Offshoring and the Onshore Composition of Tasks and Skills

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Background

- Studies of the effect of FDI (in-house offshoring) on the composition of labor demand typically find small or negligible effects.
- Offshoring of intermediate inputs contributes to an increased relative demand for high-skilled workers.
- US imports contribute 15-40 percent to an increased relative demand for non-production workers (Feenstra and Hanson, 1999).
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Potential explanations for weak correlation between offshoring and changes in the skill composition of the work force:

- Offshoring may increase the relative demand for unskilled workers, depending on effect on productivity (Jones and Kierzkowski, 2001, Grossman and Rossi-Hansberg, 2008, Kohler, 2008).
- The ease to which jobs can be offshored may be only weakly correlated with its skill content (Markusen, 2006).
- Computer programmer versus janitor.
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The tradability of tasks

The *tradability* of tasks is related to whether they:

- are routine tasks that can be easily summarized by deductive rules (Levy and Murnane, 2004)
- require codifiable rather than tacit information (Leamer and Storper, 2001).
- do not require physical contact and geographic proximity (Blinder, 2006).

Evidence that IT has had effects on the nature of tasks performed on the job.

- Autor, Levy, and Murnane (2003): US computerization associated with reduced inputs of workers carrying out *routine manual* and *cognitive* tasks and increased inputs of workers carrying out *nonroutine cognitive* tasks.
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Our contribution

- Revisit the issue of how FDI affects the composition of labor demand at parent firms.
- Use data that enable us to distinguish between:
  - (i) occupations (white-collar versus blue-collar),
  - (ii) education (at least upper-secondary education versus at most lower secondary education), and
  - (iii) tasks (non-routine versus routine/interactive versus non-interactive).
- Provide empirical evidence on the relevance of a focus on tasks when analyzing effects of offshoring on relative labor demand.
- Provide evidence for the service sector as well as the manufacturing sector.
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Data

- We match data from the Deutsche Bundesbank on affiliate activities of German MNEs (MIDI-USTAN database) with worker-level social security data from the German Federal Labor Agency (Bundesagentur für Arbeit, BA).
  - Use information at plant level.
  - Use commercial database MARKUS (from Verband der Vereine Creditreform) to identify all German affiliates of MIDI-USTAN firms, to which we then link BA plants.
  - Panel at plant level 1998-2001 containing 1,252 plants at about 500 MNEs.

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Task content of occupations

- Inferred from 81 questions about:
  - tools, instruments and other equipment used by the employee.
  - the extent to which the work is related to computer programming, repairing and supervision.
- Create indicators of whether a job implies:
  - non-routine (NR) tasks.
  - tasks requiring personal interaction (Int) with other workers in the firm and/or with the firm’s customers.
- Suppose maximum number of NR tasks carried out by any occupation is 20 and secretaries report an average of 5.
  - We assign secretaries the value $5/20=0.25$.
  - 25% of the wagebill of secretaries at a plant is wages paid for NR tasks.
  - 25% of the labor input of secretaries at a plant is input of NR tasks.
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Descriptives

▶ Higher levels and larger increases in the share of all four "advanced" work types (non-routine/interactive/upper-sec. education/white-collar) in MNEs compared to non-MNEs.

▶ Changes in the composition of tasks relatively small in comparison with the other measures.

▶ Increases in wage-bill shares of "advanced" work types larger in services than in manufacturing.
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Non-routine tasks

Manufacturing

Services

MNEs    non_MNEs


MNEs    non_MNEs

Upper-secondary education

Manufacturing

Services


MNEs non_MNEs

MNEs non_MNEs
## Correlations between wage-bill shares

<table>
<thead>
<tr>
<th></th>
<th>NR tasks</th>
<th>IA tasks</th>
<th>Upp.-sec. educ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interact. tasks</td>
<td>0.519</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upp.-sec. educ.</td>
<td>0.615</td>
<td>0.302</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td></td>
</tr>
<tr>
<td>White-collar</td>
<td>0.198</td>
<td>0.109</td>
<td>0.229</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
</tbody>
</table>
Estimation Strategy

- Estimating equation based on translog cost function:

\[
\theta_{ijt} = \alpha_j + \beta_K \ln \frac{K_{kt}}{Y_{kt}} + \beta_Y \ln Y_{jt} + \beta_w \ln \frac{w_{ijt}}{w_{-ijt}} + \sum \gamma_\ell OE_{k\ell t} + \delta_t + \epsilon_{ijt},
\]

- "FDI-exposure" OE measured as the foreign share of the firm’s employment (distinguishing between high-income and low-income countries)

- Control for sector-level offshoring, R&D intensity and import penetration

- Use different measures for non-routine and interactive tasks (more restrictive, less restrictive, Spitz-Oener (2006))
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### Table 6

Offshoring and non-routine and interactive tasks.


<table>
<thead>
<tr>
<th>Sectors estimator</th>
<th>Non-routine tasks</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>All</td>
<td>Manuf.</td>
<td>Serv.</td>
<td>Comm.</td>
</tr>
<tr>
<td></td>
<td>FE</td>
<td>Random effects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Offshore empl. share</td>
<td>2.693</td>
<td>2.505</td>
<td>3.671</td>
<td>4.317</td>
<td>.735</td>
</tr>
<tr>
<td></td>
<td>(.686)**</td>
<td>(.585)**</td>
<td>(2.214)*</td>
<td>(2.030)**</td>
<td>(1.474)</td>
</tr>
<tr>
<td>LogCap./val. add.</td>
<td>.033</td>
<td>.524</td>
<td>.139</td>
<td>-.423</td>
<td>.503</td>
</tr>
<tr>
<td></td>
<td>(.165)</td>
<td>(.144)***</td>
<td>(.314)</td>
<td>(.458)</td>
<td>(.271)*</td>
</tr>
<tr>
<td>Log value added</td>
<td>-.331</td>
<td>.322</td>
<td>-.221</td>
<td>-.411</td>
<td>.782</td>
</tr>
<tr>
<td></td>
<td>(.126)***</td>
<td>(.102)***</td>
<td>(.435)</td>
<td>(.456)</td>
<td>(.390)***</td>
</tr>
<tr>
<td>Year 1999</td>
<td>.270</td>
<td>.206</td>
<td>.527</td>
<td>.653</td>
<td>-.217</td>
</tr>
<tr>
<td></td>
<td>(.124)**</td>
<td>(.125)*</td>
<td>(.189)***</td>
<td>(.420)</td>
<td>(.193)</td>
</tr>
<tr>
<td>Year 2000</td>
<td>.305</td>
<td>.243</td>
<td>.592</td>
<td>.781</td>
<td>-.170</td>
</tr>
<tr>
<td></td>
<td>(.125)**</td>
<td>(.126)*</td>
<td>(.186)***</td>
<td>(.503)</td>
<td>(.190)</td>
</tr>
<tr>
<td>Year 2001</td>
<td>.275</td>
<td>.197</td>
<td>.613</td>
<td>.654</td>
<td>-.177</td>
</tr>
<tr>
<td></td>
<td>(.127)**</td>
<td>(.127)</td>
<td>(.210)***</td>
<td>(.489)</td>
<td>(.222)</td>
</tr>
<tr>
<td>Hausman test ($F$ statistic)</td>
<td>$\gamma_{FE}^{FE} - \gamma_{RE}^{RE}$</td>
<td>.187</td>
<td>(.359)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obs.</td>
<td>5008</td>
<td>5008</td>
<td>1876</td>
<td>1020</td>
<td>2112</td>
</tr>
<tr>
<td>$R^2$ (within)</td>
<td>.010</td>
<td>.004</td>
<td>.026</td>
<td>.023</td>
<td>.002</td>
</tr>
<tr>
<td>$R^2$ (between)</td>
<td>.003</td>
<td>.069</td>
<td>.012</td>
<td>.001</td>
<td>.098</td>
</tr>
<tr>
<td>$R^2$ (overall)</td>
<td>.002</td>
<td>.064</td>
<td>.013</td>
<td>.002</td>
<td>.093</td>
</tr>
</tbody>
</table>

*Notes: Wage-bill shares in percent, varying between zero and 100. Estimators are plant fixed (FE) and $\gamma$ sectors against FE specification. Standard errors in parentheses: * significance at 10%, ** 5%, and *** 1%.*
### Interactive tasks

<table>
<thead>
<tr>
<th>All</th>
<th>FE</th>
<th>All</th>
<th>Manuf.</th>
<th>Serv.</th>
<th>Comm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(6)</td>
<td>Random effects</td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
<td>(10)</td>
</tr>
</tbody>
</table>

| 1.319 | 1.653 | 2.265 | 2.594 | .683 |
| (.352)** | (.293)** | (1.429) | (.974)** | (.587) |
| .025 | .042 | −.053 | −.477 | .029 |
| (.085) | (.072) | (.167) | (.208)** | (.177) |
| .044 | −.072 | −.125 | −.212 | .204 |
| (.065) | (.051) | (.215) | (.187) | (.191) |
| .088 | .087 | .292 | .272 | −.167 |
| (.064) | (.063) | (.092)** | (.158)* | (.094)* |
| .103 | .092 | .254 | .363 | −.126 |
| (.064) | (.064) | (.110)** | (.195)* | (.098) |
| −.001 | −.016 | .198 | .209 | −.228 |
| (.065) | (.065) | (.119)* | (.265) | (.126)* |
| −.334 | (.195) | 5008 | 5008 | 1876 | 1020 | 2112 |
| .006 | .005 | .025 | .007 | .015 |
| .013 | .024 | .022 | .067 | .00002 |
| .013 | .023 | .022 | .061 | .0001 |
Statistical and economic significance

- Estimated coefficients for offshore employment in Table 6 are positive and (mostly) statistically significant, except in commerce.
- Coefficient estimate in column 2, for instance, implies a .15 (2.505 * .059) percentage point increase in the wage-bill share of non-routine tasks across all sectors.
- That corresponds to 10 percent of the observed 1.5 percentage point increase in the wage-bill share of non-routine tasks.
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Motivation Data Estimation Strategy Results Conclusion

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Table 7
Offshoring and non-routine and interactive tasks: four world regions.

<table>
<thead>
<tr>
<th></th>
<th>Non-routine tasks</th>
<th></th>
<th>Interactive tasks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All (1)</td>
<td>Manuf. (2)</td>
<td>Serv. (3)</td>
<td>All (4)</td>
</tr>
<tr>
<td>Offshore</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>empl. share</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in CEE</td>
<td>−.541 (1.182)</td>
<td>−2.240 (1.481)</td>
<td>.922 (2.427)</td>
<td>.343 (.465)</td>
</tr>
<tr>
<td>empl. share</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in DEV</td>
<td>4.178 (2.413)*</td>
<td>6.080 (2.248)**</td>
<td>1.149 (3.730)</td>
<td>2.636 (.970)**</td>
</tr>
<tr>
<td>Offshore</td>
<td>3.074 (1.788)*</td>
<td>3.389 (2.272)</td>
<td>6.210 (2.768)**</td>
<td>1.615 (.679)**</td>
</tr>
<tr>
<td>empl. share</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in WEU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 8
Offshoring, education and occupations.

<table>
<thead>
<tr>
<th></th>
<th>Highly educated (Abitur+)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Manuf. (1)</td>
</tr>
<tr>
<td>Offshore empl.</td>
<td>7.486 (3.573)**</td>
</tr>
<tr>
<td>Offshore empl. share in DEV</td>
<td>5.753 (3.997)</td>
</tr>
<tr>
<td>White-collar occupations</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Manuf.</td>
<td>9.726</td>
</tr>
<tr>
<td>(5)</td>
<td>(5.056)*</td>
</tr>
<tr>
<td>Manuf.</td>
<td>25.002</td>
</tr>
<tr>
<td>(6)</td>
<td></td>
</tr>
<tr>
<td>Serv.</td>
<td>(4.464)**</td>
</tr>
<tr>
<td>(7)</td>
<td></td>
</tr>
<tr>
<td>Serv.</td>
<td></td>
</tr>
<tr>
<td>(8)</td>
<td></td>
</tr>
</tbody>
</table>
### Table 10
Offshoring predictions of wage bill shares.


<table>
<thead>
<tr>
<th></th>
<th>Coefficient estimate</th>
<th>Change in offsh. emp.</th>
<th>Pred. change in wage-bill sh.</th>
<th>Obs. change in wage-bill sh.</th>
<th>Contrib. to obs. change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All sectors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-routine tasks</td>
<td>2.51</td>
<td>.059</td>
<td>.148</td>
<td>1.44</td>
<td>10.2%</td>
</tr>
<tr>
<td>Interactive tasks</td>
<td>1.65</td>
<td>.059</td>
<td>.097</td>
<td>1.03</td>
<td>9.4%</td>
</tr>
<tr>
<td>Highly educated</td>
<td>8.44</td>
<td>.059</td>
<td>.497</td>
<td>4.23</td>
<td>11.7%</td>
</tr>
<tr>
<td>(Abitur +)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White-collar occupations</td>
<td>6.45</td>
<td>.059</td>
<td>.380</td>
<td>4.56</td>
<td>8.3%</td>
</tr>
<tr>
<td><strong>Manufacturing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Non-routine tasks</td>
<td>3.67</td>
<td>.039</td>
<td>.145</td>
<td>1.03</td>
<td>14.1%</td>
</tr>
<tr>
<td>Interactive tasks</td>
<td>2.27</td>
<td>.039</td>
<td>.089</td>
<td>.94</td>
<td>9.5%</td>
</tr>
<tr>
<td>Highly educated</td>
<td>7.49</td>
<td>.039</td>
<td>.295</td>
<td>3.08</td>
<td>9.6%</td>
</tr>
<tr>
<td>(Abitur +)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White-collar occupations</td>
<td>9.73</td>
<td>.039</td>
<td>.384</td>
<td>3.44</td>
<td>11.2%</td>
</tr>
<tr>
<td><strong>Services</strong></td>
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<td></td>
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<td></td>
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<tr>
<td>Non-routine tasks</td>
<td>4.32</td>
<td>.090</td>
<td>.390</td>
<td>4.34</td>
<td>9.0%</td>
</tr>
<tr>
<td>Interactive tasks</td>
<td>2.59</td>
<td>.090</td>
<td>.235</td>
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<tr>
<td>Highly educated</td>
<td>12.33</td>
<td>.090</td>
<td>1.115</td>
<td>11.60</td>
<td>9.6%</td>
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<tr>
<td>(Abitur +)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>White-collar occupations</td>
<td>2.23</td>
<td>.090</td>
<td>.202</td>
<td>9.84</td>
<td>2.1%</td>
</tr>
</tbody>
</table>

*Notes: Wage-bill shares in percent, varying between zero and 100. Services exclude*
Summary

- The task-based measures have a statistically significant relationship to offshoring in the direction theory leads us to expect:
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    - this is the case even when we control for the composition of tasks at plant level.
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- Skills measured by educational attainment is a more important workforce dimension than whether tasks are non-routine or interactive.

- The estimated relationships (within plants over time) are relatively modest:

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