People Versus Machines: Minimum Wages and Labor Reallocation Towards Automatable Jobs

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LSE

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Current Landscape

- 30 states have a minimum wage higher than the federal minimum wage of $7.25.
- Examples: $11 in Washington State and $11.50 in the District of Columbia.
- Seattle and Sea-Tac now reaching $15.
Objective

- Explore whether minimum wages induces substitution away from workers whose jobs are more easily automated.
Our Added Value

- Quantify how shares in automatable employment change following a minimum wage change.
- Provide a full picture of labor market adjustments across industries and demographic groups.
- Analyze whether particular types of individuals working in automatable jobs are less likely to stay in the same occupation following a minimum wage increase.
Data

- CPS data from 1980-2015
- Distinguish between occupations that are intensive in automatable tasks by drawing on definitions provided in Autor and Dorn (2013) and Autor et al. (2015).
Headline Findings

- Increasing the minimum wage decreases significantly the share of automatable employment held by low-skilled workers.
- An increase of the minimum wage by $1 decreases the share of low-skilled automatable jobs by 0.43 percentage point (an elasticity of $-0.11$).
- Average effects mask significant heterogeneity.
- Larger effects on the shares of automatable employment in manufacturing (0.73 percentage point decline)
- The share of older, female and Black workers in automatable employment also declines sharply.
Methodology (1)

- Focus on low skilled workers
- Use data Autor and Dorn (2013) and Autor et al. (2015) measure of routine task intensity.

\[ RTI_k = \ln(T_k^R) - \ln(T_k^M) - \ln(T_k^A) \]

- Calculate for each industry \( i \), within each area, in year \( t \), a routine employment share:

\[ RSH_{iat} = \left( \sum_{k=1}^{K} (L_{iat}) \cdot \mathbb{1}[RTI_k > RTI_{P66}] \right) \left( \sum_{k=1}^{K} (L_{iat}) \right)^{-1} \]

- First analysis focuses on:

\[ RSH_{iat} = b_1 MW_{st} + A_{at} \gamma + T_i \lambda + I_i \phi + \varepsilon_{iat} \]
Data (1)

- CPS samples from 1980-2015 matched to monthly state-level data on the minimum wage
- Allow for a period of adjustment by defining the minimum wage as the average over the current month plus the last 11 months.
- Measure of routine task intensity is from Autor and Dorn (2013).
Methodology (2)

• We also estimate the effects of being in an automatable job on the probability a person remains employed in the next period:

\[ \text{Emp}_{jiai+1} = b_1(RSH_{jiai} \cdot MW_{at}) + b_2RSH_{jiai} + T_i \cdot S_s \lambda + I_i \varphi + \varepsilon_{jia} \]

• A variation of the above equation considers occupational switchers
• Data is drawn from the Annual Social and Economic Supplement (ASEC) of the CPS.
# Full Sample Estimates, Shares of Employment in Automatable Jobs

Full sample estimates, shares of employment in automatable jobs.

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<td>Retail</td>
<td>Finance</td>
<td>Services</td>
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<td><strong>Dependent variable</strong> = share of automatable employment</td>
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<td>Log Min Wage</td>
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<td>-0.052</td>
<td>0.025</td>
<td>-0.021</td>
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<td>(0.014)</td>
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Notes: OLS coefficient estimates of Eq. (3) are reported, with standard errors in parentheses. Standard errors are clustered by state. Low-skilled workers are defined as those who have a high school diploma equivalent or less. The share of automatable employment is based on Eq. (2), with data derived from Autor and Dorn (2013) and Autor et al. (2015). A job is classified as automatable at the three-digit occupation code level. The share of automatable employment is calculated by industry, state (urban and nonurban areas), and year. All regressions include area (state x urban) and year fixed effects. The minimum wage is measured in 2015 dollars (for which the average minimum wage is $6.77).
### Disaggregated Estimates, Shares of Employment in Automatable Jobs

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**Dependent Variable = Share of Automatable Employment**

**Pooled**

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<tr>
<th>Log Min Wage</th>
<th>-0.031</th>
<th>-0.051</th>
<th>-0.036</th>
<th>-0.052</th>
<th>0.025</th>
<th>-0.021</th>
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<td>(0.014)</td>
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**Manufacturing Only**

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<th>-0.132</th>
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<td>(0.033)</td>
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<td>2538</td>
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Individual Level Estimates

- Effects of remaining employed have consistent narrative to shares of employment analysis.
- Small significant effect on pooled estimates (-0.001), and larger effects for older (-0.0062) and Black (-0.0038) workers.
- Male and female estimates are closer together (-0.0039 versus -0.0028).
- Manufacturing effects are always the largest (-0.0048).
- We also find significant effects on the probability of switching jobs:
  - (-0.0213 on pooled). Across industries, the effect is negative and significant in manufacturing, transport, wholesale, finance, services, and public administration.
Comment on Hours Analysis

- Significant decreases in hours worked for those initially in automatable jobs, following a minimum wage increase.

- For example a $1 increase in the minimum wage generates a -1.646 hours decrease in hours worked for low-skilled individuals who held an automatable job in the previous period.

- Across demographic groups, the estimated coefficients are also mostly significant and negative. For example, a $1 increase in the minimum wage is estimated to reduce hours worked for low-skilled males who held an automatable job in the previous period by 2.669.
Comment on Contemporary Analysis

- Move towards automation has accelerated over time, technology has been getting cheaper, and labor more expensive.
- The substitution towards automation in place of low-skilled workers in response to a minimum wage increase is stronger in an analysis of more recent years.
Conclusions

- Minimum wage increases affects the share of low-skilled employment available in automatable jobs, and the probability that a low-skilled individual working in an automatable job stays employed (or in the same occupation).

- Document considerable heterogeneity in effects across demographic groups, and across industries.
Discussion

- Sharp minimum wage increases may shape the types of jobs held by low-skilled workers.
- We identify some workers who are more vulnerable to substitution of machines for people.
- Definitions of automatable work by Autor and Dorn (2013) are very useful for a retrospective analysis.
- In the future many more occupations that employ low-skill workers are on track to be automated, even if they are not currently labelled as ‘automatable.’
- Effects may spread to more workers in the future as other jobs become automatable.
Further Work

• LPC replication Lordan (2018)
• Skills needed in next decade Lordan and Josten (2018)
• EC analysis Lordan (2018)
• Gender and Technology (ongoing)
Questions? Comments?