Job Polarization and Unskilled Employment Losses in France

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Introduction

Topics: technical change, labor taxation policies, unskilled employment

Job polarization:
- Diffusion of ICT
  - Acemoglu and Autor (2010), Autor and Dorn (2013)
- Job polarization in developed countries
  - Goos et al. (2009), Moreno-Galbis and Sopraseuth (2012), Catherine et al. (2015), Harrigan et al. (2016)
- Unskilled labor costless in the U.S
  - Autor et al. (2012), Autor et al. (2013)

Employment outcomes:
- This might not be the case in France...
- Underdeveloped service sector
- The role of labor market institutions
  - Blanchard (2005), Langot et al. (2015)
Introduction

Motivation
How labor market policies influence employment outcomes arising from technical change?

Contribution
- Consistent time series based on the FLFS
  - Employment structure (occupational level)
  - Employment level
- Interaction between job polarization and labor taxation
  - Intertwine effect of technical change and labor taxation
  - Link the occupational structure to the employment level
- General equilibrium model with occupational choice
  - Parsimonious
  - Counter-factual analysis
- Measure unskilled employment losses/gains
  - Job polarization
  - Differentiated payroll tax reduction policies
Data outlines

- FLFS from 1982-2008
- Civilian population
- 15-64 year olds
- Two samples
  - Employed salary workers\(^1\) (Job polarization)
  - Entire working age population (Employment outcomes)
- Changes in survey design in 1990 and 2003
  - Occupational crosswalk
  - Statistical break correction model
- Task definition

\(^1\)Drop CSE 11, 12, 13, 21, 22, 23, 31, 44, 69
Job polarization over 1982–2008

Note: Sample includes salary workers who are 15–64 year old during the sample year (appendix A). Observed variable (grey) is smoothed (black) by using a locally linear model with a .5 bandwidth. Source: Enquête emploi, INSEE. Author’s computations.
Job polarization over 1982–2008

Note: Sample includes salary workers who are 15–64 year old during the sample year (appendix A). Observed variable is smoothed by using a locally linear model with a .5 bandwidth. Source: Enquête emploi, INSEE. Author’s computations.
Wages over 1982–2008

Note: Sample includes salary workers who are 15–64 year old during the sample year (appendix A)
Observed variable (grey) is smoothed (black) by using a locally linear model with a .5 bandwidth.
Source: Enquête emploi, INSEE. Author’s computations.
Average labor tax rate

\[ \bar{\tau} = \bar{\tau}_{inc} + \bar{\tau}_{SS} \]
Differentiated payroll tax reduction policies

Payroll tax reduction policies

- Balladur 1993
- Juppé 1996
- Aubry II 2000*
- Fillon 2005**
- Fillon 2007***

* Apply only for firms that implemented the 35–hour working time reductions (GMR).
** Also apply for firms with more than 19 employees after the 2007 reform.
*** Apply only for firms with less than 20 employees.

Sources: Legislation, Ourliac and Nouveau (2012) and author’s computation.
Employment outcomes

Aggregate employment rate

Note: Sample includes 15–64 year old individuals during the sample year (appendix A). Observations are corrected for 1990, 2003 breaks (grey) and then smoothed (black) using a locally linear model with a 0.4 bandwidth.
Source: Enquête emploi, INSEE. Author’s computations.
Employment outcomes

Note: Sample includes 15–64 year old individuals during the sample year (appendix A). Unskilled individuals are defined as individuals who have at most a high–school degree (Bac). Observations are corrected for 1990, 2003 breaks (grey) and then smoothed (black) using a locally linear model with a 0.4 bandwidth.
Source: Enquête emploi, INSEE. Author’s computations.
Employment outcomes

Note: Sample includes 15–64 year old individuals during the sample year (appendix A). Skilled individuals are defined as individuals who have at least a post high-school degree (Bac+2). Observations are corrected for 1990, 2003 breaks (grey) and then smoothed (black) using a locally linear model with a 0.4 bandwidth.
Source: Enquête emploi, INSEE. Author’s computations.
Employment outcomes

Employment rate skill decomposition

\[ e_t = \theta_{t}^{SK} e_{t}^{SK} + \theta_{t}^{UN} e_{t}^{UN} \]

Skill decomposition of aggregate employment rate change

\[ \Delta e_{t-x,t} = \theta_{t-x}^{SK} \Delta e_{t-x,t}^{SK} + \theta_{t-x}^{UN} \Delta e_{t-x,t}^{UN} + \]

Employment Effect

\[ e_{t}^{SK} \Delta \theta_{t-x,t}^{SK} + e_{t}^{UN} \Delta \theta_{t-x,t}^{UN} \]

Skill Composition Effect

<table>
<thead>
<tr>
<th></th>
<th>Employment Effect</th>
<th>Skill Composition Effect</th>
<th>Total</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\theta_{t-x}^{SK} \Delta e_{t-x,t}^{SK})</td>
<td>(\theta_{t-x}^{UN} \Delta e_{t-x,t}^{UN})</td>
<td>Total</td>
<td>(e_{t}^{SK} \Delta \theta_{t-x,t}^{SK})</td>
<td>(e_{t}^{UN} \Delta \theta_{t-x,t}^{UN})</td>
</tr>
<tr>
<td>1982 – 1995</td>
<td>-0.36</td>
<td>-3.49</td>
<td>-3.84</td>
<td>1.94</td>
<td>-1.48</td>
</tr>
<tr>
<td>1995 – 2008</td>
<td>0.51</td>
<td>0.74</td>
<td>1.25</td>
<td>10.98</td>
<td>-8.00</td>
</tr>
<tr>
<td>1982 – 2008</td>
<td>0.03</td>
<td>-2.72</td>
<td>-2.69</td>
<td>13.05</td>
<td>-9.50</td>
</tr>
</tbody>
</table>
Employment outcomes

Skill x task decomposition of aggregate employment rate change

\[
\Delta e_{t-x,t} = \sum_{k \in \{m, r, a\}} \left( \theta^{SK}_{t-x} \Delta e^{SK,k}_{t-x,t} + \theta^{UN}_{t-x} \Delta e^{UN,k}_{t-x,t} \right) + \sum_{k \in \{m, r, a\}} \left( e^{SK,k}_{t} \Delta \theta^{SK}_{t-x,t} + e^{UN,k}_{t} \Delta \theta^{UN}_{t-x,t} \right)
\]

<table>
<thead>
<tr>
<th></th>
<th>Employment Effect</th>
<th>Skill Composition Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\theta^{SK}<em>{t-x} \Delta e^{SK,k}</em>{t-x,t}$</td>
<td>$\theta^{UN}<em>{t-x} \Delta e^{UN,k}</em>{t-x,t}$</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>R</td>
</tr>
<tr>
<td>1982 – 1995</td>
<td>0.03</td>
<td>0.15</td>
</tr>
<tr>
<td>1995 – 2008</td>
<td>0.13</td>
<td>0.51</td>
</tr>
<tr>
<td>1982 – 2008</td>
<td>0.12</td>
<td>0.54</td>
</tr>
</tbody>
</table>
Model outlines

» Three inputs
  » Skilled workers
  » Unskilled workers
  » Capital
» Two market sectors
  » Goods sector
  » Market service sector
» A non-market sector (non-employment)
  » No wages
  » Not taxed
» Three types of exogenous trends
  » Diffusion of new technologies
  » Labor taxation policies
  » Relative non-market productivity
Supply side

Unskilled labor
\[ \{a, r, m\} = \{0, \eta, 1\} \] with
\[ f(\eta) = e^{-\eta} \]
\[ (1 - \tau_r)\omega_r \eta \leq (1 - \tau_{ms})\omega_{ms} \]

Manual task
\[ l_{ms} + l_n = 1 - e^{-\eta} \]

Non employment
\[ Y_n = A_n l_n \]
\[ A_n = e^{(t-1)\delta_n} \]

Market service sector
\[ \Pi_{ms} = \rho Y_{ms} - \omega_{ms} l_{ms} \]
\[ Y_{ms} = A_{ms} l_{ms} \]

Routine task
\[ l_r = (1 + \eta)e^{-\eta} \]

Capital
\[ K = Y_k e^{(t-1)\delta_k} \]
\[ p_k = e^{-(t-1)\delta_k} \]

Abstract task
\[ l_a = 1 \]

Goods sector
\[ \Pi_g = Y_g - \omega_a l_a - \omega_r l_r - p_k K \]
\[ Y_g = l_1^{1-\beta} \left[ (\alpha_k K)^\mu + ((1 - \alpha_k) l_r)^\mu \right]^{\frac{\beta}{\mu}} \]

Skilled labor
\[ \{a, r, m\} = \{1, 0, 0\} \]
Demand side

Representative household

\[
\begin{align*}
\max_{\{C_g, C_{ms}, C_n, l_n\}} & \quad \left[ a_g C^\varepsilon + (1 - a_g) F(C_{ms}, C_n)^\varepsilon \right]^{\frac{1}{\varepsilon}} \\
\text{s.t.} & \quad C_g + p C_{ms} = \sum_{i \in \{a, r, ms\}} (1 - \tau_i) w_i l_i + T \\
& \quad F(C_{ms}, C_n) = \left[ a_s C_{ms}^\nu + (1 - a_s) C_n^\nu \right]^{\frac{1}{\nu}} \\
& \quad 1 - e^{-\eta} = l_{ms} + l_n \\
& \quad Y_n = A_n l_n \\
& \quad Y_n = C_n
\end{align*}
\]

with \( \varepsilon < 0, \nu > 0 \) and non negativity constraints.
Closing the model

Market clearing conditions

\[ Y_g = C_g + p^K K \]
\[ Y_{ms} = C_{ms} \]
\[ Y_n = C_n \]

Government budget constraint

\[ T = \sum_{i \in \{a, r, ms\}} \tau_i w_i l_i \]
General equilibrium conditions

\[
\begin{align*}
  w_r &= \beta (1 - \alpha_k)^\mu l_r^{\mu-1} l_a^{1-\beta} \left[ ((1 - \alpha_k) l_r)^\mu + (\alpha_k K)^\mu \right]^{\beta \mu - 1} \\
  w_a &= (1 - \beta) l_a^{-\beta} \left[ ((1 - \alpha_k) l_r)^\mu + (\alpha_k K)^\mu \right]^{\beta \mu} \\
  p_k &= \beta \alpha_k^\mu K^{\mu-1} l_a^{1-\beta} \left[ ((1 - \alpha_k) l_r)^\mu + (\alpha_k K)^\mu \right]^{\beta \mu - 1} \\
  w_{ms} &= A_{ms} p \\
  \bar{\eta} &= \frac{(1 - \tau_{ms}) w_{ms}}{(1 - \tau_r) w_r} \\
  l_{ms} + l_n &= 1 - e^{-\bar{\eta}} \\
  l_r &= (1 + \bar{\eta}) e^{-\bar{\eta}} \\
  l_a &= 1 \\
  p &= \frac{a_s (1 - a_g)}{a_g} \frac{F(C_{ms}, C_n) \epsilon - \nu}{C_g^{\epsilon - 1}} \frac{C_{ms}^{\nu - 1}}{} \\
  l_{ms} &= \left( \frac{A_{ms}}{A_n} \right)^{\frac{1}{1-\nu}} \left( \frac{(1 - \tau_{ms}) a_s}{(1 - a_s)} \right)^{\frac{1}{1-\nu}} l_n
\end{align*}
\]
General equilibrium conditions

\[ C_g + pC_{ms} = \sum_{i \in \{a, r, ms\}} (1 - \tau_i)w_i l_i + T \]

\[ T = \sum_{i \in \{a, r, ms\}} \tau_i w_i l_i \]

\[ Y_{ms} = A_{ms} l_{ms} \]

\[ Y_n = A_n l_n \]

\[ Y_g = C_g + p_k K \]

\[ Y_{ms} = C_{ms} \]

\[ Y_n = C_n \]

\[ p_k = e^{-(t-1)\delta_k} \]

\[ A_n = e^{(t-1)\delta_n} \]
Calibration

- Enquête emploi (INSEE), EU KLEMS, social security report (Amer et al., 2009), Rogerson (2008).
- Empirically relevant case: $\varepsilon < \frac{\mu}{\beta}$, $\varepsilon < 0$, $\mu > 0$.

**Asymptotic analysis**

Employment data to match

<table>
<thead>
<tr>
<th>Year</th>
<th>$e_{t}^{UN} = e_{t}^{UN,r} + e_{t}^{SN,m}$</th>
<th>$e_{t}^{UN,r} = \int_{-\infty}^{+\infty} e^{-\eta} d\eta$</th>
<th>$e_{t}^{SN,m} = l_ms$</th>
<th>$1 - e_{t}^{UN} = l_n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>.6174</td>
<td>.5498</td>
<td>.0676</td>
<td>.3826</td>
</tr>
<tr>
<td>2008</td>
<td>.5878</td>
<td>.4671</td>
<td>.1207</td>
<td>.4122</td>
</tr>
</tbody>
</table>

Labor share data to match

<table>
<thead>
<tr>
<th>Year</th>
<th>Labor share</th>
<th>$\Delta$Labor share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>.7684</td>
<td>-</td>
</tr>
<tr>
<td>2008</td>
<td>.6539</td>
<td>-11.45pp</td>
</tr>
</tbody>
</table>

External parameters

<table>
<thead>
<tr>
<th>$\beta$</th>
<th>$A_{ms}$</th>
<th>$\nu$</th>
<th>$\tau_a,1982 = \tau_r,1982 = \tau_{ms,1982}$</th>
<th>$\tau_a,2008$</th>
<th>$\tau_r,2008$</th>
<th>$\tau_{ms,2008}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>.67</td>
<td>1</td>
<td>.45</td>
<td>.35</td>
<td>.39</td>
<td>.34</td>
<td>.29</td>
</tr>
</tbody>
</table>

Calibrated parameters

<table>
<thead>
<tr>
<th>$\delta_k$</th>
<th>$\alpha_k$</th>
<th>$\delta_n$</th>
<th>$a_s$</th>
<th>$a_g$</th>
<th>$\varepsilon$</th>
<th>$\mu$</th>
</tr>
</thead>
<tbody>
<tr>
<td>.031</td>
<td>.40</td>
<td>-.016</td>
<td>.37</td>
<td>.96</td>
<td>-.84</td>
<td>.42</td>
</tr>
</tbody>
</table>
Results

Model fit

\[ e^{UN} \]

\[ e^{UN,m} \]

\[ e^{UN,r} \]

\[ 1 - e^{UN} \]
Results

The role of capital diffusion
Results

The role of differentiated payroll tax reduction policies

\[
\begin{align*}
\text{UN}^{e} & = 62, 58, 56, 54 \\
\text{UN,m} & = 14, 12, 10, 8 \\
\text{UN,r} & = 45, 50, 55, 60 \\
1 - \text{UN} & = 38, 42, 44, 46
\end{align*}
\]
Results

Labor share

![Labor share graph](image)

- **Data**
- \( \delta_k = 0.031 \)
- \( \delta_k = 0 \)
Conclusion

- Four French stylized facts
  - Job polarization
  - Unskilled employment losses
  - Imperfect reallocation of unskilled workers from routine to manual jobs
  - High average labor tax rate but massive differentiated payroll tax reductions since 1993

- General equilibrium model with occupational choice
  - Parsimonious
  - Match the data
  - Counter-factual analysis
  - Unskilled employment losses from high and increasing labor taxation
  - Unskilled employment gains from differentiated payroll tax subsidies
Thank You
References


References


References


References


References

Timo Boppart. Structural change and the Kaldor facts in a growth model with relative price effects and non-Gorman preferences. ECON - Working Paper 002, Department of Economics - University of Zurich, 2011.


Pierre Cahuc and Stéphane Carcillo. Les conséquences des allègements généraux de cotisations patronales sur les bas salaires. Sciences po publications, Sciences Po, October 2012.


References


References


References


References


References


Appendix
Occupational crosswalk

PCS 1982

Waits staff in cafes and restaurants (5611)

\( \omega \)

\( \theta_1 \)

\( \theta_2 \)

\( \theta_3 \)

\( \theta_4 \)

PCS 2003

Food and beverage supervisory staff (hotels and restaurants) (468a)

\( \omega \theta_1 \)

Hotel industry and events employees (561e)

\( \omega \theta_2 \)

Kitchen helpers and apprentices (561d)

\( \omega \theta_3 \)

Waits staff in cafes and restaurants (561a)

\( \omega \theta_4 \)

with \( \sum_{i=1}^{4} \theta_i = 1. \)
Statistical break correction model

Two steps correction

▶ First step

\[ \tilde{\gamma}_t = \alpha_1 + \delta_1 t + \beta_1 \text{ind}2003_t + \epsilon_t \]
\[ \tilde{\gamma}_t = \tilde{\gamma}_t - \hat{\beta}_1 \text{ind}2003_t \]

▶ Second step

\[ \tilde{\gamma}_t = \alpha_2 + \delta_2 t + \beta_2 \text{ind}1990_t + \epsilon_t \]
\[ y_t = \tilde{\gamma}_t - \hat{\beta}_2 \text{ind}1990_t \]
Statistical break correction model

Statistical break correction

Unskilled employment rate

Year

1980 1990 2000 2010

Non-corrected  Corrected  Breaks

%
Statistical break correction model

Statistical break correction

Skilled employment rate

Year

Non-corrected Corrected Breaks

Statistical break correction

1980 1990 2000 2010

%
Statistical break correction model

Statistical break correction
Aggregate employment rate

Year
1980 1990 2000 2010
Non−corrected Corrected Breaks
Aggregate employment rate
Statistical break correction

Back
Data

Manual jobs: low-skilled manual services
- Personal service jobs
- Some public servants

Routine jobs: industrial, clerical and other manual jobs
- Business administrative personnel
- Maintenance, storage, and transportation workers
- Foremen, skilled and unskilled industry workers
- Salespeople
- Drivers

Abstract jobs: direction, scientific, and technical jobs
- Heads of companies
- Professors and scientific professions
- Business administration, engineers and technicians
- Technicians
Data

Manual jobs
- CSE: 56, 52 (except 521a, 521b, 522a, 523a, 524a)
- Additional job codes: 631a, 636d, 684a

Routine jobs
- CSE: 11, 12, 13, 21, 48, 54, 55, 62, 63 (except 636a, 631d), 64, 65, 67, 68 (except 684a), 69
- Additional job codes: 521a, 521b, 522a, 523a, 524a

Abstract jobs
- CSE: 22, 23, 31, 33, 34, 35, 37, 38, 42, 43, 44, 45, 46, 47, 53
- Additional job codes: -
Job polarization over 1982–2008

Note: Sample includes salary workers who are 15–64 year old during the sample year (appendix A). Observed variable is smoothed by using a locally linear model with a .5 bandwidth. Source: Enquête emploi, INSEE. Author’s computations.
Job polarization over 1982–2008

Aggregated occupational groups (CSE)

Note: Sample includes salary workers who are 15–64 year old during the sample year (appendix A). Observations are corrected for 1990, 2003 breaks. The smoothed curve is obtained by using a unweighted quadratic fit.

Source: Enquête emploi, INSEE. Author’s computations.
Sample weight

\[ \omega_{i,t_0}^{t_0} = f(x_i \mid T_x = t_0, Occ) \cdot h(Occ \mid T_{Occ} = t_0) \]

Counter-factual sample weight

\[ \omega_{i,t_0}^{t_1} = f(x_i \mid T_x = t_1, Occ) \cdot h(Occ \mid T_{Occ} = t_0) \\
= \psi_i(Occ) \cdot f(x_i \mid T_x = t_1, Occ) \cdot h(Occ \mid T_{Occ} = t_1) \\
= \psi_i(Occ) \cdot \omega_{i,t_0}^{t_1} \]

Re-weighting factor

\[ \psi_i(Occ) = \frac{h(Occ \mid T = t_0)}{h(Occ \mid T = t_1)} \\
= \frac{P(T = t_0 \mid Occ = Manual) \cdot 1 - P(T = t_0)}{1 - P(T = t_0 \mid Occ = Manual) \cdot P(T = t_0)} \]

since \( h(Z = z) = \frac{h(Z \mid t_z = t_i) \cdot P(t = t_i)}{P(t = t_i \mid Z = z)} \) with \( i = 0, 1 \).
Wages over 1982–2008

Note: Sample includes salary workers who are 15–64 year old during the sample year (appendix A).
Observed variable is smoothed by using a locally linear model with a .5 bandwidth.
Source: Enquête emploi, INSEE. Author’s computations.
### 10 Least Paid Occupations (ascending order)

<table>
<thead>
<tr>
<th>Code</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>683a</td>
<td>Baker, butcher apprentices</td>
</tr>
<tr>
<td>563a</td>
<td>Childcare assistants, nannies, host families</td>
</tr>
<tr>
<td>563b</td>
<td>Home health aides, housekeepers, family workers</td>
</tr>
<tr>
<td>564a</td>
<td>Janitors, caretakers</td>
</tr>
<tr>
<td>562b</td>
<td>Fully employed hairdressers</td>
</tr>
<tr>
<td>563c</td>
<td>Domestic workers</td>
</tr>
<tr>
<td>682a</td>
<td>Unskilled metalworkers, locksmiths, mechanical repairers</td>
</tr>
<tr>
<td>681b</td>
<td>Unskilled secondary construction workers</td>
</tr>
<tr>
<td>636b</td>
<td>Pork butchers (except meat industry)</td>
</tr>
<tr>
<td>684a</td>
<td>Cleaners</td>
</tr>
</tbody>
</table>

### 10 Most Paid Occupations (ascending order)

<table>
<thead>
<tr>
<th>Code</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>388d</td>
<td>Engineers and technical sales executives in IT and telecommunications</td>
</tr>
<tr>
<td>342a</td>
<td>Higher education instructors</td>
</tr>
<tr>
<td>386d</td>
<td>Engineers and managers in the production and distribution of energy, water</td>
</tr>
<tr>
<td>381a</td>
<td>Engineers, research and managers for agriculture, fisheries, water and forest</td>
</tr>
<tr>
<td>385b</td>
<td>Engineers and managers of manufacturing processing industries</td>
</tr>
<tr>
<td>383b</td>
<td>Engineers and managers in manufacturing of electrical, electronic materials</td>
</tr>
<tr>
<td>331a</td>
<td>Public service management personnel (State, local authorities, hospitals)</td>
</tr>
<tr>
<td>371a</td>
<td>Top administrative, finance and commercial management for large companies</td>
</tr>
<tr>
<td>333a</td>
<td>Magistrates</td>
</tr>
<tr>
<td>380a</td>
<td>Technical directors of large companies</td>
</tr>
</tbody>
</table>
Job rank in 1982

10 Most Declining Occupations (ascending order)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>675a</td>
<td>Unskilled workers in textile and dressmaking, tanneries, and leather work</td>
</tr>
<tr>
<td>543d</td>
<td>Administrative employees of various companies</td>
</tr>
<tr>
<td>542a</td>
<td>Secretaries</td>
</tr>
<tr>
<td>543a</td>
<td>Financial or accounting service employees</td>
</tr>
<tr>
<td>542b</td>
<td>Typists, stenographers, (non secretarial) word processing operators</td>
</tr>
<tr>
<td>681a</td>
<td>Unskilled structural works construction workers</td>
</tr>
<tr>
<td>671b</td>
<td>Unskilled workers in public works, concrete and extraction work, excluding state and local government</td>
</tr>
<tr>
<td>682a</td>
<td>Unskilled metalworkers, locksmiths, mechanical repairers</td>
</tr>
<tr>
<td>641a</td>
<td>Drivers and long-haul truck drivers (full employed)</td>
</tr>
<tr>
<td>675b</td>
<td>Unskilled production workers in woodworking and furniture</td>
</tr>
</tbody>
</table>

10 Most Growing Occupations (ascending order)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>553a</td>
<td>Non-specialized vendors</td>
</tr>
<tr>
<td>451f</td>
<td>Class B administrative staff of local authorities and hospitals</td>
</tr>
<tr>
<td>525c</td>
<td>Civil service officials (outside of schools, hospitals)</td>
</tr>
<tr>
<td>523a</td>
<td>Deputy civil service administrators (including education)</td>
</tr>
<tr>
<td>341a</td>
<td>Professors specializing and certified in secondary education</td>
</tr>
<tr>
<td>431f</td>
<td>General care nurses, fully employed</td>
</tr>
<tr>
<td>526a</td>
<td>Caregivers (civil service or private sector)</td>
</tr>
<tr>
<td>388a</td>
<td>Engineers and research managers, research and development in computer science</td>
</tr>
<tr>
<td>563a</td>
<td>Childcare assistant, nannies, host families</td>
</tr>
<tr>
<td>563b</td>
<td>Home health aides, housekeepers, family workers</td>
</tr>
</tbody>
</table>
## Task composition of employment by skill level

<table>
<thead>
<tr>
<th>Skill level</th>
<th>Unskilled</th>
<th>Skilled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Occupation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manual</td>
<td>Routine</td>
</tr>
<tr>
<td>Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>10.95</td>
<td>65.69</td>
</tr>
<tr>
<td>1995</td>
<td>16.16</td>
<td>57.90</td>
</tr>
<tr>
<td>2008</td>
<td>20.53</td>
<td>53.01</td>
</tr>
</tbody>
</table>
Asymptotic labor allocation

As $t \to +\infty$, $p_k(t) \to 0$ and $K(t) \to +\infty$

$$
\lim_{t \to +\infty} l_s = \begin{cases} 
1 & \text{if } \varepsilon < \frac{\mu}{\beta} \\
]0; 1[ & \text{if } \varepsilon = \frac{\mu}{\beta} \\
0 & \text{if } \varepsilon > \frac{\mu}{\beta} 
\end{cases}
$$

$$
\lim_{t \to +\infty} l_r = \begin{cases} 
0 & \text{if } \varepsilon < \frac{\mu}{\beta} \\
1 - l_s & \text{with } l_s \in ]0; 1[ \text{ if } \varepsilon = \frac{\mu}{\beta} \\
1 & \text{if } \varepsilon > \frac{\mu}{\beta} 
\end{cases}
$$
Asymptotic labor allocation

\[ \lim_{t \to +\infty} l_{ms} = \begin{cases} 
\frac{1}{1+\Theta} & \text{if } \varepsilon < \frac{\mu}{\beta} \\
\frac{1}{1+\Theta} l_s & \text{with } l_s \in ]0; 1[ \text{ if } \varepsilon = \frac{\mu}{\beta} \\
0 & \text{if } \varepsilon > \frac{\mu}{\beta}
\end{cases} \]

\[ \lim_{t \to +\infty} l_n = \begin{cases} 
\frac{\Theta}{1+\Theta} & \text{if } \varepsilon < \frac{\mu}{\beta} \\
\frac{\Theta}{1+\Theta} l_s & \text{with } l_s \in ]0; 1[ \text{ if } \varepsilon = \frac{\mu}{\beta} \\
0 & \text{if } \varepsilon > \frac{\mu}{\beta}
\end{cases} \]

with \( \Theta = \left( \frac{A_{ms}}{A_n} \right)^{\frac{\nu}{\nu-1}} \left[ \frac{a_s(1-\tau_{ms})}{1-a_s} \right]^{\frac{1}{\nu-1}} \)

\[ \downarrow \downarrow \tau_{ms}, \downarrow A_n \Rightarrow \downarrow \downarrow \Theta \Rightarrow \left\{ \begin{array}{l}
\uparrow \uparrow l_{ms} \\
\downarrow \downarrow l_n
\end{array} \right. \]

\[ \text{Back} \]
Wage ratios

If $\varepsilon < \frac{\mu}{\beta}$,

\[
\lim_{t \to +\infty} \frac{w_{ms}}{w_r} = +\infty
\]

\[
\lim_{t \to +\infty} \frac{w_a}{w_{ms}} = \begin{cases} 
+\infty & \text{if } \varepsilon > 0 \\
\frac{\Omega}{1+\Theta} & \text{if } \varepsilon = 0 \\
0 & \text{if } \varepsilon < 0
\end{cases}
\]

\[
\lim_{t \to +\infty} \frac{l_aw_a}{l_rw_r} = 0
\]
Calibration

Benchmark labor tax rates

Figure: Average labor tax rate by task
Results

Job polarization

Employment Share Changes 1982-2008

- Manual
- Routine
- Abstract

100 x Change in Employment Share
Results

Net wage ratios

\[
\frac{(1 - \tau_a)w_a}{(1 - \tau_{ms})w_{ms}}
\]

1980 1990 2000 2010

\[
\frac{(1 - \tau_{ms})w_{ms}}{(1 - \tau_r)w_r}
\]

1980 1990 2000 2010
Results

Sensitivity analysis $\tau$
Results
Sensitivity analysis $\delta_n$

$e_{UN}$

$e_{UN,m}$

$e_{UN,r}$

$1 - e^{UN}$
Results

Sensitivity analysis $\nu$