

WTO Trade Dialogues Lectures Series: Drivers of Job Polarization: A Global Supply Chain Perspective

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Job polarization: employment in low- and high-wage occupations increases relative to those initially in the middle of the wage distribution

Table: Illustration: job structure changes in country A

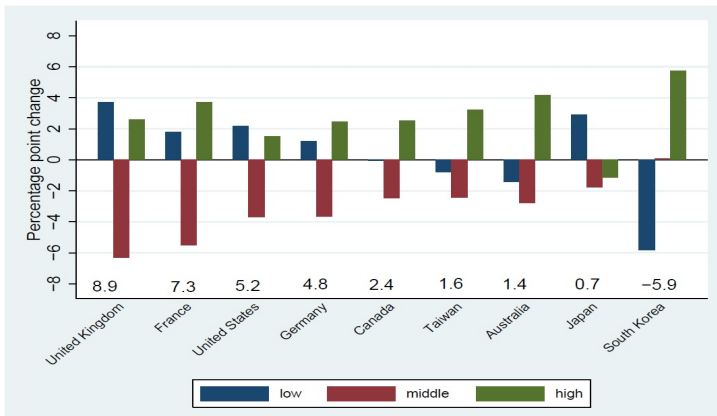
Number employed			
Occupation-wage	Year 0	Year 1	% Change
low	30	70	133%
medium	40	60	50%
high	30	70	133%
total	100	200	100%

Employment share			
Occupation-wage	Year 0	Year 1	Change
low	30 %	35 %	5 p.p.
medium	40 %	30 %	-10 p.p.
high	30 %	35 %	5 p.p.
total	100 %	100 %	

$$\text{polarization index} = \min\{x_{low}, x_{high}\} - x_{medium} = 5 - -10 = 15$$

Job polarization in advanced countries

Percentage point changes in occupational employment shares between 1999 and 2007



Note: Agricultural occupations are omitted

Source: Based on authors' calculations using detailed occupations data

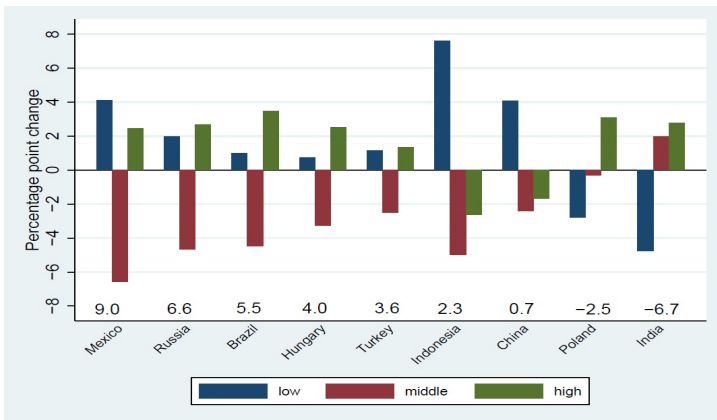
Open questions

1. Do labour markets in emerging countries also polarize?

Answer: Yes, but...

Job polarization in emerging countries

Percentage point changes in occupational employment shares between 1999 and 2007



Note: Agricultural occupations are omitted

Source: Based on authors' calculations using detailed occupations data

What accounts for these changes in the job structure?

- ▶ Two key explanations, both based on an examination of the type of tasks workers perform
 - (1) Routine-biased technological change
 - (2) Routine task relocation to low-cost destinations

A word of caution: No single cause or explanation can fully account for the diversity in country experiences. Many other factors are also relevant, such as minimum wages, occupational licensing, labour unions, and business cycles

Routine-biased technological change (Autor et al. 2003)

- ▶ Many middle-wage occupations, such as bookkeeping, administrative support and factory jobs, are relatively routine-task intensive
- ▶ A task can be computerized when we know the rules: well-specified procedures, such as copying, calculating, and measuring
- ▶ So: spreadsheets replace bookkeepers; robots replace factory workers

Routine-biased technological change (Autor et al. 2003)

- ▶ 'Knowing the rules' is not a trivial requirement. Procedures for accomplishing many commonplace tasks not explicitly understood (Polanyi's paradox)
- ▶ Two broad categories of tasks for which we do not know the rules:
 - (1) *Abstract tasks*: Requires mental flexibility, problem-solving, and creativity, such as teachers, doctors, managers, scientists, lawyers, engineers, and artists
 - (2) *Manual tasks*: Requires physical adaptability or interpersonal interactions, such as janitors, security guards, construction workers, home health aides
- ▶ A more nuanced view on technological change: from *skill-biased* to *routine-biased* technological change

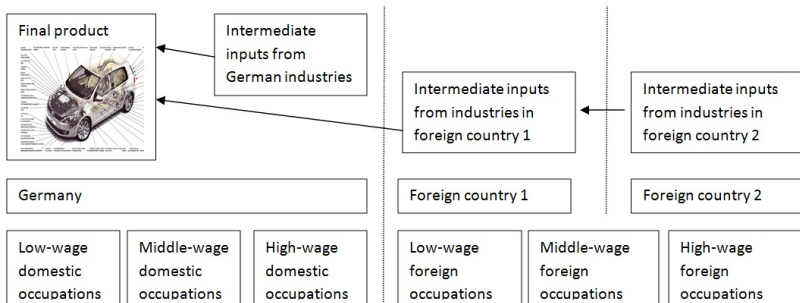
Offshoring

- ▶ When we know the rules of a task it can also be off-shored to a cheaper location without a substantial deterioration in quality (Baldwin 2016)
- ▶ Relocation of middle-wage routine-task intensive occupations, such as bookkeeping, administrative support and factory jobs
- ▶ Design and innovation is kept at home, while low-wage services occupations are difficult to offshore since they require physical presence

Open questions

- ▶ Determining the role of task relocation and technological change in accounting for job polarization is ultimately an empirical question

Approach here: disentangle the role of offshoring and technology in accounting for job polarization using a task-based model of employment demand in Global Supply Chains (GSC)



What is in World Input-Output Tables?

		France			Germany			USA			Tot	
		M ... S ... C	M ... S ... C	M ... S ... C	H I G	H I G	H I G	H I G				
France	Mining	•	•	•	•	•	•	•	•	•	•	•
	•	•	•	•	•	•	•	•	•	•	•
	Steel manuf	•	•	•	•	•	•	•	•	•	•	•
	•	•	•	•	•	•	•	•	•	•	•
	Car manuf	•	•	•	•	•	•	•	•	•	•	•
Germany	Mining	•	•	•	•	•	•	•	•	•	•	•
	•	•	•	•	•	•	•	•	•	•	•
	Steel manuf	•	•	•	•	•	•	•	•	•	•	•
	•	•	•	•	•	•	•	•	•	•	•
	Car manuf	•	•	•	•	•	•	•	•	•	•	•
USA	Mining	•	•	•	•	•	•	•	•	•	•	•
	•	•	•	•	•	•	•	•	•	•	•
	Steel manuf	•	•	•	•	•	•	•	•	•	•	•
	•	•	•	•	•	•	•	•	•	•	•
	Car manuf	•	•	•	•	•	•	•	•	•	•	•
Value added		•	•	•	•	•	•	•	•	•	•	•
Total		•	•	•	•	•	•	•	•	•	•	•

From: US mining
 To: German steel manufacturing

What is in World Input-Output Tables?

		France			Germany			USA			France	Germ	USA	Tot
		M ... S ... C	M ... S ... C	M ... S ... C	M ... S ... C	H | I | G	H | I | G	H | I | G	H | I | G					
France	Mining	•	•	•	•	•	•	•	•	•	•	•	•	
	•	•	•	•	•	•	•	•	•	•	•	•	
	Steel manuf	•	•	•	•	•	•	•	•	•	•	•	•	
	•	•	•	•	•	•	•	•	•	•	•	•	
	Car manuf	•	•	•	•	•	•	•	•	•	•	•	•	
Germany	Mining	•	•	•	•	•	•	•	•	•	•	•	•	
	•	•	•	•	•	•	•	•	•	•	•	•	
	Steel manuf	•	•	•	•	•	•	•	•	•	•	•	•	
	•	•	•	•	•	•	•	•	•	•	•	•	
	Car manuf	•	•	•	•	•	•	•	•	•	•	•	•	
USA	Mining	•	•	•	•	•	•	•	•	•	•	•	•	
	•	•	•	•	•	•	•	•	•	•	•	•	
	Steel manuf	•	•	•	•	•	•	•	•	•	•	•	•	
	•	•	•	•	•	•	•	•	•	•	•	•	
	Car manuf	•	•	•	•	•	•	•	•	•	•	•	•	
Value added		•	•	•	•	•	•	•	•	•	•	•	•	
Total		•	•	•	•	•	•	•	•	•	•	•	•	

From: French car manufacturing
To: German household consumption

From: US mining
To: German steel manufacturing

What is in World Input-Output Tables?

		France			Germany			USA			France			Germ			USA			Tot
		M	S	C	M	S	C	M	S	C	H	I	G	H	I	G	H	I	G	
France	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Germany	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
USA	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Value added		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

From: French car manufacturing
To: German household consumption

From: US mining
To: German steel manufacturing

Production "recipe" of
French steel manufacturing

A Global Supply Chain in a WIOT

		France			Germany			USA			France			Germ			USA			Tot						
		M	...	S	...	C	M	...	S	...	C	M	...	S	...	C	H	I	G	H	I	G	H	I	G	
France	Mining	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Steel manuf	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Car manuf	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Germany	Mining	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Steel manuf	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Car manuf	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
USA	Mining	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Steel manuf	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Car manuf	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Value added		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Total		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Employment		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
CO2 emissions		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

German exports of cars require:
production in German car manufacturing

A Global Supply Chain in a WIOT

		France			Germany			USA			France			Germ			USA			Tot
		M	S	C	M	S	C	M	S	C	H	I	G	H	I	G	H	I	G	
France	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Germany	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

USA	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Value added		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Employment		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CO2 emissions		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

German car manufacturing requires:
inputs from French steel manufacturing

and German labour

A Global Supply Chain in a WIOT

		France			Germany			USA			France			Germ			USA			Tot
		M	S	C	M	S	C	M	S	C	H	I	G	H	I	G	H	I	G	
France	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Germany	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
USA	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Value added		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Employment		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CO2 emissions		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

French steel manufacturing requires:
inputs from US mining

and French labour

A Global Supply Chain in a WIOT

		France			Germany			USA			France			Germ			USA			Tot
		M	S	C	M	S	C	M	S	C	H	I	G	H	I	G	H	I	G	
France	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.....	
Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Germany	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.....	
Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
USA	Mining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	Steel manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.....	
Car manuf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Value added		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Employment		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CO2 emissions		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

US mining requires:
US labour

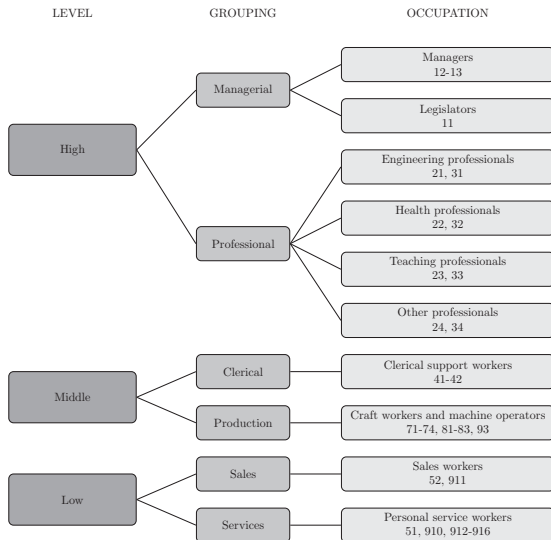
- ▶ Over-simplified example!
- ▶ Essentially, however, US consumption of cars imported from Germany generates jobs and income for workers in Germany, France and the USA
- ▶ We use an input-output technique to measure the direct and indirect jobs related to the production of a final product

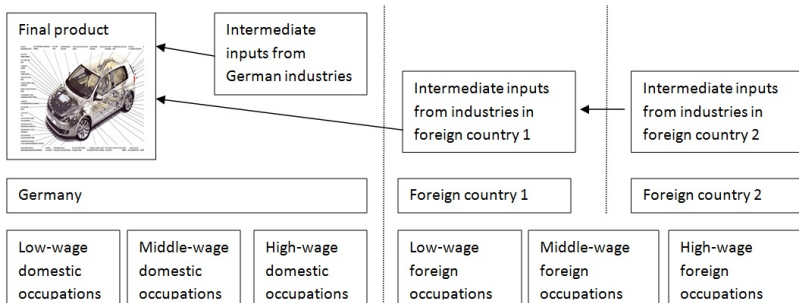
The OECD/WTO TiVA database

- ▶ For formulating policies, a strong statistical basis is needed to systematically study global supply chains. WIOD is only a proof of concept, which requires a better institutional embedding.
- ▶ The 'Made in the World' initiative at the OECD and WTO is therefore very much welcomed, not only because it aims to update the type of data provided in WIOD, but also as it aims to extend the country coverage and closely engages with statistical offices to reduce inconsistencies in the raw data.
- ▶ Current analysis uses WIOD because it provides WIOTs in previous years' prices

Occupation data

- ▶ Occupational employment from Annual Labour Force Surveys and Population Censuses
- ▶ Countries covered are the 27 members of the EU (per January 2007), Australia, Brazil, Canada, China, India, Indonesia, Japan, Mexico, Russia, South Korea, Taiwan, Turkey and the US
- ▶ National occupation classifications mapped to a common harmonized occupation classification, necessary for GSC analysis
- ▶ Occupation-industry-year specific employment shares from 1999-2007 that match with the countries and industries distinguished in the World Input-Output Database (Timmer et al. 2015)





Occupational labour demand in the GSC of cars finalized in Germany

Occupation, Country	1999	2007	Change	% Change
Services	228	314	86	38%
Germany	72	88	16	22%
China	43	63	19	44%
Sales	233	283	50	21%
Germany	79	79	0	0%
China	42	59	17	40%
Production	1579	1826	247	16%
Germany	748	653	-96	-13%
China	118	212	94	80%
Clerical	377	403	27	7%
Germany	221	218	-3	-1%
China	17	23	6	34%
Professional	722	936	214	30%
Germany	446	528	82	18%
China	22	34	12	54%
Managerial	204	264	59	29%
Germany	98	106	8	8%
China	10	13	3	35%

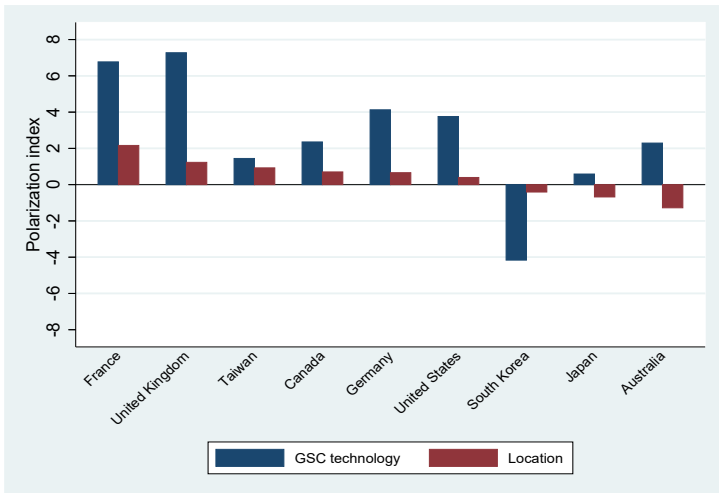
Notes: Employment in thousands of jobs.

Intuition

- ▶ Our analysis encompasses both offshoring countries and offshore destinations in a single framework.
- ▶ Key idea: constructing a harmonized occupational classification means that we can determine for each Global Supply Chain:
 - ▶ Changes in the total demand for workers with a certain occupation (*GSC technology*)
 - ▶ Changes in the distribution of workers with a certain occupation across countries (*task relocation*)

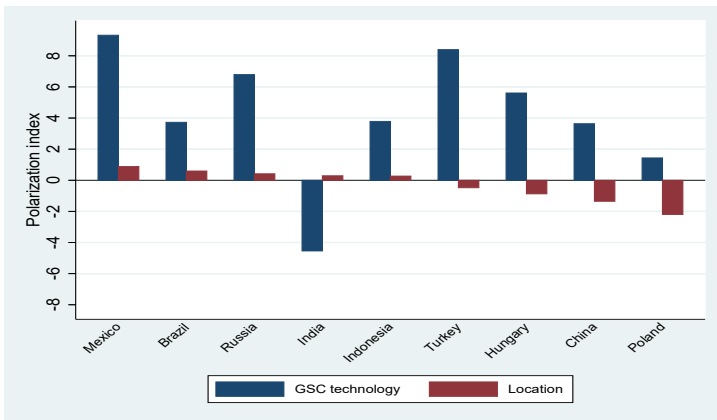
Drivers of job polarization, advanced countries

The role of task relocation and technological change in Global Supply Chains



Drivers of job polarization, emerging countries

The role of task relocation and technological change in Global Supply Chains



Policy implications

- ▶ Routine-biased technological change appears a key force driving down demand for middle relative to low and high-wage occupations
- ▶ This needs to be recognized and prioritized by policy makers, both in advanced and emerging countries
- ▶ Job polarization due to technological change may call forth a different set of policies compared to offshoring

Policy implications

One important area to consider: education

- ▶ Education and job training system to prepare humans with skills that are complemented by rather than substituted for technological change
- ▶ In the 19th century, universal high school education was the response to the rise of industry
- ▶ Societal adjustments to technological advancements have been typically slow and expensive

Specific

- ▶ Re-structure incentives for re-training?
- ▶ Life long learning and retraining currently much more common among high-educated compared to mid-educated. That should change
- ▶ Subsidizing technical education?