The Impacts of Technical Change on Labour Markets in Europe and Japan

Itsuki Maeda and Kazufumi Yugami

Graduate School of Economics, Kobe University

18th October, 2016

Bruegel Institute-Graduate School of Economics, Kobe University Conference
“Innovation and Economic Reform in Europe and Japan”

Outline

1. Facts: Polarization in the labour markets
2. Theory: Biased technical change
3. Empirics: Routine-biased technological change
4. Policy issues

Stylized fact: Polarization in the labour markets

Wage “polarization”

- Relative wage growth for upper- and lower-tail of wage distribution over the last two decades.

Job “polarization”

- During the same period, there has been an increase in well-paid skilled jobs and in low-paid least-skilled jobs, and a decrease in the “middling” jobs.

Empirics

- For the US: Autor *et al*. (2006, 2008) ; Autor and Dorn (2013)
- For the UK: Goos and Manning (2007)
- For Germany: Spitz-Oener (2006); Dustmann *et al*. (2009)
- For 16 Western European countries: Goos *et al*. (2009); Michaels *et al*. (2014)
- For Japan: Ikenaga (2009); Ikenaga and Kambayashi (2016)

European countries

Percentage Changes in Employment Shares over 1993–2006 for Jobs Ranked by Their 1994 Log Wage
Source: Goos et al. (2009), Figure 1.

Goos et al. (2009)

- Job polarization in 16 European countries between 1993 and 2006.
- The high- and low-paying occupations (measured by their 1994 log wage) increase their employment shares, whereas the occupations paying close to the mean wage decrease their employment share.

Japan

Employment Growth over 1970-2005 for Job-Quality by their 1970 average wage.
Source: Ikenaga and Kambayashi (2016), Figure 1.

Ikenaga and Kambayashi (2016)

- Slight polarization between 1970-2005.
- There is a decline of middle-paid occupations and maintenance of employment in lowest-paid occupations, whereas employment growth was mainly induced by the highest-paid occupations.

Technical Change and wage inequality: SBTC

- The relative demand for skills is linked to the skill bias of technical change.
- The Skill-Biased Technical Change (SBTC) hypothesis…
  - predicts that demand for “skilled” jobs is rising relative to that for “unskilled” jobs → Wage growth depending on skill level
  - could explain a rapid growth in wage inequality during the 1980s, especially between college graduates and non-college graduates.
- However, the SBTC hypothesis **cannot explain the growth in wage and demand for low wage occupation**, which was observed in the last two decades.

Technical Change: Task-based framework

- Acemoglu and Autor (2011)
  - A **task**: a unit of work activity that produces output (occupation)
  - A **skill**: worker's endowment of capabilities for performing various tasks (education)
  - Skills applied to **tasks** produce output.
- Autor, Levy and Murnane (2003)
  - Technological developments have enabled **information and communication technologies (ICT)** to perform the **core job tasks** previously performed by middle skill workers, thus causing a substantial change in **the returns to certain types of skills** and a measurable shift in **the assignment of skills to tasks**.

Task measures (by O*NET in the US)

i.Abstract	1.Analytical	Analyzing data/information, Thinking creatively, Interpreting information for others
	2.Interpersonal	Establishing and maintaining personal relationships, Guiding, directing, and motivating subordinates, Coaching and developing others
ii. Routine	3. Cognitive	Importance of repeating the same tasks, Importance of being exact or accurate, Structured versus unstructured work
	4. Manual	Controlling machines and processes, Keeping a pace set by machinery or equipment, Time spent making repetitive motions
iii. Nonroutine	5. Manual	Operating vehicles, mechanized devices, or equipment, Time spent using hands to handle, control, or feel objects, tools, or controls, Manual dexterity, Spatial orientation

Source: Autor and Handel (2013), Appendix

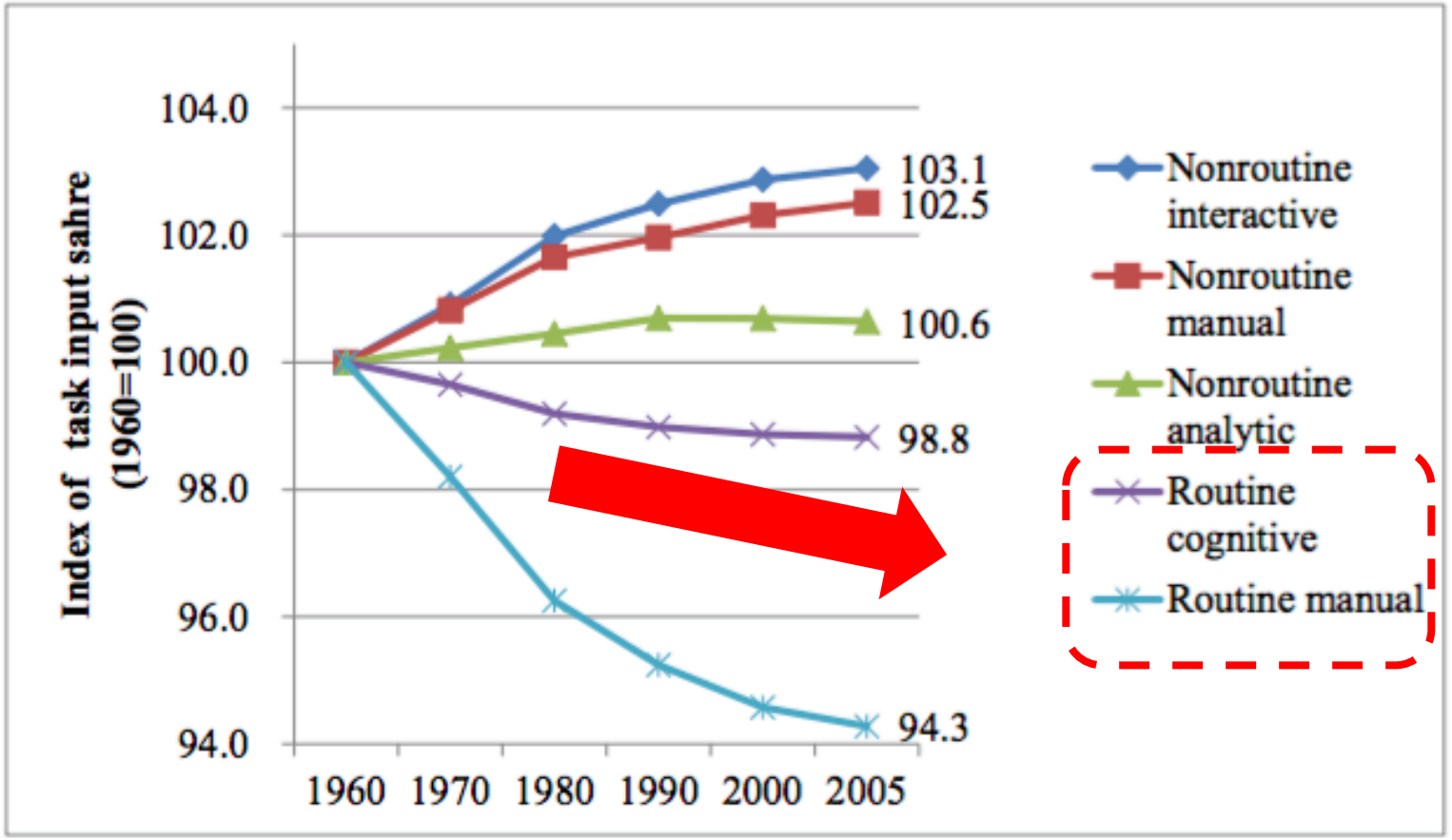
Routine task intensity in 16 European countries, 1993-2010

	Average employment share in 1993 (%)	% point change 1993-2010	Routine Task Intensity (RTI)
High-paying occupations e.g.) managers, engineers	31.67	5.62	-0.72
Middling occupations e.g.) office clerks, craft and related trade workers	46.75	**-9.27**	**0.69**
Low-paying occupations e.g.) sales persons, service persons	21.56	3.65	-0.08

Note: RTI = ln(R) − ln(M) − ln(A) where R, M, and A are occupation-level measures for routine, manual, and abstract tasks derived from the Dictionary of Occupational Titles (DOT) 1977.
Source: Goos et al. (2014), Table 1

Routine task intensity (RTI) is high for middling occupations, which deceased their employment share between 1993 and 2010.

Trends in task input in Japan, 1960-2005



Share of **routine task input** in occupations has declined over the past five decades in Japan

Source: Ikenaga and Kambayashi (2016), Figure 2

Sources of job polarization: Europe

Linear time-trend interacted with:	(1)	(2)	(3)	(4)	(5)
RTI	−0.900***	−0.888***	−0.866***	−0.868***	
	(0.126)	(0.135)	(0.141)	(0.129)	—
Offshorability	−0.013	−0.005	−0.006		−0.383**
	(0.159)	(0.175)	(0.180)	—	(0.165)
log industry marginal costs		0.854***	0.895***	0.895***	0.899***
	—	(0.145)	(0.161)	(0.161)	(0.161)
log industry output		0.142**	1	1	1
	—	(0.061)			
Observations	48,139	44,062	44,062	44,062	44,062
R^2	0.954	0.947			

Source: Goos et al. (2014), Table 3.

There is a shift in relative demand away from occupations that are more routine → **"Routine-biased technological change" (RBTC)**

Sources of job polarization: Japan

	ΔNonroutine analytic	ΔNonroutine interactive	ΔRoutine cognitive	ΔRoutine manual	ΔNonroutine manual
Ln (Kit/L)	0.000	0.001	–0.001	–0.001	0.000
	[0.000]	[0.000]***	[0.000]*	[0.000]**	[0.001]
Ln (Knonit/L)	0.001	0.000	–0.001	–0.002	0.002
	[0.001]	[0.001]	[0.001]*	[0.001]***	[0.002]
Constant	0.190	0.197	0.207	0.210	0.197
	[0.011]***	[0.015]***	[0.010]***	[0.009]***	[0.022]***
No. of obs.	312	312	312	312	312

Source: Ikenaga and Kambayashi (2016), Table 3.

Real non-ICT capital stock have replaced routine labour task, and **ICT capital reinforces the tendency.**

Summary

- In Europe (Goos et al. 2009)
  - **Technologies** are becoming **more intense in the use of nonroutine tasks** concentrated in high-paid and low-paid service jobs, **at the expense of routine tasks** concentrated in manufacturing and clerical work.

- In Japan (Ikenaga and Kambayashi 2016)
  - Since the 1980s, **the introduction of ICT capital** probably accelerated both the **increase in nonroutine task inputs** and the **decrease in routine task inputs**.

Remaining issues: other aspects of wage differentials

Wage differentials within groups

- **College major**: growth in **returns to abstract task** explained the increase in wage inequality across college majors
  - For the US, 1993-2003 (Altonji, Kahn and Speer, 2014).
  - For Japan, 1995-2005 (Maeda, 2016)

Wage differentials between groups

- **Gender**: A relative **decline in routine task inputs** and a relative **increase in abstract task inputs** among women explain a substantial fraction of the closing of the gender wage gap in West Germany (Black and Spitz-Oener 2010)

Remaining issues: Job tasks and workers' characteristics: Case of Japan

Data

- A web-based survey conducted by our research team in March 2016.

Sample

- Employed persons those who are 18 years old and over at survey date.

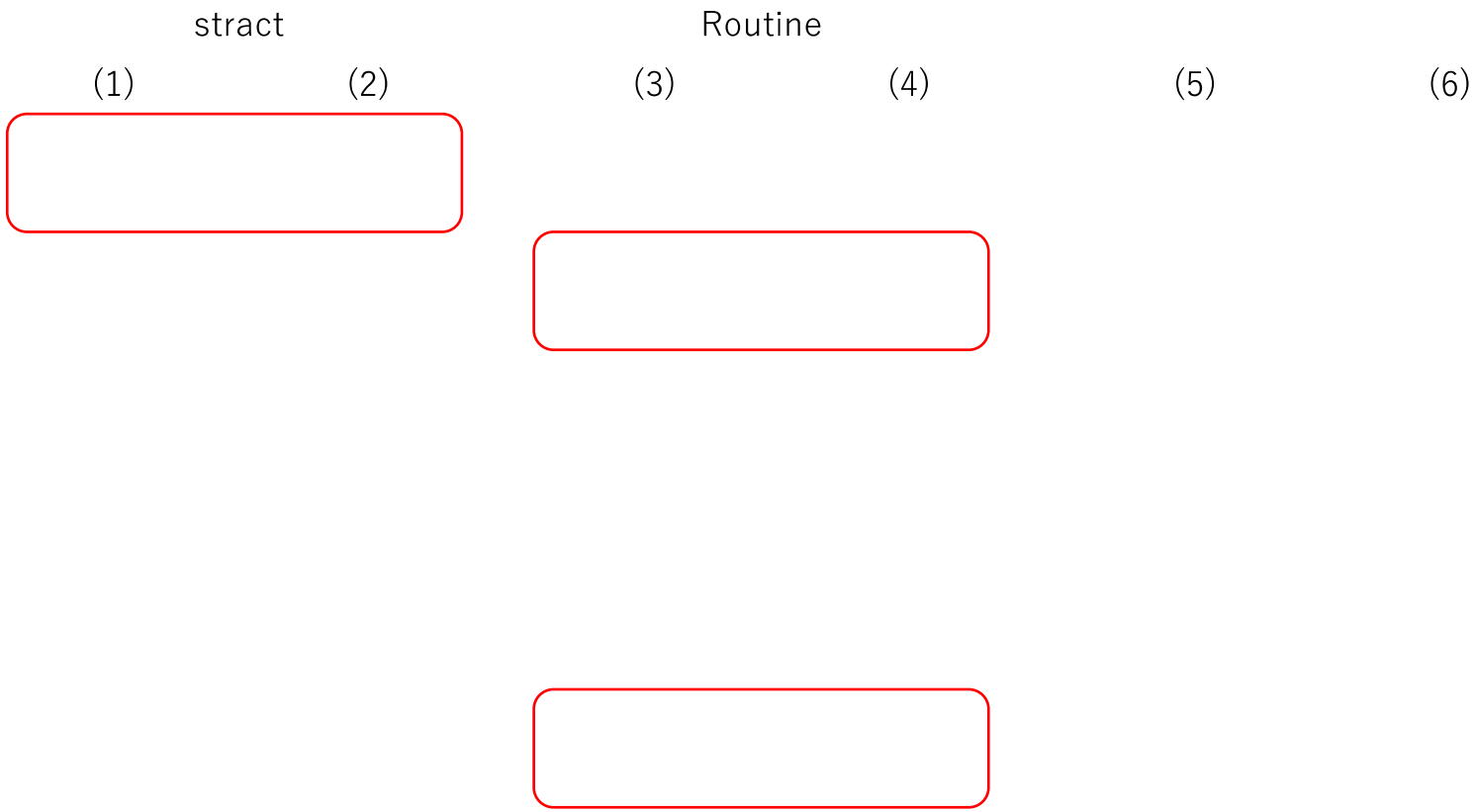
Number of observations

- 1,557 for whole sample → 720 for full-time and permanent employees under 60 years old

Task measures: Abstract, Routine and Manual

- are based on the O*NET questionnaire, described in Autor and Handel (2013).
- All three task measures are standardized to have a mean of 0 and a standard deviation of 1.

Descriptive regressions for Task intensity



Implications

Tentative results

- The intensity of **Abstract task** for an individual job mainly depends on **occupations**, while females' low use of Abstract tasks persists after controlling for human capital and occupation.
- As for **routine task and non-routine manual task**, measures of human capital—in particular, **higher education and years of experience**—are significant predictors of within- as well as between-occupation variation in job tasks

Importance of human capital investment

- Higher education →Education policy
- Job training →Active labor market policy

References

- **Acemoglu, D. and D. H. Autor.** (2011) “Skills, Tasks and Technologies: Implications for Employment and Earnings” Ch.12 in Handbook of Labor Economics, Volume 4b.
- **Altonji, J. G., L. B. Kahn and J. D. Speer.** (2014) “Trends in Earnings Differentials across College Majors and the Changing Task Composition of Jobs,” American Economic Review, 104(5), 387–393.
- **Autor, D. H., and D. Dorn.** (2013) “The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market.” American Economic Review 103(5), 1553–97.
- **Autor, D. H. and M. J. Handel.** (2013) “Putting Tasks to the Test: Human Capital, Job Tasks, and Wages,” Journal of Labor Economics, University of Chicago Press, vol. 31(S1), pages S59–S96.
- **Autor, D. H., L. F. Katz, and M. S. Kearney.** (2006) “The Polarization of the U.S. Labor Market.” American Economic Review 96(2), 189–94.
- **Autor, D. H., L. F. Katz, and M. S. Kearney.** (2008) “Trends in U.S. Wage Inequality: Revising the Revisionists.” Review of Economics and Statistics 90(2), 300–23.
- **Autor, D., F. Levy and R. J. Murnane.** (2003) “The Skill Content of Recent Technological Change: An Empirical Exploration,” Quarterly Journal of Economics, 118(4), 1279–1333.
- **Black, S. E. and A. Spitz-Oener.** (2010) “Explaining Women's Success: Technological Change and the Skill Content of Women's Work” The Review of Economics and Statistics, February 2010, 92(1), 187–194.
- **Dustmann, C., J. Ludsteck, and U. Schönberg.** (2009) “Revisiting the German Wage Structure.” Quarterly Journal of Economics 124(2), 843–81.

References (Cont.)

- **Goos, M., and A, Manning.** (2007) “Lousy and Lovely Jobs: The Rising Polarization of Work in Britain.” Review of Economics and Statistics 89(1), 118–33.
- **Goos, M., A. Manning and A. Salomons.** (2009) “Job Polarization in Europe” American Economic Review: Papers & Proceedings 2009, 99(2), 58–63.
- **Goos, M., A. Manning and A. Salomons.** (2014) “Explaining Job Polarization: Routine-Biased Technological Change and Offshoring” American Economic Review 2014, 104(8), 2509–2526.
- **Ikenaga, T.** (2009) “Rodo shijo no nikyokuka: IT no donyu to gyomu naiyo no henka ni tsuite [Polarization of the Japanese Labor Market: The Adoption of IT and Changes in Task Contents],” The Japanese Journal of Labour Studies 584, 73-90.
- **Ikenaga, T. and R. Kambayashi.** (2016) “Task Polarization in the Japanese Labor Market: Evidence of a Long-term Trend,” Volume 55, 267–293.
- **Maeda, I.** (2016) “What Determines Earning Differentials across College Faculty? : An Examination using the “Task Approach””, unpublished manuscript.
- **Michaels, G., A. Natraj, and J. Van Reenen.** (2014) “Has ICT Polarized Skill Demand? Evidence from Eleven Countries over Twenty-Five Years.” Review of Economics and Statistics 96(1), 60–77.
- **Spitz-Oener, A.** (2006) “Technical Change, Job Tasks, and Rising Educational Demands: Looking Outside the Wage Structure.” Journal of Labor Economics 24(2), 235–70.