

# Firm Innovation and Wage Premium Across Occupations and Gender

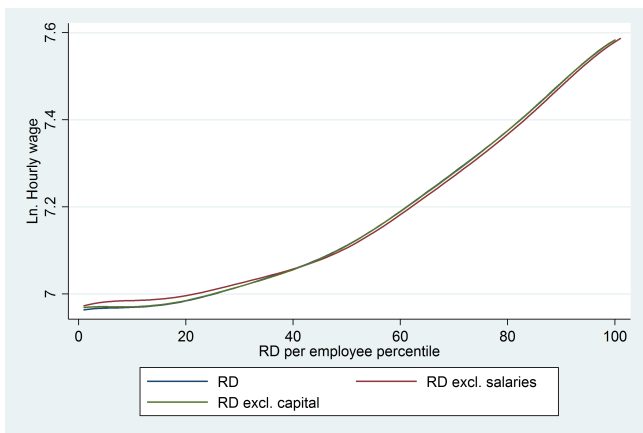
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## Motivation

- Differences between firms explains 2/3 of earnings variability (Card et. al. 2018, 2014, Song et. al. 2016)
- Innovation is a source of rent creation. What about rent-sharing? (Van Reenen 1996)



# This association is heterogeneous

- By type of occupation
  - ▶ Ranked by median earnings: wage quintiles
  - ▶ Ranked by the routine component: Routine Task Index
- By gender
- Question: is there rent-sharing?
  - ▶ If so, sharing with whom?

# Contribution

- Using matched employer-employee data from the manufacturing sector in the UK, we estimate the elasticity of R&D expenditure on hourly earnings
- We find a positive elasticity (between 0.24 and 0.41), which varies across different groups:
  - ▶ Top paid occupations gain more
  - ▶ Highly routinised occupations gain less
  - ▶ There is an important male premium
- Implications:
  - ▶ Is employment polarization matched with higher increase in wages for top paid occupations?
  - ▶ Likewise, larger share for less routinised jobs
  - ▶ Why male premium?

# Data

- Innovation
  - ▶ R&D private expenditure from the Business Enterprise Research and Development Survey (BERD). 400-500 firms responsible for 80% UK's R&D expenditure.
  - ▶ For the remaining 20% BERD targets 80-90% of medium to large businesses.
  - ▶ Small businesses are under-represented. We, therefore, focus on R&D performed by large firms.
- Earnings
  - ▶ Annual Survey of Hours and Earnings (ASHE).
- Trade
  - ▶ Comtrade
- Period of analysis: 2009-2015. Sector: manufacturing

## Empirical Strategy

$$\ln w_{ijt} = \alpha + \beta \ln RD_{jt} + X_{it} + \tau_t + \mu_{ij} + \varepsilon_{ijt} \quad (1)$$

- OLS estimation of  $\beta$  may be downward biased: unobserved heterogeneity or measurement error. Thus, we implement an IV estimation where we predict  $RD_{jt}$  using the growth of US imports from China following China's accession to the WTO

$$IMP_{Chi} = \kappa_k \Delta M_k^{USA} \quad (2)$$

- $\kappa_k$  are the China import shares of UK+US+EU by industry  $k$  for the period before China's accession to WTO, while  $\Delta M_k^{USA}$  are change in imports from China by USA  $k$ -industry.
  - ▶ The idea is that import competition increases R&D (Bloom et. al. 2016, ReStud)
  - ▶ In the context of R&D special relationship between USA and UK (Griffith et. al. 2006, AER)
  - ▶ In a way that UK firm's have to resort to niches (trapped factors model, Bloom et. al. 2013, AER)

# Results: Baseline

|                              | (1)                | (2)                 | (3)                 | (4)                 | (5)                 | (6)                 |
|------------------------------|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| <b>Panel a. Second-stage</b> |                    |                     |                     |                     |                     |                     |
| $\ln(R\&D)$                  | 0.109<br>(0.084)   | -0.089<br>(0.078)   | 0.241***<br>(0.068) | 0.411***<br>(0.139) | 0.384***<br>(0.119) | 0.325**<br>(0.090)  |
| <b>Panel b. First-stage</b>  |                    |                     |                     |                     |                     |                     |
| $IMPChi_t$                   | -0.784*<br>(0.436) |                     |                     |                     |                     |                     |
| $IMPChi_1$                   |                    | -0.718**<br>(0.354) |                     |                     |                     |                     |
| $IMPChi_2$                   |                    |                     | 1.255***<br>(0.318) |                     |                     |                     |
| $IMPChi_3$                   |                    |                     |                     | 0.832***<br>(0.314) |                     |                     |
| $IMPChi_4$                   |                    |                     |                     |                     | 0.864***<br>(0.307) |                     |
| $IMPChi_5$                   |                    |                     |                     |                     |                     | 0.943***<br>(0.281) |
| Obs.                         | 59480              | 59480               | 59480               | 59480               | 59480               | 59480               |
| F-Stat                       | 65                 | 65.4                | 65.1                | 65.1                | 65.2                | 65.6                |

## Result remains after variations

| IV used:   | (1)<br><i>IMPChi<sub>3</sub></i> | (2)<br><i>IMPChi<sub>4</sub></i> | (3)<br><i>IMPChi<sub>5</sub></i> |
|--|----------------------------------|----------------------------------|----------------------------------|
| <b>Panel a. R&amp;D net of salaries</b>                          |                                  |                                  |                                  |
| Ln (R&D excl. salaries)  | 0.233***<br>(0.059)              | 0.200***<br>(0.041)              | 0.230***<br>(0.053)              |
| Obs.   | 59434                            | 59434                            | 59434                            |
| <b>Panel b. R&amp;D net of capital</b>                           |                                  |                                  |                                  |
| Ln (R&D excl. capital)   | 0.368***<br>(0.114)              | 0.313***<br>(0.082)              | 0.259***<br>(0.061)              |
| Obs.   | 59480                            | 59480                            | 59480                            |
| <b>Panel c. Excluding top 1% R&amp;D per employee performers</b> |                                  |                                  |                                  |
| <i>Ln(R&amp;D)</i>   | 0.419***<br>(0.158)              | 0.425***<br>(0.155)              | 0.374***<br>(0.124)              |
| Obs.   | 57756                            | 57756                            | 57756                            |
| <b>Panel d. Excluding top 5% R&amp;D per employee performers</b> |                                  |                                  |                                  |
| <i>Ln(R&amp;D)</i>   | 0.510**<br>(0.234)               | 0.621*<br>(0.343)                | 0.482**<br>(0.205)               |
| Obs.   | 54514                            | 54514                            | 54514                            |



## Heterogeneity across occupations

|                                       | Wage<br>Quantile    | RTI                  | Routinisation        |                      |
|---------------------------------------|---------------------|----------------------|----------------------|----------------------|
|                                       | (1)                 | (2)                  | NS-SEC 7<br>(3)      | NS-SEC 6+7<br>(4)    |
| $\ln(R\&D)$                           | 0.207**<br>(0.093)  | 0.430***<br>(0.150)  | 0.402***<br>(0.133)  | 0.442***<br>(0.149)  |
| $\ln(R\&D) \times \text{quintile } 2$ | 0.068**<br>(0.029)  | -0.011<br>(0.014)    |                      |                      |
| $\ln(R\&D) \times \text{quintile } 3$ | 0.104***<br>(0.029) | -0.001<br>(0.020)    |                      |                      |
| $\ln(R\&D) \times \text{quintile } 4$ | 0.105***<br>(0.028) | -0.036*<br>(0.021)   |                      |                      |
| $\ln(R\&D) \times \text{quintile } 5$ | 0.131***<br>(0.034) | -0.083***<br>(0.028) |                      |                      |
| $\ln(R\&D) \times \phi(7)$            |                     |                      | -0.143***<br>(0.045) |                      |
| $\ln(R\&D) \times \phi(6,7)$          |                     |                      |                      | -0.109***<br>(0.031) |
| Obs.                                  | 59475               | 57863                | 59480                | 59480                |

# Heterogeneity across gender x occupations

| D =                              | Gender Gap          | Wage Distribution   |                     |                     | Routinisation       |                     |
|----------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|                                  | (1)                 | Top Half<br>(2)     | Top 20%<br>(3)      | Top 10%<br>(4)      | Top Half RTI<br>(5) | $\phi(7)$<br>(6)    |
| $\ln(R\&D)$                      | 0.192*<br>(0.103)   | 0.111<br>(0.083)    | 0.171*<br>(0.098)   | 0.175*<br>(0.095)   | 0.232**<br>(0.107)  | 0.212**<br>(0.106)  |
| $\ln(R\&D) \times D$             |                     | 0.040**<br>(0.018)  | 0.068*<br>(0.036)   | 0.090<br>(0.105)    | -0.053**<br>(0.022) | -0.124*<br>(0.070)  |
| $\ln(R\&D) \times Male$          | 0.170***<br>(0.048) | 0.136***<br>(0.042) | 0.160***<br>(0.047) | 0.165***<br>(0.049) | 0.124**<br>(0.055)  | 0.147***<br>(0.054) |
| $\ln(R\&D) \times D \times Male$ |                     | 0.012<br>(0.023)    | -0.036<br>(0.040)   | -0.087<br>(0.105)   | 0.044<br>(0.027)    | -0.006<br>(0.075)   |
| Obs.                             | 59480               | 59475               | 59475               | 59475               | 57863               | 59480               |

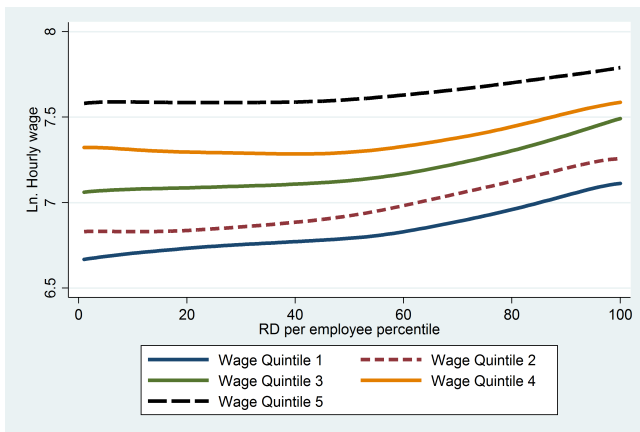
# Conclusions

- More innovative firms pay more: estimated elasticity ranges between 0.24 and 0.41.
- But it is uneven
  - ▶ Top 20% occupations gain 0.13 percentage points more (60% higher) than bottom 20%
  - ▶ Most routinised occupations enjoy a lower elasticity than least routinised occupations: 0.083 percentage points (19% smaller)
  - ▶ Male gap: 0.17 percentage points more than women (88% higher)
  - ▶ No evidence of male-top occupation or male-routinisation gap: i.e. different intercept, but same slope across type of occupation

# OLS Estimates

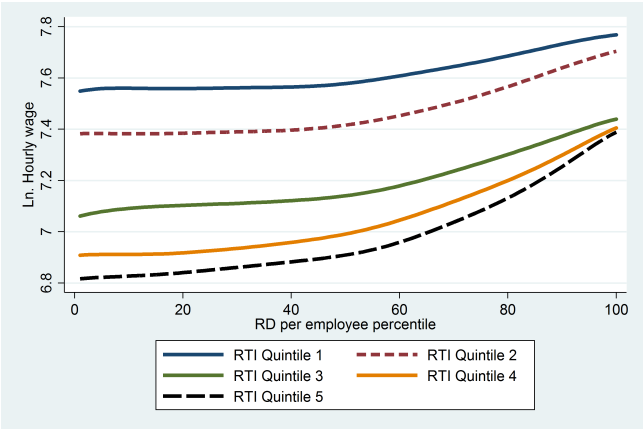
|                          | (1)                  | (2)                  | (3)                  | (4)                  |
|--------------------------|----------------------|----------------------|----------------------|----------------------|
| <i>Ln(R&amp;D)</i>       | 0.049***<br>(0.001)  | 0.037***<br>(0.001)  | 0.007***<br>(0.001)  | 0.001<br>(0.001)     |
| Age                      | 0.063***<br>(0.002)  | 0.046***<br>(0.001)  | 0.042***<br>(0.008)  | 0.046***<br>(0.007)  |
| Age2                     | -0.001***<br>(0.000) | -0.000***<br>(0.000) | -0.001***<br>(0.000) | -0.001***<br>(0.000) |
| Male                     | 0.194***<br>(0.008)  | 0.150***<br>(0.006)  |                      |                      |
| Full-time                | 0.061***<br>(0.012)  | -0.003<br>(0.010)    | -0.122***<br>(0.013) | -0.129***<br>(0.013) |
| Tenure                   | 0.006***<br>(0.000)  | 0.004***<br>(0.000)  | 0.002***<br>(0.001)  | 0.001<br>(0.001)     |
| Obs.                     | 59376                | 59371                | 59480                | 59480                |
| Fixed Effects            |                      |                      |                      |                      |
| Year                     | Yes                  | Yes                  | Yes                  | Yes                  |
| TTWA                     | Yes                  | Yes                  | No                   | No                   |
| TTWA × Year              | Yes                  | Yes                  | No                   | No                   |
| Occupation               | No                   | Yes                  | No                   | No                   |
| Occupation × TTWA        | No                   | Yes                  | No                   | No                   |
| Occupation × TTWA × Year | No                   | Yes                  | No                   | No                   |
| Individual               | No                   | No                   | Yes                  | Yes                  |
| Firm                     | No                   | No                   | No                   | Yes                  |
| Individual × Firm        | No                   | No                   | No                   | Yes                  |

# Wage quintiles



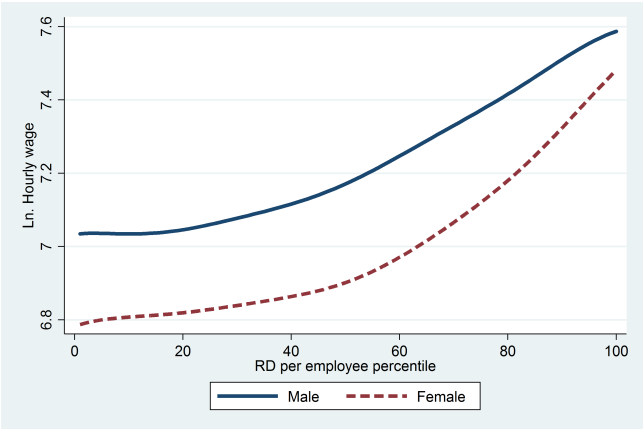
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# Routine component



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# Gender



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