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

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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→ 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

Non-routine cognitive Analyzing data/information Thinking creatively Interpreting information for others Establishing and maintaining personal relationships Guiding, directing and motivating subordinates Coaching/developing others	**Routine cognitive** Importance of repeating the same tasks Importance of being exact or accurate Structured v. Unstructured work (reverse)
Routine manual Pace determined by speed of equipment Controlling machines and processes Spend time making repetitive motions	**Non-routine manual physical** Operating vehicles, mechanized devices, or equipment Spend time using hands to handle, control or feel objects, tools or controls Manual dexterity Spatial orientation

Occupation	**Non-routine Manual**	**Non-Routine Cognitive**	**Routine Manual**	**Routine Cognitive**
General Mangers	34.1	**63.8**	23.7	40.2
Office Clerks	16.9	43.0	34.6	**62.8**
Drivers	**66.9**	42.0	45.	51.1
Transport labourers	59.2	46.9	**62.5**	57.6

Examples of Occupations in Each Category

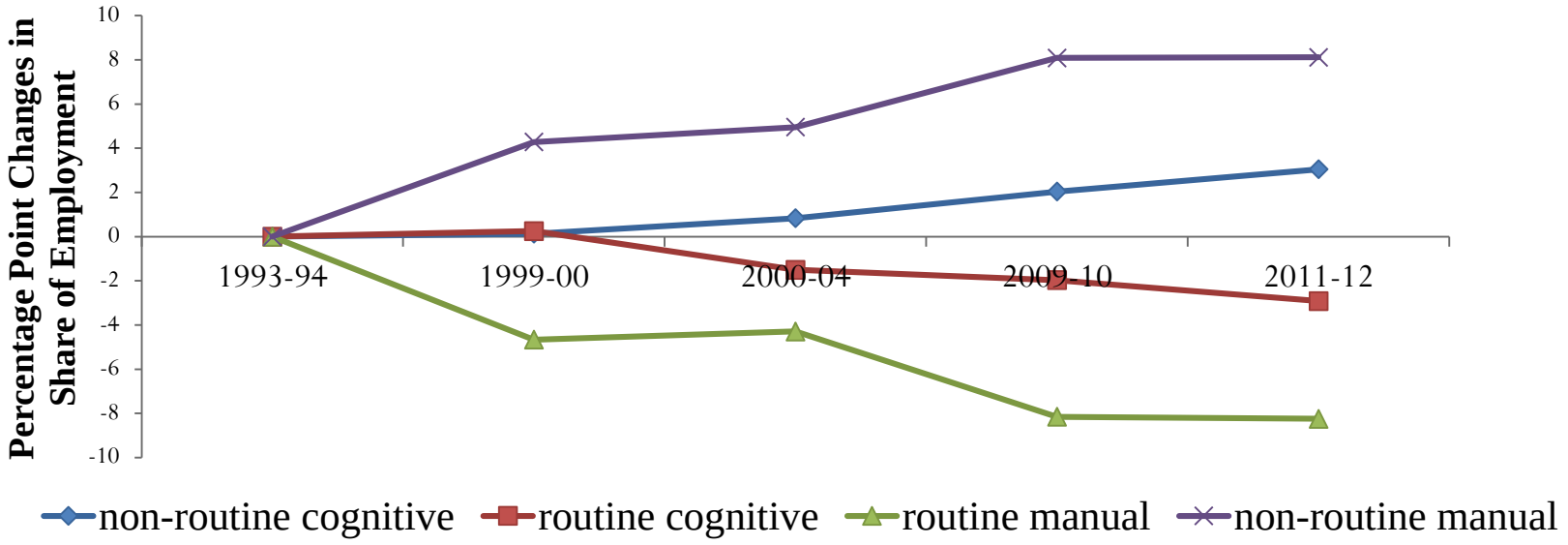
Non-Routine Cognitive	Routine Cognitive
• Shop Salespersons and Demonstrators • Teaching Professionals and Associates • Computing Professionals • General Managers • Business Professionals	• Housekeeping & Restaurant Services Workers • Office Clerks • Secretaries and Key Board- Operating Clerks • Cashiers, Tellers and Related Clerks • Physical and Engineering Science Technicians
Non-Routine Manual	**Routine Manual**
• Mining and Construction Labourers • Painters, Building Structure Cleaners etc • Motor Vehicle Drivers • Building Frame and Related Trades Workers • Machinery Mechanics and Fitters	• Manufacturing Labourers • Textile, Garment and Related Trades Workers • Domestic Helpers, Cleaners and Launderers • Transport Labourers and Freight Handlers • Garbage Collectors and Related Labourers

Employment Share (in percentage) in Each Category (1993-94)

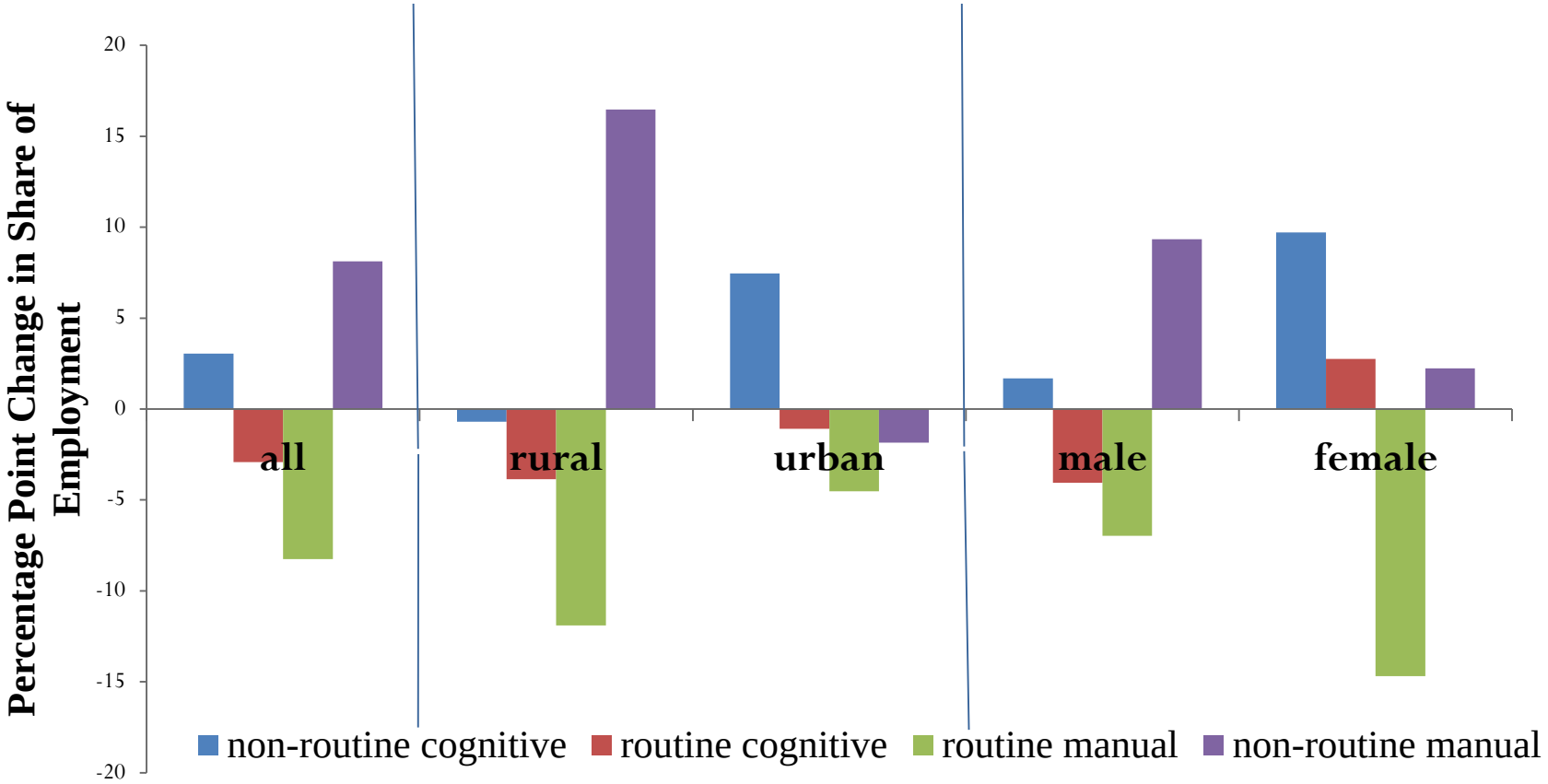
	Non-Routine Cognitive	Routine Cognitive	Routine Manual	Non-Routine Manual
Total	18.6	16.9	33.7	30.7
Rural	15.8	12.7	33.7	37.8
Urban	20.9	20.3	33.7	25.0
Male	17.6	18.0	31.4	32.9
Female	23.9	11.5	45.0	19.6

Note: Each row adds to 100

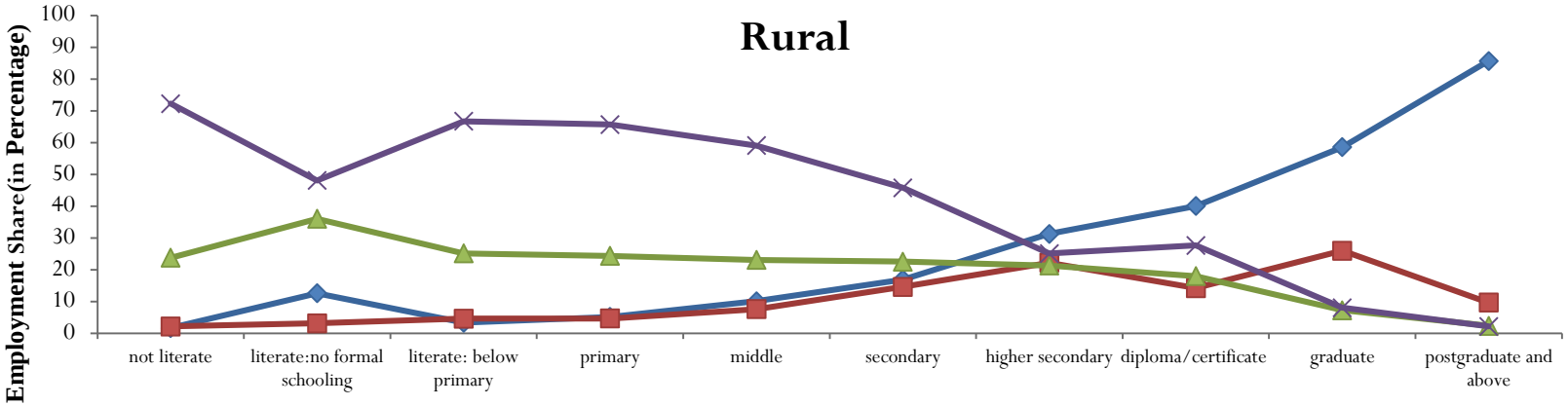
Trends in aggregate skill inputs (relative to 1993-94)

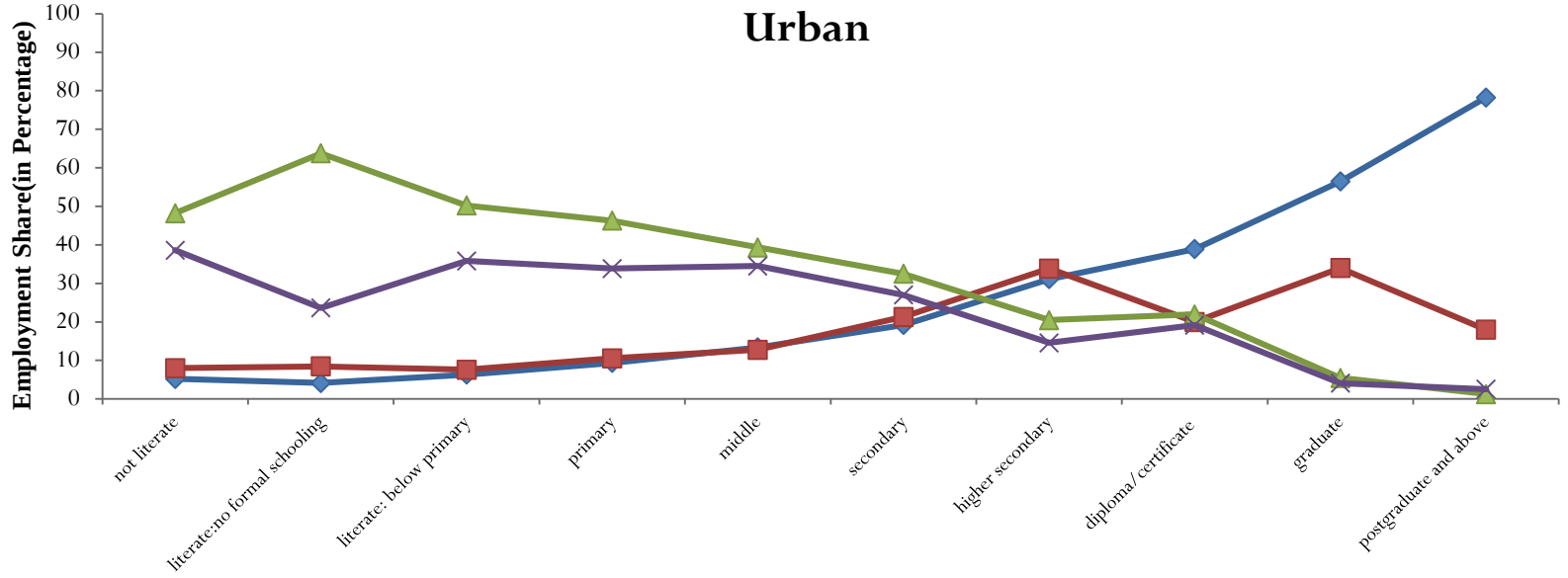


Percentage Point Change in Employment Share in Each Category by Location and Gender(1993-94 to 2011-12)

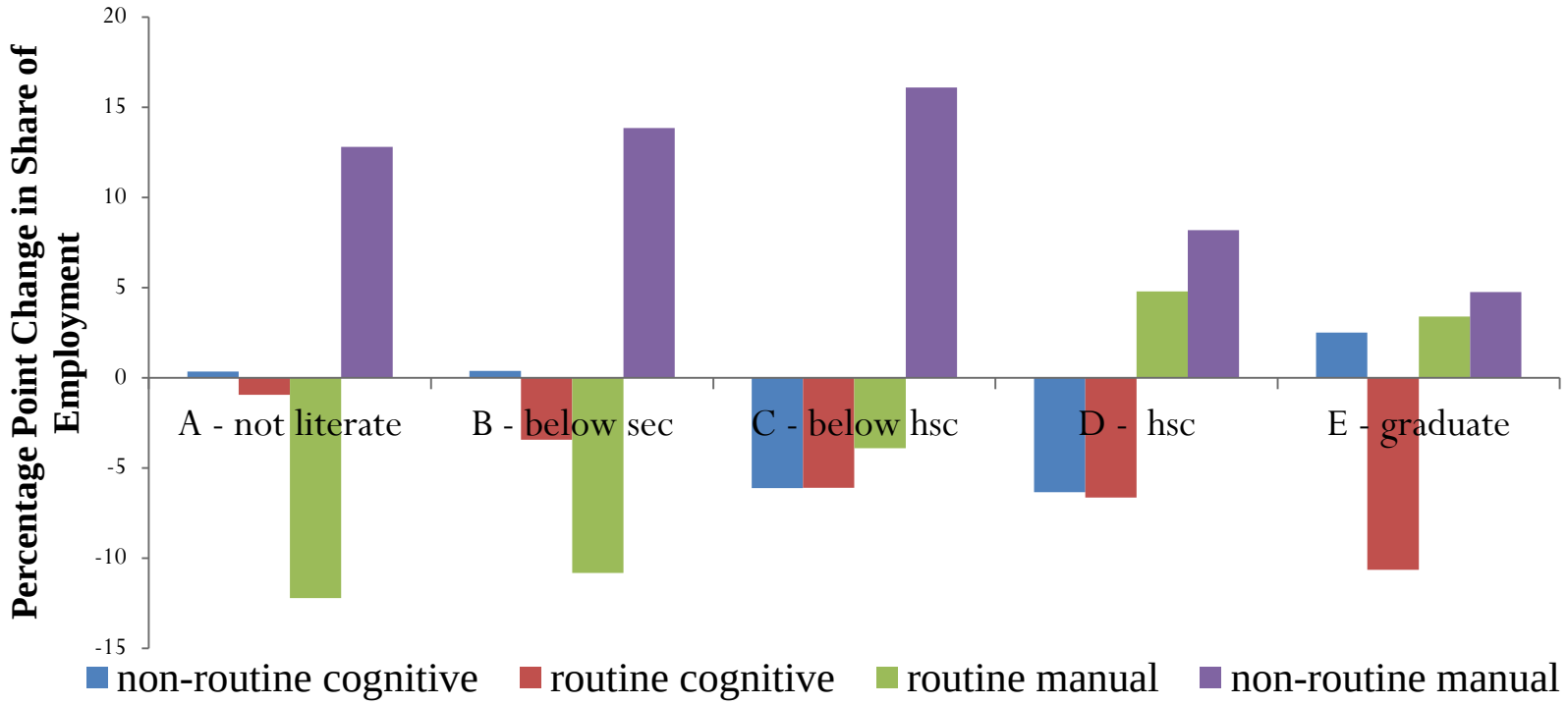


Employment Share in Each Category by Education Level (2011-12)





Percentage Point Change in Employment Share in Each Category by level of Education (1993-94 to 2011-12)



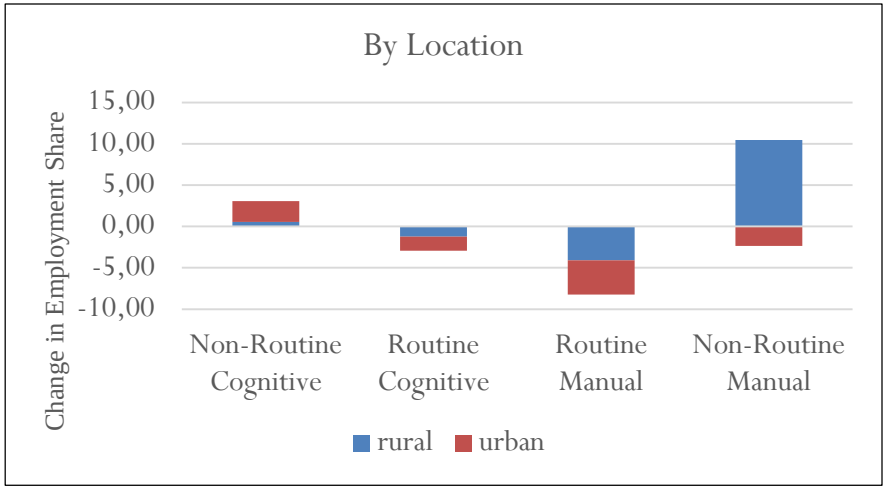
Decomposition of overall change between demographic groups

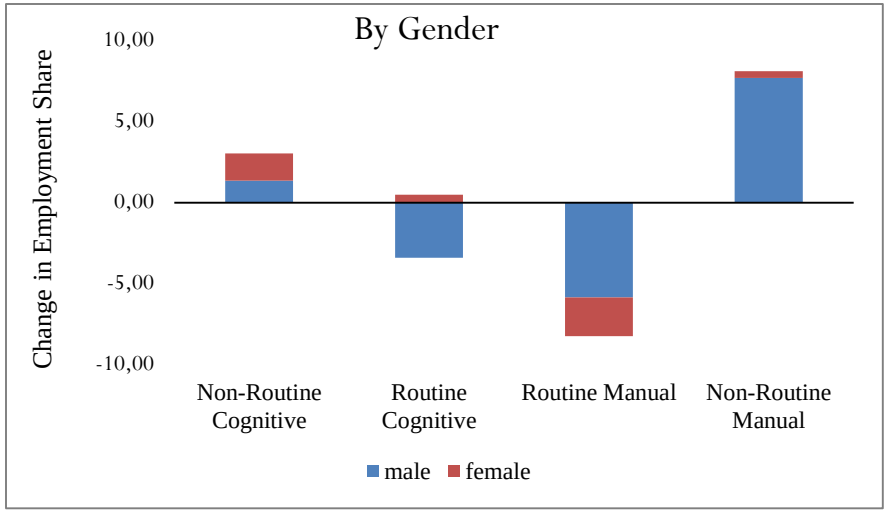
- Summary:

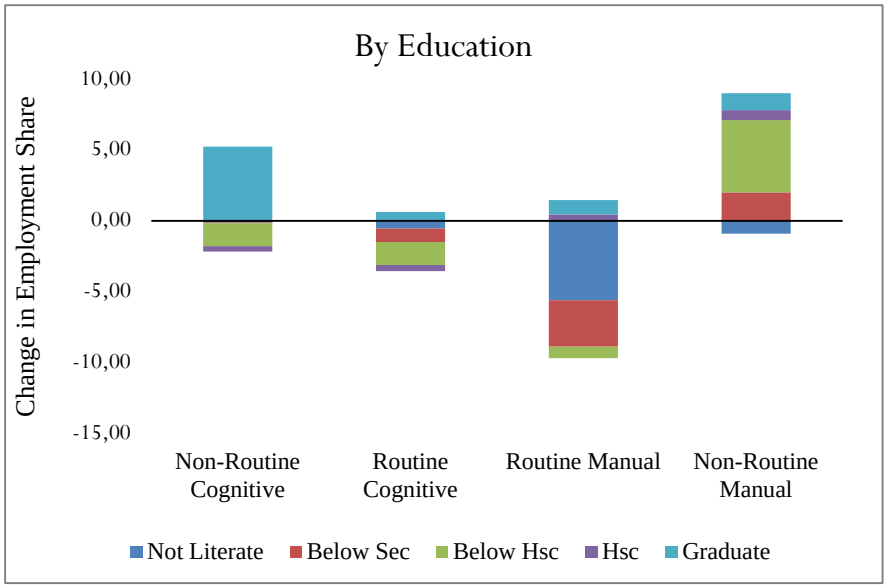
  NRC and NRM – increase by 3 and 8 pp respectively

  RC and RM – decrease by 3 and 8 pp respectively

$$\frac{E_{cT}}{E_T} - \frac{E_{ct}}{E_t} = \underbrace{\sum_i \left(\frac{E_{icT}}{E_{iT}} - \frac{E_{ict}}{E_{it}} \right) * \frac{E_{iT}}{E_T}}_{\text{Within effect}} + \underbrace{\sum_i \left(\frac{E_{iT}}{E_T} - \frac{E_{it}}{E_t} \right) * \frac{E_{ict}}{E_{it}}}_{\text{Between Effect}}$$


By Location
Change in Employment Share
15,00
10,00
5,00
0,00
-5,00
-10,00
Non-Routine Cognitive
Routine Cognitive
Routine Manual
Non-Routine Manual
rural
urban


By Gender
Change in Employment Share
10,00
5,00
0,00
-5,00
-10,00
Non-Routine Cognitive
Routine Cognitive
Routine Manual
Non-Routine Manual
male
female


By Education
Change in Employment Share
10,00
5,00
0,00
-5,00
-10,00
-15,00
Non-Routine Cognitive
Routine Cognitive
Routine Manual
Non-Routine Manual
Not Literate
Below Sec
Below Hsc
Hsc
Graduate

		NRC	RC	RM	NRM
Gender	Within	3.04	-2.91	-8.27	8.14
	Between	0.01	-0.01	0.03	-0.02
Location	Within	3.34	-2.48	-8.25	7.39
	Between	-0.29	-0.43	0.00	0.73
Education	Within	-1.66	-5.55	-4.69	11.90
	Between	4.71	2.63	-3.55	-3.79
Total		3.05	-2.92	-8.25	8.12

- 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**

		NRC	RC	RM	NRM
Male	Within	-2.20	-6.31	-4.36	12.87
	Between	3.88	2.25	-2.60	-3.52
		1.68	-4.06	-6.97	9.34
Female	Within	-0.17	-1.39	-6.16	7.72
	Between	9.88	4.14	-8.53	-5.49
		9.71	2.75	-14.69	2.23
Rural	Within	-4.54	-5.65	-9.67	19.86
	Between	3.84	1.79	-2.21	-3.38
		-0.70	-3.87	-11.90	16.46
Urban	Within	1.00	-4.94	1.28	2.66
	Between	6.45	3.86	-5.79	-4.50
		7.45	-1.08	-4.53	-1.84

- 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→net increase (except rural)**
- **RC: +ss effect, -dd effect, dd>ss→net decrease(except women)**
- **RM: -ss effect, -dd effect(except urban)→net decrease**
- **NRM: -ss effect, +dd effect, dd>ss→**

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 dint 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!!