Emerging Patterns in Skills and Tasks: Understanding the Changing Occupational Structure in India

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Paper Prepared for ‘Transforming Economies – for Better Jobs’
WIDER Development Conference in partnership with UNESCAP,
11-13 September 2019,
Bangkok, Thailand.
A Prelude

Characteristics of a Job

- A job/occupation entails several tasks
- Each of these tasks requires several skills
- Think about a job as a point in a two dimension space (Level of Routine Task and Level of Cognitive Abilities Required)

Context

- Disruption in the work organization: Technological change, automation, offshoring
- Skills and tasks are changing at the workplace
- Skills of workforce do not match those required at the workplace $\Rightarrow$ Employability!!!
Measuring Skill-Content Using O-NET

- NSS: NCO of individuals; Census: Distribution of NCO
- How to map NCO to skills/tasks?
- Job requirements approach – Using survey based measures on the skills required by a worker to perform the tasks involved in a given occupation
- We don’t have such data; So use O-NET by mapping NCO to O-NET codes
- Occupational Information Network (O-NET) developed by the US Department of Labor/Employment and Training Administration (USDOL/ETA)
- Survey based database which uses inputs from both employees and occupational analysts to describe and quantify each occupation in terms of several characteristics/variables.
Explaining Changes in Skill-Task Structure

- **SBTC Hypothesis**
  High skilled (cognitive) jobs replace low skilled (manual) jobs

- **Autor et al (2003) Routinization Hypothesis**
  To explain job polarization
  Automation changes the task composition of job
  Routine manual and cognitive jobs are replaced by non-routine manual and cognitive jobs

- **Frey and Osborne (2013)**
  Even routine tasks can be automated
Is routinization happening in India?

- Every job entails some amount of routine/non-routine tasks and some amount of cognitive/manual abilities
- Divide the occupations into four categories – non-routine cognitive, routine cognitive, routine manual, non-routine manual
- Sample excludes cultivators, other self-employed, agricultural labourers; data from NSS EUS (1993-94 to 2011-12)
- For each occupation, create four indices; all indices follow the same scale; take the max of the four indices; assign occupation in that category
- Creating the indices
  - How to choose the variables that constitute the index? – following Acemoglu and Autor (2010)
  - How to combine these variables? – all variables take values in the same range; take a mean of all the variables
### O-NET measures used to build the four indices

<table>
<thead>
<tr>
<th>Non-routine cognitive</th>
<th>Routine cognitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzing data/information</td>
<td>Importance of repeating the same tasks</td>
</tr>
<tr>
<td>Thinking creatively</td>
<td>Importance of being exact or accurate</td>
</tr>
<tr>
<td>Interpreting information for others</td>
<td>Structured v. Unstructured work (reverse)</td>
</tr>
<tr>
<td>Establishing and maintaining personal relationships</td>
<td></td>
</tr>
<tr>
<td>Guiding, directing and motivating subordinates</td>
<td></td>
</tr>
<tr>
<td>Coaching/developing others</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Routine manual</th>
<th>Non-routine manual physical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pace determined by speed of equipment</td>
<td>Operating vehicles, mechanized devices, or equipment</td>
</tr>
<tr>
<td>Controlling machines and processes</td>
<td>Spend time using hands to handle, control or feel objects, tools or controls</td>
</tr>
<tr>
<td>Spend time making repetitive motions</td>
<td>Manual dexterity</td>
</tr>
<tr>
<td></td>
<td>Spatial orientation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>General Mangers</td>
<td>34.1</td>
<td>63.8</td>
<td>23.7</td>
<td>40.2</td>
</tr>
<tr>
<td>Office Clerks</td>
<td>16.9</td>
<td>43.0</td>
<td>34.6</td>
<td>62.8</td>
</tr>
<tr>
<td>Drivers</td>
<td>66.9</td>
<td>42.0</td>
<td>45.3</td>
<td>51.1</td>
</tr>
<tr>
<td>Transport labourers</td>
<td>59.2</td>
<td>46.9</td>
<td>62.5</td>
<td>57.6</td>
</tr>
</tbody>
</table>
### Examples of Occupations in Each Category

<table>
<thead>
<tr>
<th>Non-Routine Cognitive</th>
<th>Routine Cognitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Shop Salespersons and Demonstrators</td>
<td>• Housekeeping &amp; Restaurant Services Workers</td>
</tr>
<tr>
<td>• Teaching Professionals and Associates</td>
<td>• Office Clerks</td>
</tr>
<tr>
<td>• Computing Professionals</td>
<td>• Secretaries and Key Board- Operating Clerks</td>
</tr>
<tr>
<td>• General Managers</td>
<td>• Cashiers, Tellers and Related Clerks</td>
</tr>
<tr>
<td>• Business Professionals</td>
<td>• Physical and Engineering Science Technicians</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-Routine Manual</th>
<th>Routine Manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Mining and Construction Labourers</td>
<td>• Manufacturing Labourers</td>
</tr>
<tr>
<td>• Painters, Building Structure Cleaners etc</td>
<td>• Textile, Garment and Related Trades Workers</td>
</tr>
<tr>
<td>• Motor Vehicle Drivers</td>
<td>• Domestic Helpers, Cleaners and Launderers</td>
</tr>
<tr>
<td>• Building Frame and Related Trades Workers</td>
<td>• Transport Labourers and Freight Handlers</td>
</tr>
<tr>
<td>• Machinery Mechanics and Fitters</td>
<td>• Garbage Collectors and Related Labourers</td>
</tr>
</tbody>
</table>
### Employment Share (in percentage) in Each Category (1993-94)

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>18.6</td>
<td>16.9</td>
<td>33.7</td>
<td>30.7</td>
</tr>
<tr>
<td>Rural</td>
<td>15.8</td>
<td>12.7</td>
<td>33.7</td>
<td>37.8</td>
</tr>
<tr>
<td>Urban</td>
<td>20.9</td>
<td>20.3</td>
<td>33.7</td>
<td>25.0</td>
</tr>
<tr>
<td>Male</td>
<td>17.6</td>
<td>18.0</td>
<td>31.4</td>
<td>32.9</td>
</tr>
<tr>
<td>Female</td>
<td>23.9</td>
<td>11.5</td>
<td>45.0</td>
<td>19.6</td>
</tr>
</tbody>
</table>

#### Note: Each row adds to 100

### Trends in aggregate skill inputs (relative to 1993-94)

![Graph showing trends in aggregate skill inputs](image-url)
Percentage Point Change in Employment Share in Each Category by Location and Gender (1993-94 to 2011-12)
Percentage Point Change in Employment Share in Each Category by level of Education (1993-94 to 2011-12)

Percentage Point Change in Share of Employment

A - not literate  B - below sec  C - below hsc  D - hsc  E - graduate

-15 -10 -5 0 5 10 15 20

non-routine cognitive  routine cognitive  routine manual  non-routine manual
Decomposition of overall change between demographic groups

- Summary:
  NRC and NRM – increase by 3 and 8 pp respectively
  RC and RM – decrease by 3 and 8 pp respectively

\[
\frac{E_{cT}}{E_T} - \frac{E_{ct}}{E_t} = \sum_i \left( \frac{E_{icT}}{E_{iT}} - \frac{E_{ict}}{E_{it}} \right) \ast \frac{E_{iT}}{E_T} + \sum_i \left( \frac{E_{iT}}{E_T} - \frac{E_{it}}{E_t} \right) \ast \frac{E_{ict}}{E_{it}}
\]

Within effect  
Between Effect
By Location

- Non-Routine Cognitive
- Routine Cognitive
- Routine Manual
- Non-Routine Manual

Change in Employment Share

- rural
- urban

By Gender

- Non-Routine Cognitive
- Routine Cognitive
- Routine Manual
- Non-Routine Manual

Change in Employment Share

- male
- female

By Education

- Non-Routine Cognitive
- Routine Cognitive
- Routine Manual
- Non-Routine Manual

Change in Employment Share

- Not Literate
- Below Sec
- Below Hsc
- Hsc
- Graduate
- Gender/Location
  - Between Effect – demographic shift
  - Within Effect – both ss (change in educational attainment of labour) and dd side (change in industrial composition and technology) factors

- Education
  - Between Effect – change in the mix of education groups → ss effect
  - Within Effect – change in occupation mix within groups → dd effect
    - Increase in NRC due to ss effect/dd effect is dampening
    - Decrease in RC is due to dd effect
    - Decrease in RM is due to both dd and ss effect
    - Increase in NRM due to demand effect
- Difference in between effect (ss effect) across groups
  - Difference in educational attainment across groups
- Difference in within effect (dd effect) across groups
  - Changes in industrial composition and technology
  - Availability/lack of opportunities (rural vs urban)
  - Differences in occupation mix (men vs women)
- NRC: + ss effect, - dd effect (except urban), ss > dd \(\rightarrow\) net increase (except rural)
- RC: + ss effect, - dd effect, dd > ss \(\rightarrow\) net decrease (except women)
- RM: - ss effect, - dd effect (except urban) \(\rightarrow\) net decrease
- NRM: - ss effect, + dd effect, dd > ss \(\rightarrow\)
Discussion

1) Why did the share of routine jobs fall?
   Demand effect
   Routinization due to automation and offshoring?

2) Compensating the slow growth of routine jobs, why didn’t NRC jobs grow as much as NRM jobs?
   Unfavourable demand effect
   Failure to create jobs for educated

3) The fall in the share of routine occupations is compensated with a higher growth of NRC jobs for some groups (women and urban) and a higher growth of NRM jobs for some groups (men and rural). Why?
   Favorable supply effect for women (and urban) coupled with an unfavorable demand effect for men (and rural)
Way Ahead

- What skills and skilling means? Employment discussion in terms of skills/tasks

- Need data like O-NET on skills and tasks embodied in jobs/tasks performed by workers in their jobs

- Ensuring universal and good quality education is absolutely important!!

- How to create non-routine cognitive jobs for the educated?

- Do not fight Automation!!

- Rethinking skilling policy in terms of the changing skill and tasks at the workplace. What kind of skilling programs would help workforce adapt?
Thank you!!