Is job automation risk traded in the European Union?

SmartEIZ final conference

Bart Verspagen, UNU-MERIT

verspagen@merit.unu.edu

Automation risk

According to Frey & Osborne, “47% of total US employment is in the high-risk category, meaning that associated occupations are potentially automatable over some unspecified number of years, perhaps a decade or two”

- High risk is 70% or more

Recent OECD working papers relax the extremes of the F&O distribution, but still find that the median risk in the OECD area is about 0.5

- Every odd job is at risk of being automated

How is this conclusion derived?

F&O identify 3 technological bottlenecks for automation technologies

1. Perception and manipulation tasks
2. Creative intelligence tasks
3. Social intelligence tasks

These kinds of tasks are not easily automated in the coming decades, but other tasks are

Data on jobs, skills and tasks

F&O take O*NET data: “key features of an occupation as a standardised and measurable set of variables … open-ended descriptions of specific tasks to each occupation. This allows us to (a) objectively rank occupations according to the mix of knowledge, skills, and abilities they require; and (b) subjectively categorise them based on the variety of tasks they involve.”

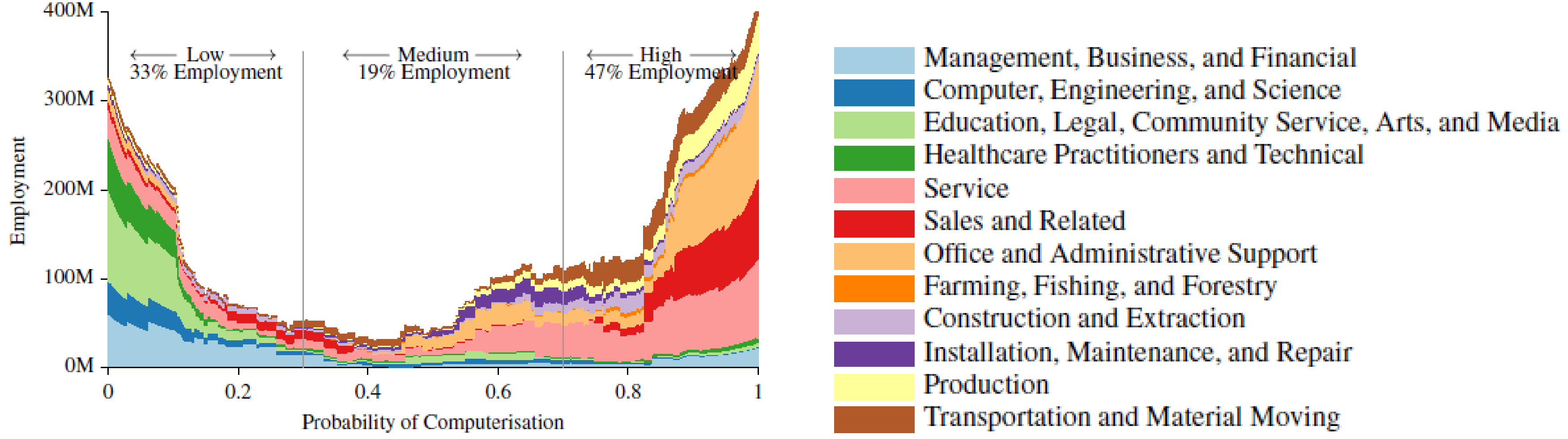
This allows (technological) experts to judge whether a particular occupation (= job code) can be automated → implemented for a small subset of 902 job codes

Statistical model of automation risk

F&O use a statistical model to estimate binary "automatability" as a function of O*NET tasks and skills for the subset of job codes

Then predict out of sample to obtain risk for all job codes

What is the frequency of risk in total US employment?



The OECD approach

Nedelkoska and Quintini use the PIAAC survey and ISCO08 job codes → OECD coverage instead of just USA

Table 4.2. PIAAC variables corresponding to FO-identified engineering bottlenecks

Engineering bottlenecks	Variable in PIAAC	Variable code	Variable description
Perception manipulation	Fingers, (dexterity)	F_Q06C	How often - using skill or accuracy with your hands or fingers?
Creative intelligence	Problem-solving, simple	F_Q05A	How often - relatively simple problems that take no more than 5 minutes to find a good solution?
	Problem-solving, complex	F_Q05B	Problem solving - complex problems that take at least 30 minutes thinking time to find a good solution?
Social intelligence	Teaching	F_Q02B	How often - instructing, training or teaching people, individually or in groups?
	Advise	F_Q02E	How often - advising people?
	Plan for others	F_Q03B	How often - planning the activities of others?
	Communication	F_Q02A	How often - sharing work-related information with co-workers?
	Negotiate	F_Q04B	How often - negotiating with people either inside or outside your firm or organisation?
	Influence	F_Q04A	How often - persuading or influencing people?
	Sell	F_Q02D	How often - selling a product or selling a service?

Source: Survey of Adult Skills (PIAAC) 2012, 2015

Table 4.3. Automatability as a function of engineering bottlenecks. PIAAC Canadian data

	Logistic regression results	
	Logit coefficients	Robust standard errors
Dexterity	0.105***	0.022
Simple problems	0.0573*	0.0309
Complex problems	-0.0691**	0.0297
Teach	-0.0691***	0.0255
Plan work of others	-0.308***	0.0234
Influence others	-0.235***	0.0267
Negotiate	0.0463*	0.0255
Sell	0.160***	0.0206
Advise	-0.199***	0.027
Communicate	0.214***	0.026
Constant	0.363**	0.152
Observations	4,656	
Pseudo R-squared	0.137	
Log Likelihood	-2769	
Area under ROC curve	0.743	
AIC	1.194	
BIC	-33693.5	

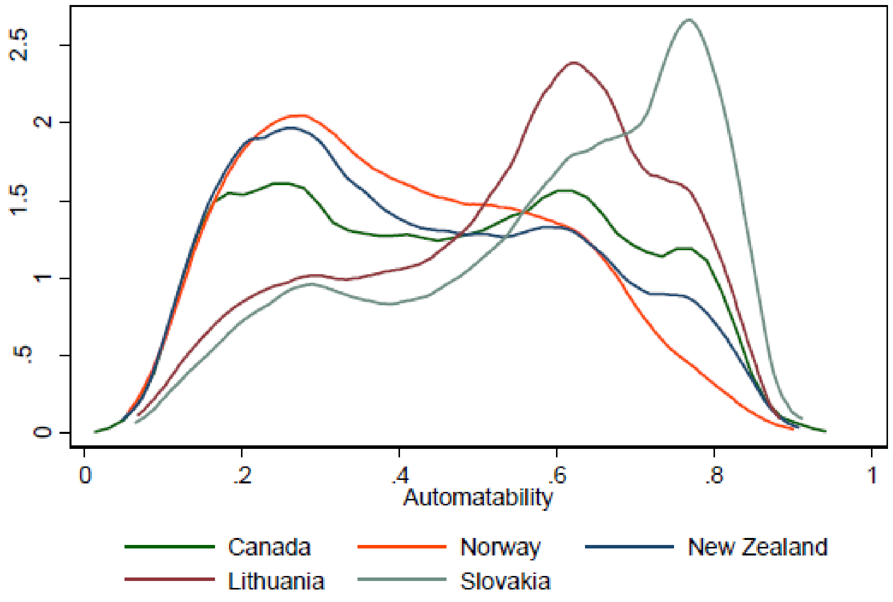
Note: Significant at: *** p<0.01, ** p<0.05, * p<0.1.
Source: Canadian Sample, Survey of Adult Skills (PIAAC) 2012.

OECD results

Table 4.5. Cross-country variation in job automatability

Country	Median	Mean	S.D.
New Zealand	0.39	0.42	0.20
Norway	0.40	0.41	0.18
Finland	0.41	0.43	0.18
United States	0.41	0.43	0.20
Northern Ireland (UK)	0.42	0.43	0.21
England (UK)	0.42	0.43	0.20
Sweden	0.43	0.44	0.19
Netherlands	0.44	0.45	0.19
Denmark	0.44	0.45	0.19
Canada	0.45	0.45	0.21
Ireland	0.45	0.46	0.22
Singapore	0.45	0.46	0.20
Belgium	0.46	0.46	0.20
Israel	0.46	0.47	0.21
Estonia	0.47	0.46	0.19
Korea	0.47	0.46	0.19
Austria	0.49	0.48	0.20
Russian Federation	0.49	0.47	0.19
Czech Republic	0.49	0.48	0.20
France	0.51	0.49	0.20
Italy	0.52	0.49	0.20
Cyprus	0.52	0.51	0.21
Poland	0.52	0.50	0.21
Japan	0.53	0.51	0.18
Slovenia	0.53	0.51	0.21
Spain	0.54	0.51	0.21
Germany	0.54	0.52	0.18
Chile	0.55	0.52	0.20
Turkey	0.55	0.52	0.18
Greece	0.57	0.54	0.19
Lithuania	0.57	0.54	0.19
Slovak Republic	0.62	0.57	0.20
All countries	**0.48**	**0.47**	**0.20**

Figure 4.1. Automatablity distribution for selected countries



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Global Value Chains and automation risk

Today's production system is globally distributed

In Global Value Chains (GVCs), firms are able to offshore particular tasks to other countries, e.g., low-skilled work to low-wage countries

Can we see any evidence that automation risk-intensive work is offshored at a higher rate than employment in general?

- Focus on intra-EU because of data

Global input-output table (WIOD)

The global input-output table records deliveries of country-sector (e.g., Agriculture in NLD) to all other country-sector (e.g., Food products in HRV), and to final demand sectors (consumption, investment)

It is a multi-country version of the old Leontief type input-output table for a single country

Fairly simple calculations give us a global value added matrix: $G = \hat{V}[I - L]^{-1}\hat{F}$

And this can be transformed into a GVC employment matrix $E = \hat{Y}G$

The GVC employment matrix

The matrix is country/sector-by-country/sector (NACE-1d sectors)

- A row sums to employment in the country/sector
- A column sums to employment that is sourced from other country/sectors and used by the country/sector in the column to serve its final demand
- Diagonal elements are called “own-GVC employment”

The GVC employment matrix – 2014

(Aggregated over sectors, so only countries remain)

	HRV	NOR	DEU	SWE	ROW	EMP
HRV	1247	2	26	4	290	1570
NOR	0	2354	29	21	342	2747
DEU	12	51	36014	107	6522	42706
SWE	1	59	70	3916	704	4750
ROW	1393	670	9284	1189		
FD	1406	3134	45398	5233		

Automation risk matrix

The automation risk matrix is of the same format, but only for jobs at risk of automation

- It is obtained by multiplying each element of the GVC employment matrix by the average automation risk of the country/sector of the row

The average automation risk of the country/sector is obtained by weighting the risk by job-code (ISCO08-3d) with the sectoral job structure

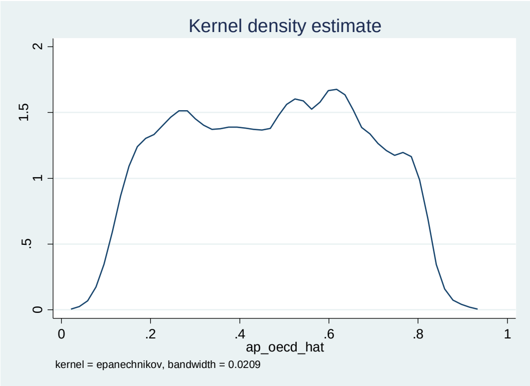
My estimations of automation risk

I use the public version of OECD's PIAAC and their model (logit), but I estimate this by 1d-NACE sector → Risks by job-code vary by sector, but not by country

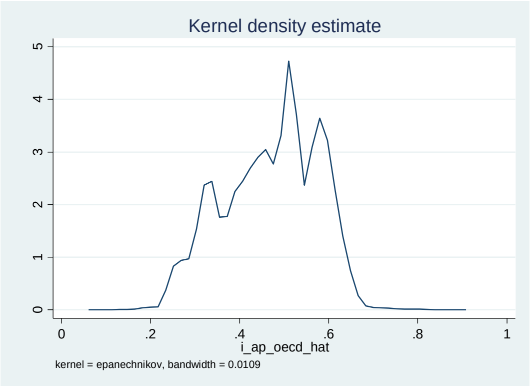
Estimation by sector is necessary to obtain sufficient variation in risk per job code

- The OECD results shown earlier are at individual worker level, not aggregated to ISCO08 job codes
- Because intra-job variation in the bottleneck variables is large, aggregating to job codes implies a very strong regression to the mean effect

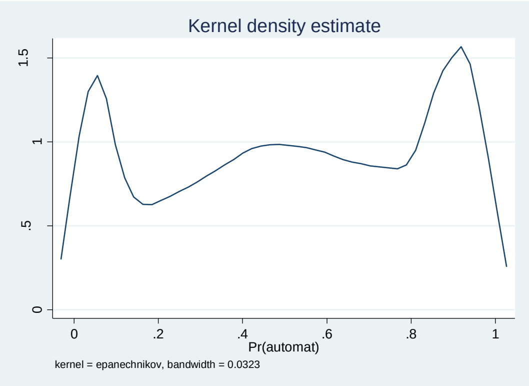
Histograms of PIAAC automation risk



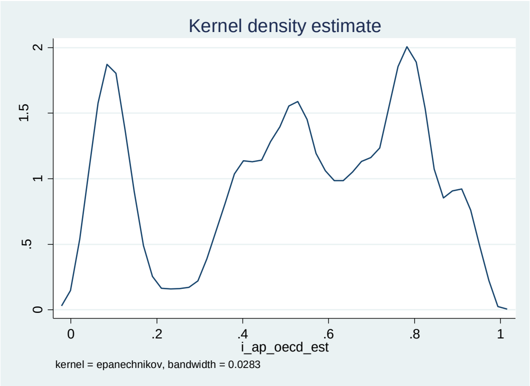
OECD - individual



OECD - jobs



Mine - individual



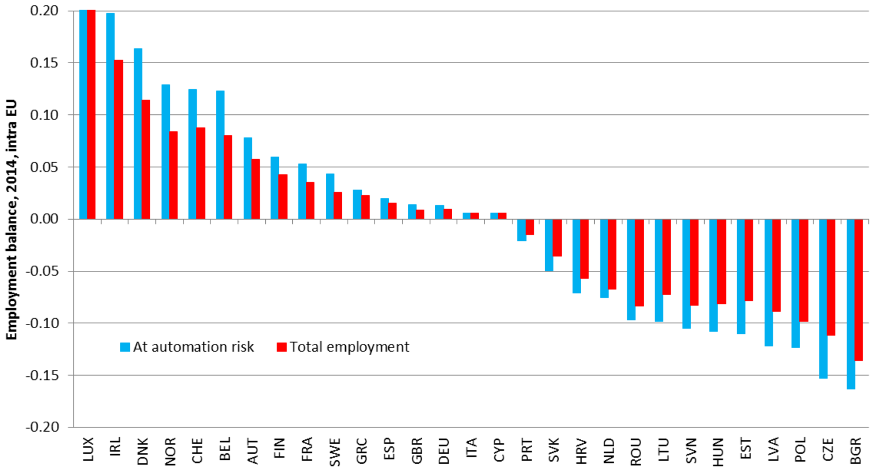
Mine - jobs

Automation risk trading

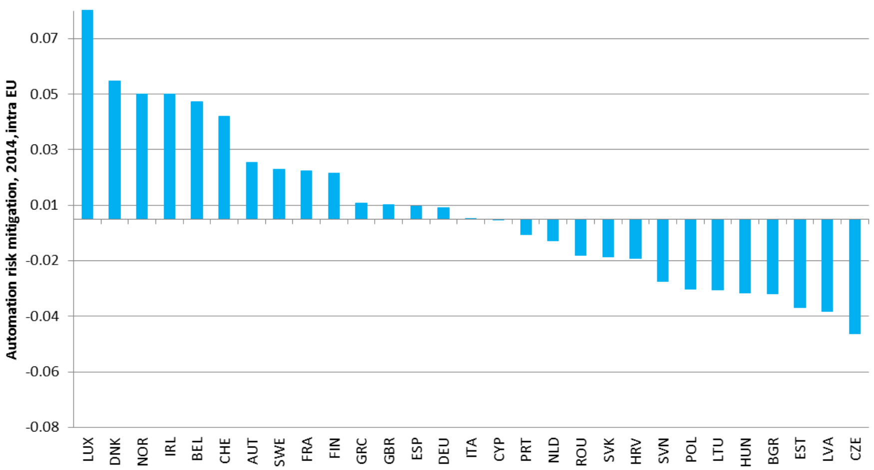
Aggregate the automation risk matrix to country-by-country level

- Only the intra-EU elements are available because we do not have 3d ISCO08 job codes for non-EU countries
- The difference between elements (i, j) and (j, i) is the automation risk balance between the countries
- The sum of these balances (intra-EU) for all (EU) countries is expressed as the diagonal element of the matrix (fully domestic automation risk)
- A negative (positive) value implies that the country absorbs (mitigates) automation risk
- Compare this to total employment balance (calculated in the same way, but directly on the GVC employment matrix)

The result – 2014



Risk mitigators | Risk absorbers



Risk mitigators | Risk absorbers

Conclusions

Jobs that are at automation risk are "traded" at a higher rate than general employment within the EU

General employment is traded from West/North/South to East and Central

Jobs at risk of automation follow this pattern

By absorbing employment from the rest of Europe, East- and Central-Europe import jobs at risk of automation at a particularly high rate

Therefore, in the EU context, these countries are most at risk of the "robot revolution"