th>
<th>True Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

- True Negative (TN)
- False Negative (FN)
- False Positive (FP)
- True Positive (TP)

Balanced F-measure = \(2 \times \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}\).

where

\[
\text{Precision} = \frac{\text{TP}}{\text{TP} + \text{FP}}
\]

\[
\text{Recall} = \frac{\text{TP}}{\text{TP} + \text{FN}}
\]
# Accuracy

<table>
<thead>
<tr>
<th>Contract type</th>
<th>Logistic Regression Model</th>
<th>Improvement to keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule flexible</td>
<td>Precision: 0.8540</td>
<td>Precision: 0.0005</td>
</tr>
<tr>
<td></td>
<td>Recall: 0.8083</td>
<td>Recall: 0.4399</td>
</tr>
<tr>
<td></td>
<td>F: 0.8303</td>
<td>F: 0.1855</td>
</tr>
<tr>
<td>Permanent</td>
<td>Precision: 0.9294</td>
<td>Precision: 0.0471</td>
</tr>
<tr>
<td></td>
<td>Recall: 0.9736</td>
<td>Recall: -0.0067</td>
</tr>
<tr>
<td></td>
<td>F: 0.9510</td>
<td>F: 0.0223</td>
</tr>
<tr>
<td>Full-time</td>
<td>Precision: 0.9162</td>
<td>Precision: 0.1898</td>
</tr>
<tr>
<td></td>
<td>Recall: 0.8881</td>
<td>Recall: 0.2236</td>
</tr>
<tr>
<td></td>
<td>F: 0.9019</td>
<td>F: 0.1314</td>
</tr>
<tr>
<td>Salaried</td>
<td>Precision: 0.8604</td>
<td>Precision: -0.1032</td>
</tr>
<tr>
<td></td>
<td>Recall: 0.8415</td>
<td>Recall: 0.3586</td>
</tr>
<tr>
<td></td>
<td>F: 0.8503</td>
<td>F: 0.2070</td>
</tr>
</tbody>
</table>
Variation in Flexible Vacancies
Share of Flexible Vacancies: Occupation

- Managers
- Professional
- Technical
- Administrative
- Missing
- Sales
- Skilled trades
- Elementary
- Process operatives
- Services

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Share of Flexible Vacancies: Wage

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Relationship with Low-Wage Vacancies

Flexible & Salaried
Slope .01, R-squared .02

Flexible & Non-Salaried
Slope .33, R-squared .42
Relationship with Permanent Vacancies

Flexible & Salaried

Slope -0.0, R-squared 0.02

Flexible & Non-Salaried

Slope -0.6, R-squared 0.41
Change Over Time

Change in Share of Flexible Vacancies

Salaried
Non-Salaried

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Minimum Wage
Minimum Wage Policy

“We strongly support the National Minimum Wage and want to see further real-terms increases in the next Parliament. We accept the recommendations of the Low Pay Commission that the National Minimum Wage should rise to £6.70 this autumn, on course for a Minimum Wage that will be over £8 by the end of the decade.”

Conservative Party Manifesto, April 14th 2015.

“I am today introducing a new national living wage. We will set it to reach £9 an hour by 2020. The new national living wage will be compulsory. Working people aged 25 and over will receive it. It will start next April at the rate of £7.20. The Low Pay Commission will recommend future rises that achieve the Government’s objective of reaching 60 percent of median earnings by 2020.”

Budget Speech, July 8th 2015.

“I’ve talked to several chief executives and been surprised by the impact on their profits. In one [big] company, it would wipe out all of their profits”

Paul Drechsler, CBI President, September 2015.

Bell & Machin (2017)
Minimum Wage Policy

- In April 2016, the UK transitioned to a “living wage” arrangement

<table>
<thead>
<tr>
<th>Year</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25 and over</td>
</tr>
<tr>
<td>April 2019 to March 2020</td>
<td>£8.21</td>
</tr>
<tr>
<td>April 2018 to March 2019</td>
<td>£7.83</td>
</tr>
<tr>
<td>April 2017 to March 2018</td>
<td>£7.50</td>
</tr>
<tr>
<td>October 2016 to March 2017</td>
<td>£7.20</td>
</tr>
<tr>
<td>April 2016 to September 2016</td>
<td>£7.20</td>
</tr>
<tr>
<td></td>
<td>21 and over</td>
</tr>
<tr>
<td>2015</td>
<td>£6.70</td>
</tr>
<tr>
<td>2014</td>
<td>£6.50</td>
</tr>
</tbody>
</table>
Methodology

- NMW is a national policy so we make use of variation in exposure to the changes across occupations and counties.

- Take a “triple” difference-in-differences strategy:
  - Changes in contract types across counties might be systematically different for reasons other than exposure to minimum wage changes:

$$\beta = (\bar{y}_{H,T,2} - \bar{y}_{H,T,1}) - (\bar{y}_{L,T,2} - \bar{y}_{L,T,1}) - (\bar{y}_{H,C,2} - \bar{y}_{H,C,1})$$

- $H/L$: high/low exposure regions
- $T/C$: high/low exposure occupations

- Cleaners in Blackpool have lower wages on average than cleaners in Oxford

- Cleaners in Blackpool have lower wages on average than security guards in Blackpool
Variation in Exposure

Services

Sales

Process Operatives

Elementary

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Methodology

- Estimating equation:

  \[ s_{oct} = \delta_t \ast \text{Exposure}_{oc} + \alpha_{ot} + \beta_{ct} + \delta_{oc} + X_{oc}\gamma_t + \epsilon_{oct} \]  

- Occupation: 3-digit SOC code

- Geography: county

- \( X \): county characteristics in 2014

- Robustness checks on-going & adapting Cengiz et al (2019) approach
Posted Wages: < £6
Posted Wages: £6-7
Posted Wages: £7-8
Posted Wages: £8-9
Posted Wages: £9-10
Posted Wages: £10-12

![Graph showing the coefficient of variation in flexible vacancies over time. The x-axis represents time with quarters from 2014Q1 to 2017Q4, and the y-axis represents the coefficient ranging from -0.8 to 0.7. The graph includes error bars for each quarter.]
Posted Wages: £12-14
Flexible Contracts

The chart shows the coefficient data over the years from 2014Q1 to 2017Q4. The coefficients vary with time, indicating fluctuations in flexible vacancies. The data is from the OECD Seminar presented by Adams-Prassl, Balgova, Qian, and Waters.
Flexible Contracts - Salaried
Permanent Contracts

![Graph showing the variation in flexible vacancies over time. The x-axis represents the years from 2014Q1 to 2017Q4, and the y-axis represents the coefficient. The graph includes error bars for each quarter.](graph.png)
Flexible Contracts - \( \leq \mathbf{\£7} \)
Flexible Contracts - £7-9

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Flexible Contracts - £9

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Covid
Change in Vacancies Over Time

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Variation Across Occupations

% change in weekly vacancies

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Change in Proportion of Low Wage Vacancies
Impact on Flexibility

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Variation Across Occupations
Conclusion

- We extract information on contract terms from job vacancy text to analyse firm demand for flexible work arrangements.
- Vacancies that advertise flexible arrangements are disproportionately low wage, lower skilled and non-salaried.
- On-going work examines the drivers of flexible work arrangements including adjustment to higher labour costs.
<table>
<thead>
<tr>
<th>Introduction</th>
<th>Data</th>
<th>Variation in Flexible Vacancies</th>
<th>Minimum Wage</th>
<th>Covid</th>
<th>Thank You!</th>
</tr>
</thead>
</table>

Thank You!