Work in the Age of Robots and AI

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Road map

1. Robots, AI and their industrial penetration
2. The impact of new technology on labour markets
3. Job destruction in the age of robots
4. Job creation in the age of robots
5. Health and care as an example
6. How can policy help?

1. Robots, AI and their industrial penetration

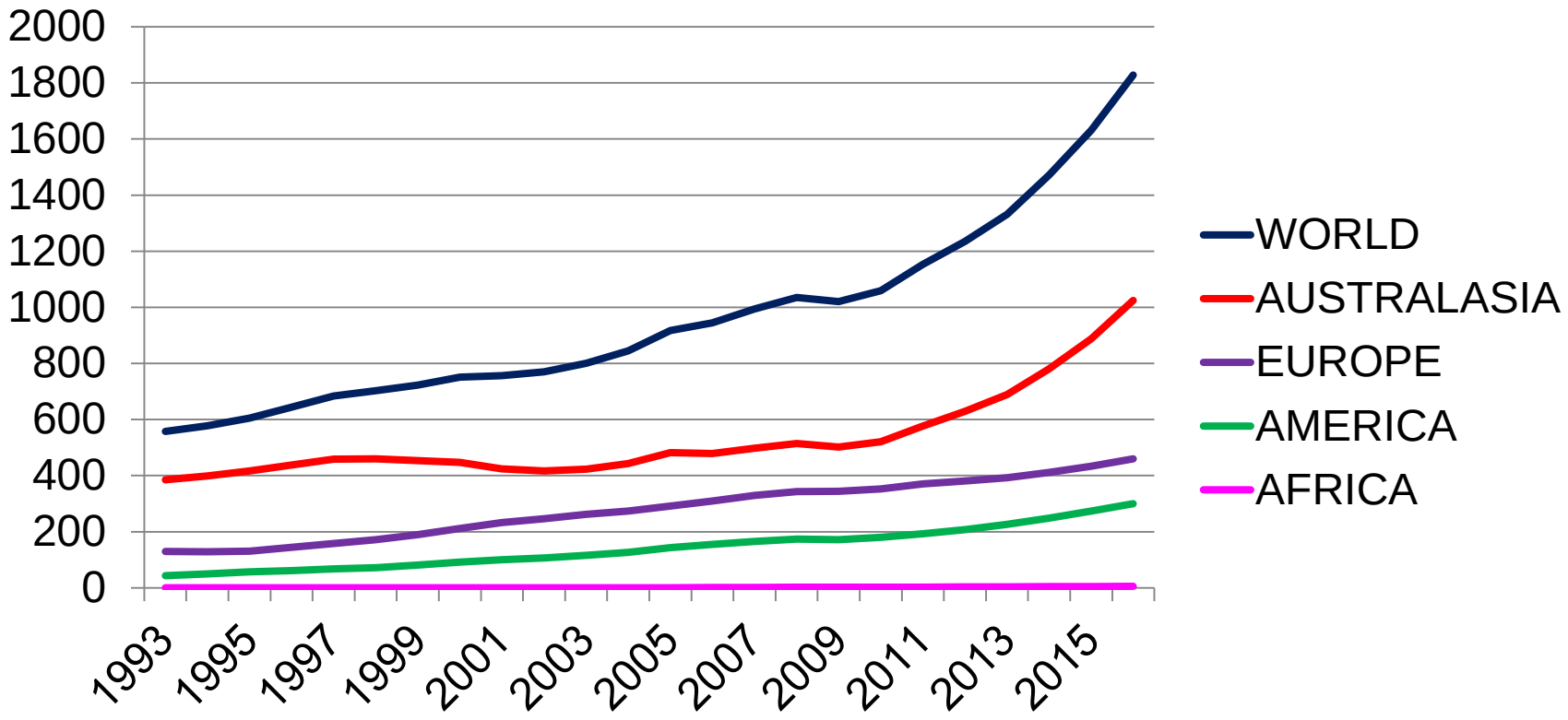
Robots and AI

- Robots and AI are the new technologies to “disrupt” labour markets
- Examples: Automation in industry, self-driving cars, electronic passport gates, voices answering questions put to electronic devices
- These are all examples of AI. Some incorporated into robots – self controlled devices
- Research in AI started a long time ago – 1950s – but commercial applications are very recent

Industrial penetration

- Difficult to measure penetration by AI
- Easier to collect data on industrial or domestic robots
- These show growth in recent years but most growth still to come
- Most growth in Asia (China and South East)

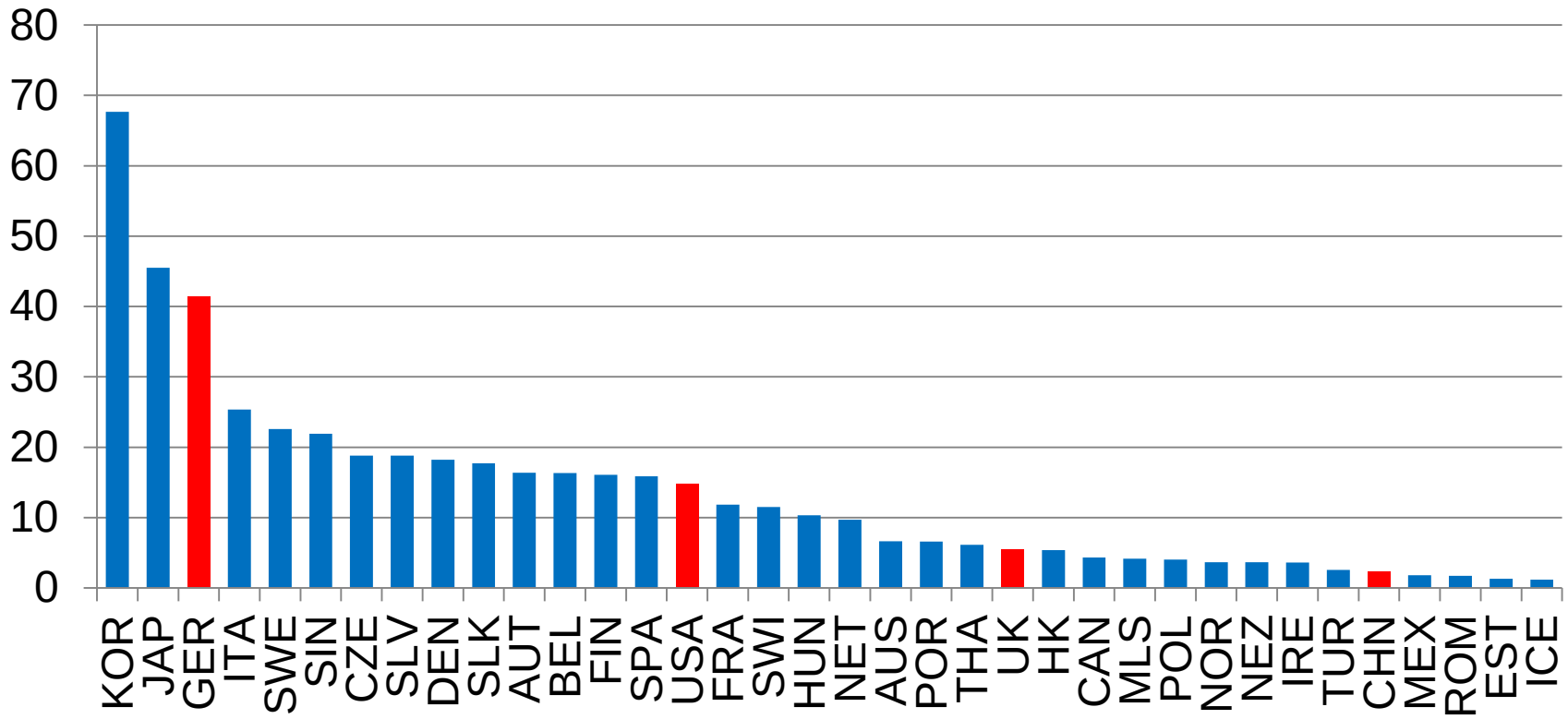
Total number of industrial robots (thousands)



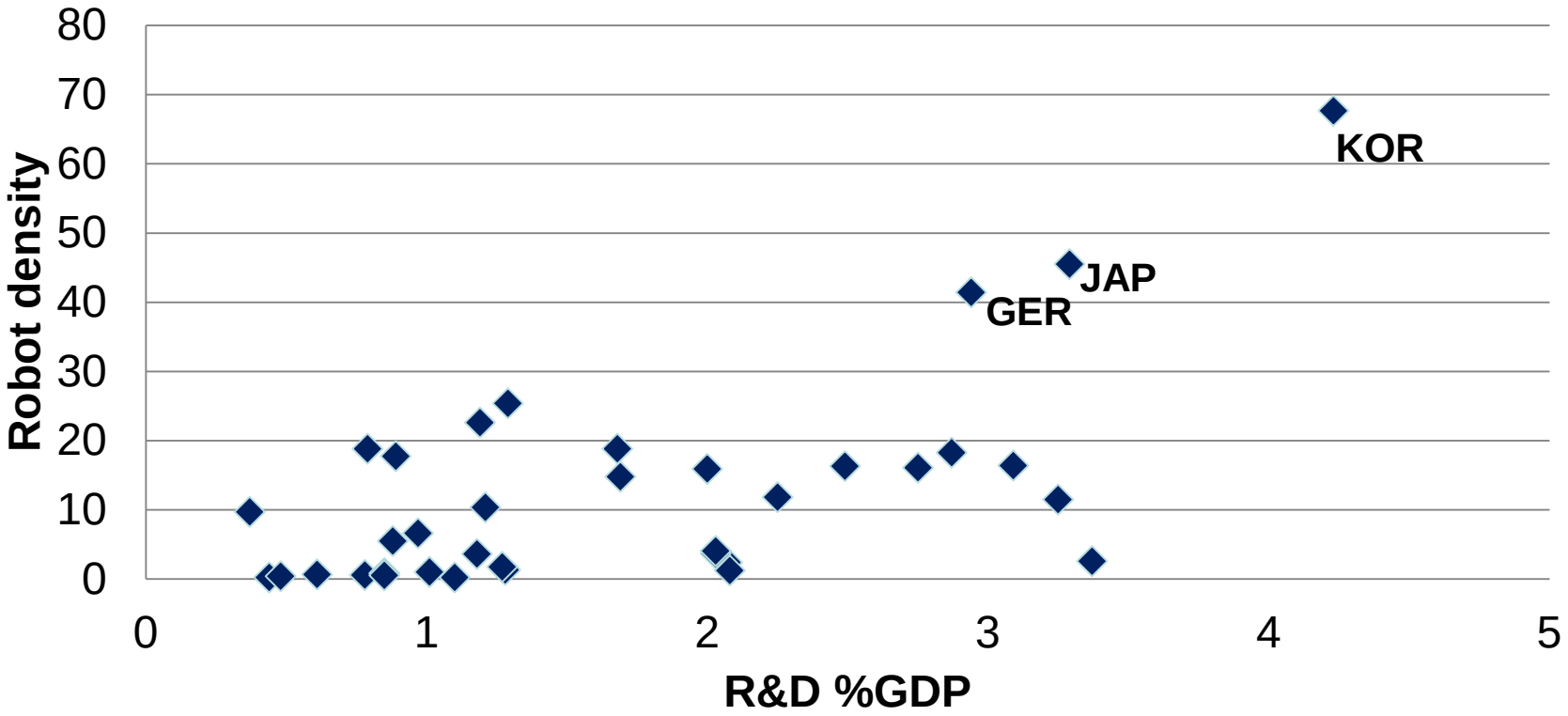
Country data

- Big differences between countries
- Korea, Japan, Germany leaders
- Poor correlation with R&D except for the three leading countries

Robots per 10,000 employees (2014, below 1.00 omitted)



Robot density on R&D



2. The impact of new technology on the labour market

The structural transformation

- Technology is not discovered and implemented uniformly across the economy, giving rise to the **structural transformation**.
- New technologies across sectors lead to restructuring of jobs: some jobs close down, new ones are created and wages grow at differential rates across the economy because of mobility frictions

Industrial revolution

- Britain went through the first industrialization in late 18th century, based on steam power, waterways and factories
- The jobs destroyed by the first factories were skilled jobs. Artisans who produced a good from raw material to final use
- The next stage of industrialization took place in late 19th century, based on the internal combustion engine, railways and eventually electricity

Job restructuring

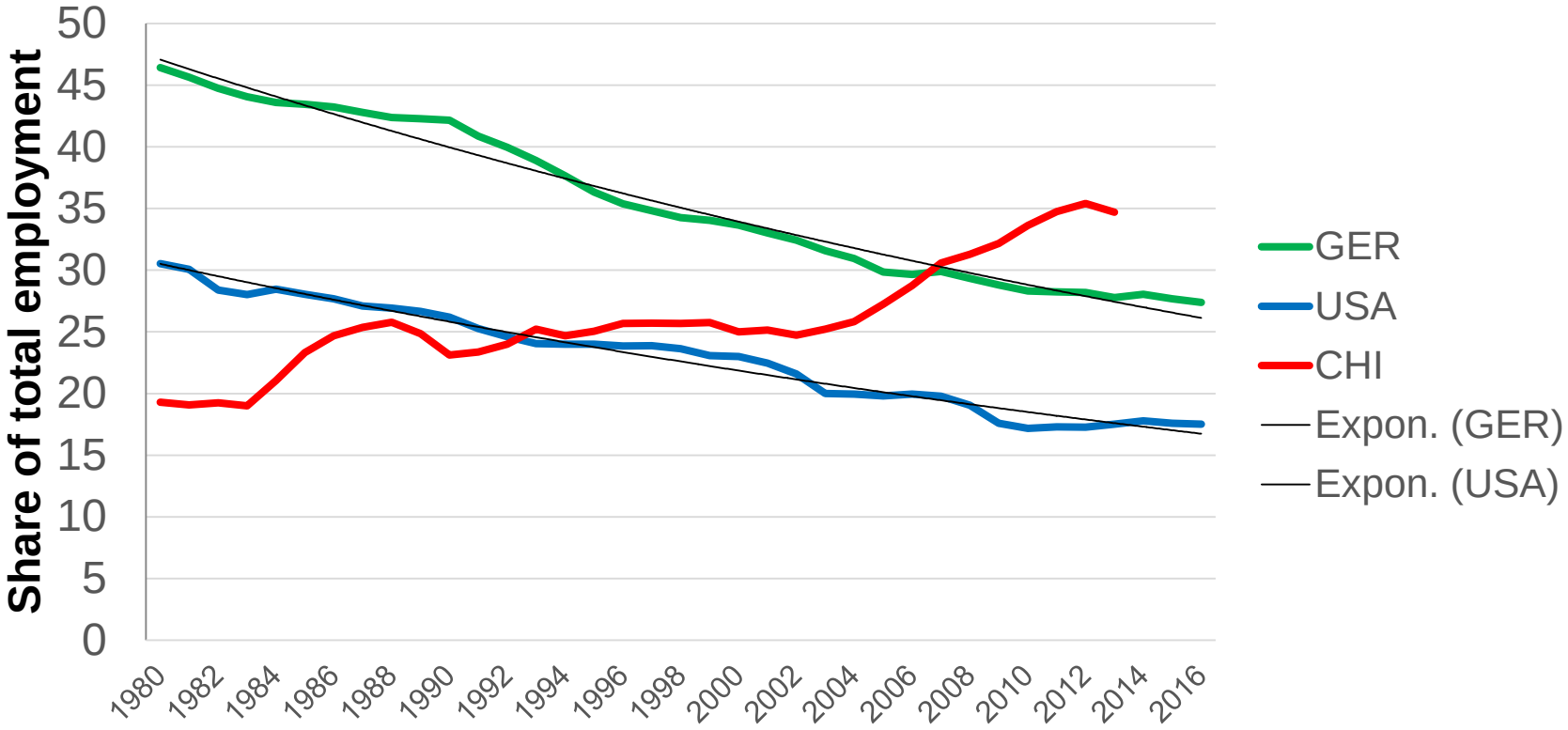
- This phase destroyed mainly unskilled jobs and increased productivity
- It led to massive production of industrial goods based on electricity – domestic appliances, the motor car, machinery and the like
- Many more jobs were destroyed by these discoveries than threatened by robots!

Technological disruption: Outside the Bank of England just before the introduction of the motor car

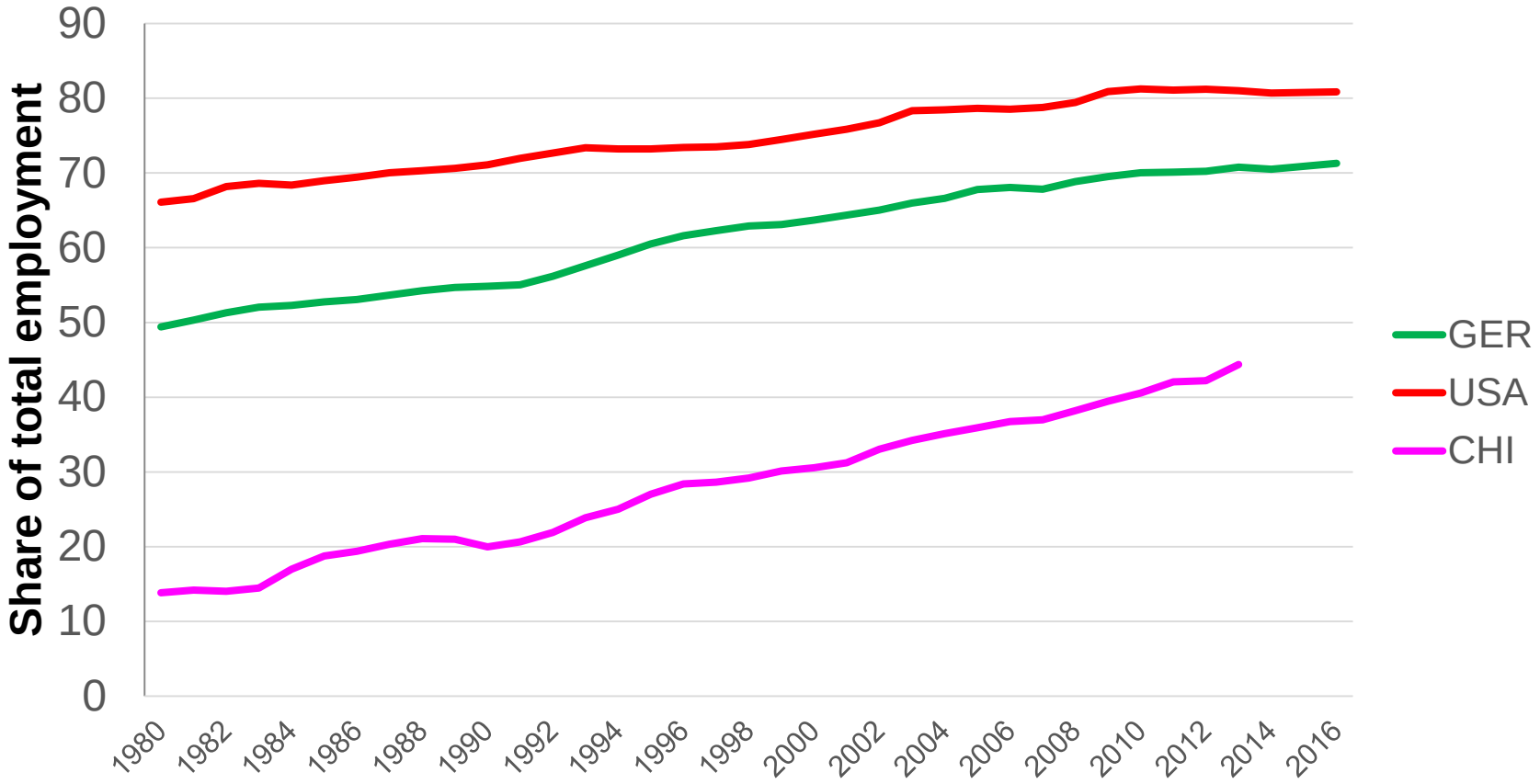
From manufacturing to service jobs

- Industrial employment expanded early in the 20th century to satisfy demand for cheap manufactured goods, based on electricity and the assembly line
- But eventually industrial employment declined due to new technology, and service jobs took its place
- The decline in the advanced countries started in the 1970s/80s and has been on trend since then

Industrial employment shares



Service employment shares



The digital revolution

- Current technologies are based on computers, the internet and artificial intelligence
- No two major technological breakthroughs are the same
- Same now, the structural transformation in the digital revolution is different from earlier technological breakthroughs

Computerization and the internet

- Compared with earlier technological breakthroughs computers destroy jobs done by more skilled people.
- Its key ingredient is big data: machines with AI process enormous amounts of data to perform tasks that are predictable, given the data input
- Such as diagnosis of known disease, driving cars

3. Job destruction in the age of robots and AI

What type of structural transformation?

- All structural transformations involve both job creation and job destruction
- The challenge is the **transition** to new jobs of the displaced labour – not the disappearance of employment
- Very difficult to distinguish jobs destroyed by computers or by computers with internet and AI – treat them together

Implications of computerization for jobs

- Large literate exists documenting that routine jobs that could be computerized are heavily concentrated in the middle of the skills distribution
  - Middle range jobs receive negative shock because they are replaced by computers
  - top jobs employ computers and increase their productivity
  - bottom jobs survive because they cannot be taken over by computers but don’t benefit from them
- These have implications for wages, increasing inequality

Still ongoing

- The process of destruction of jobs from computerization is still ongoing
- Only US has been studied in detail: studies show possible destruction of jobs with big range, from 10% to nearly 50% of jobs over the next 20 years
- Some research for Europe shows less destruction

Range of estimates

- Estimates of job destruction is bases on replacement of tasks (activities) by computers.
- Fairly easy to obtain estimates of tasks at risk from the new technology
- But the mapping from tasks to jobs is difficult because task composition of jobs is flexible
- Frey and Osborne's estimated probabilities of jobs at risk – based on tasks

Jobs at risk

Worst affected		Least affected	
Telemarketer	99%	Mental health social worker	0.30%
Loan officer	98%	Occupational therapist	0.35%
Cashier	97%	Dietician nutritionist	0.39%
Legal assistant	94%	Doctor and surgeon	0.42%
Taxi driver	89%	Clergy	0.81%
Fast food cook	81%		

Some estimates

- General consensus emerging that up to half of tasks at risk over the next 20 years
- This translates to 10-20% of jobs (OECD about 10%, McKinsey 14%)
- Could prove completely wrong: lots of anecdotal evidence of jobs redefining themselves, changing task composition; e.g. bank tellers, university professors

What do we know?

- We still know very little about automation in the 21st century, either how to research in economic theory or how to estimate
- Each new innovation puts at risk different kinds of jobs
- So it's not possible for either companies or workers to plan on how to avoid the risk of job loss
- One thing we know is that computers and AI will replace jobs that have **predictable environments** – they need to be programmed to respond to their environment

Technical capabilities vs. economics

- So far most studies focused on technical capabilities of robotics
- But implementation and diffusion depends on the economics
- Robots and AI are replacing human labour or other machines
- Their speed of adoption depends on the cost of the alternative factors
- High-wage countries are more likely to adopt them than low-wage ones

Analytical framework

- There is still no consensus model in the economics literature how to study robotics
- An approach that takes the “task” as the production input and embeds it into the standard growth model is most promising (Autor, Acemoglu, Restrepo)

From hours of work to jobs to tasks

- Parallel with matching theory: using “employment,” or hours of work, as the input was not helpful in the study of unemployment
- Key breakthrough was the adoption of the “job” as the unit of analysis
- Here using the job not very useful because of changing task composition of jobs
- But one more tricky step needed: The mapping from tasks to jobs

4. Job creation in the age of robots and AI

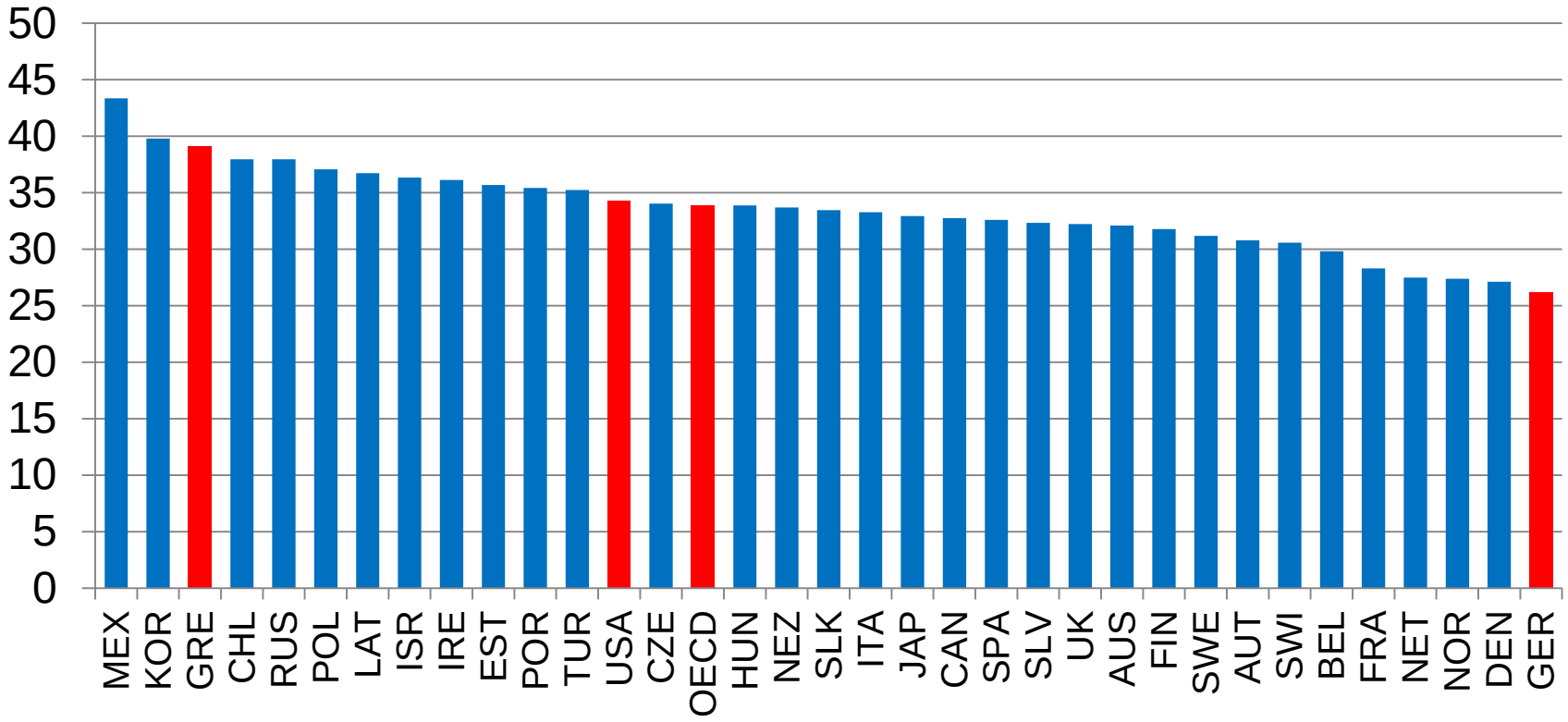
Total hours

- On average countries with higher productivity work shorter hours
- John Maynard Keynes writing in 1933 famously predicted that in the longer term the working week will be cut to 15 hours if full employment is to be maintained
- But his prediction was based on availability of work, not voluntary increases of leisure time

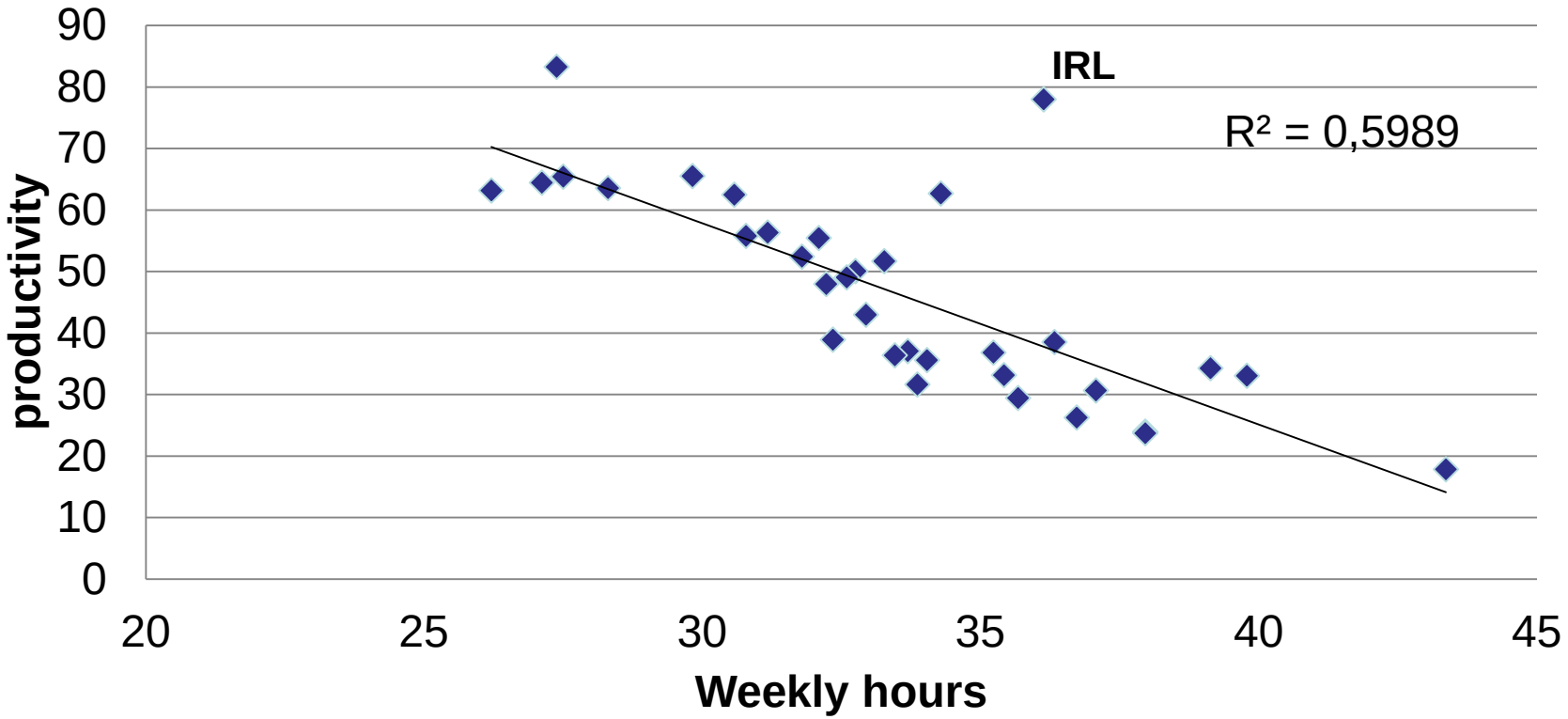
Overall employment

- Yet overall employment in more productive countries is as high as that in countries with lower productivity (or even more)
- Some of the gains from new technology are taken as increased leisure time, normally longer annual leave

Weekly hours of work, 2016



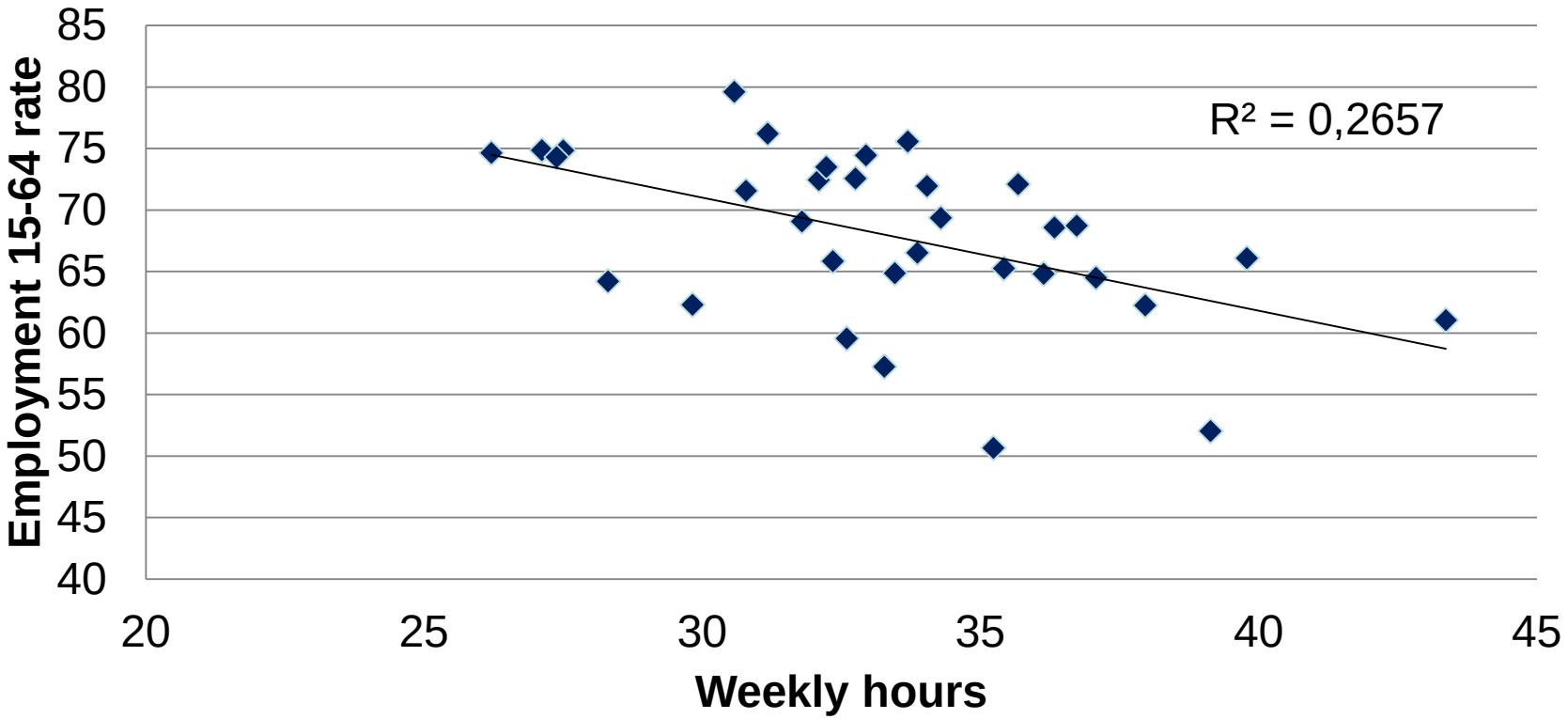
Hourly labour productivity and weekly hours of work, 2016



Job sharing

- In Germany, with lowest hours in the OECD, weekly hours are still 26 per week
- Germany also has very high employment
- Of course, full-time workers work longer hours but many jobs are part-time, giving the average of 26 hours: this is a form of “job sharing”
- Women are still more frequent in part-time jobs but a rising share of men now take them

Employment rates and hours of work, OECD, 2016



Job creation

- Reducing hours of work is one way of keeping employment high
- But there are others
  - Companies invent new tasks as some get automated, e.g., bank cashiers now do “relationship banking” with customers
  - New jobs created in the sectors of the new technology, e.g., app development, robot repairing etc.
  - New jobs created in other sectors of the economy, e.g., carers for children, old people and pets; plastic surgeons

First two types of job creation

- The new tasks invented by companies are equivalent to new products: employment growth through increases in product variety
- The specialist jobs in the tech sectors are the complementary tasks to the new technologies
- These are most likely not enough to employ those who lose their jobs

Sector expansion

- Most new jobs will be created in service sectors where productivity growth is low (Ngai-Pissarides)
- In sectors where home production gets marketized as societies become wealthier
- Or in sectors whose products have income elasticity bigger than 1 (Rogerson and co-authors)
- Difficult to empirically distinguish between last two

Which sectors will create jobs?

- Likely sectors that will create jobs for above reasons:
  - Health and care
  - Education
  - Hospitality industry – leisure
  - Real estate management
  - Household services
  - Personal services

Wealthy aging societies

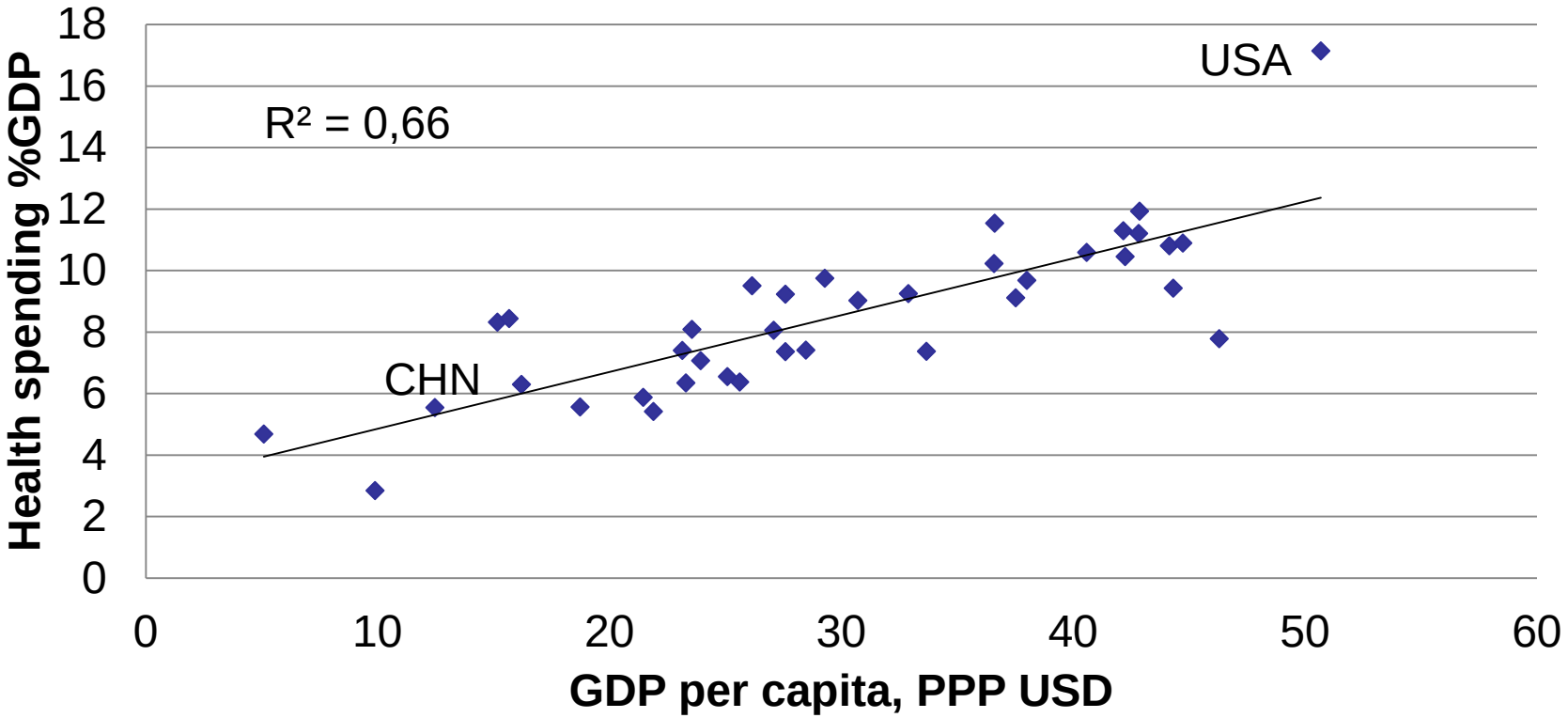
- Especially health and care will create jobs, because of higher demand for good quality health care and aging societies
- The leisure industry because of fewer aggregate hours of work and attractions of good service and “creativity”
- Household services, real estate management because societies become wealthy enough to specialise further and marketize “chores”

5. Health and care as an example

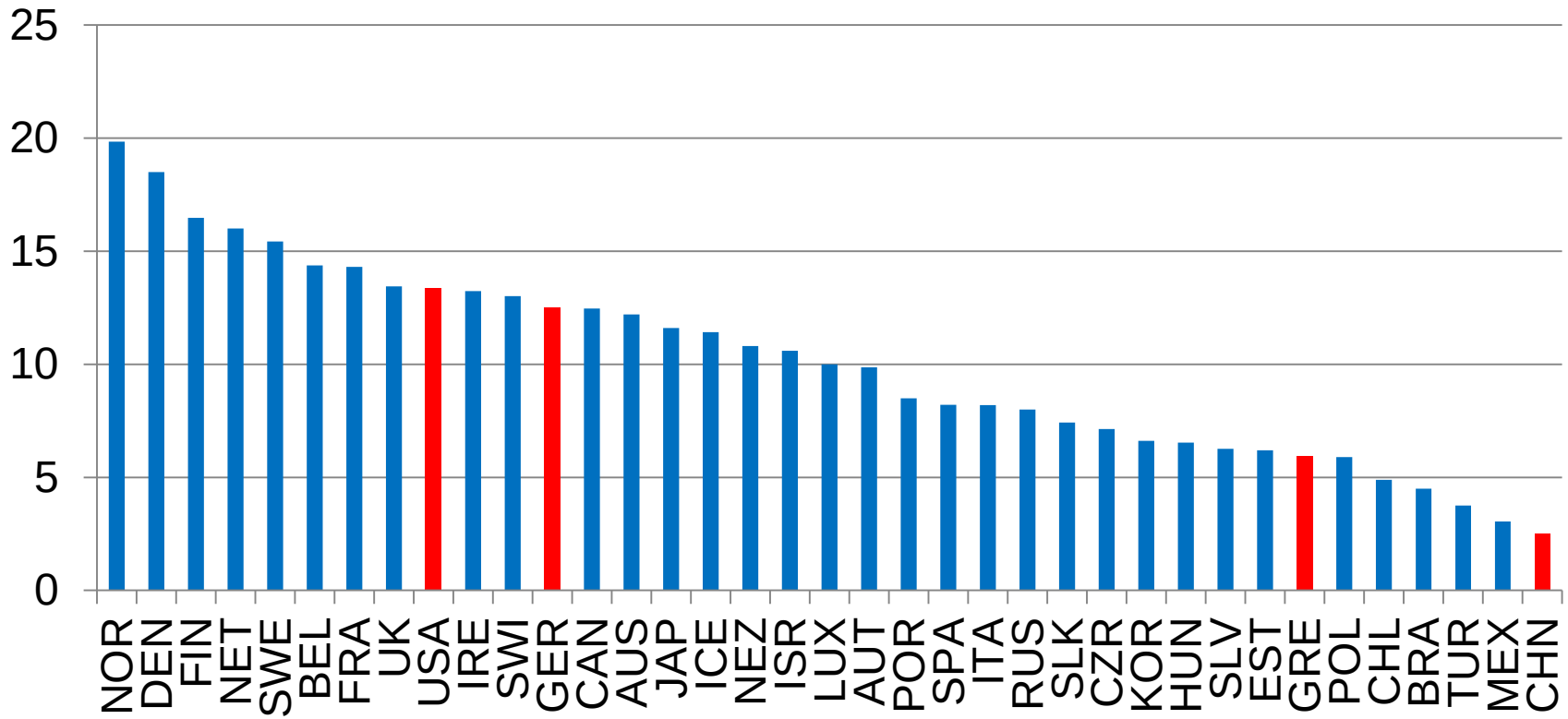
Job creation in health and care

- The health and care sector will be the main beneficiary from growth and higher living standards
- Demand for health-related services will increase faster than income because of the “marketization” of caring services
- Services that in poorer societies are either not available or are done at home (like recovery from illness)
- Also because of population ageing

Health services as “luxuries” (major economies, 2014)



Employment share of health and care sector, %, 2014 or latest year



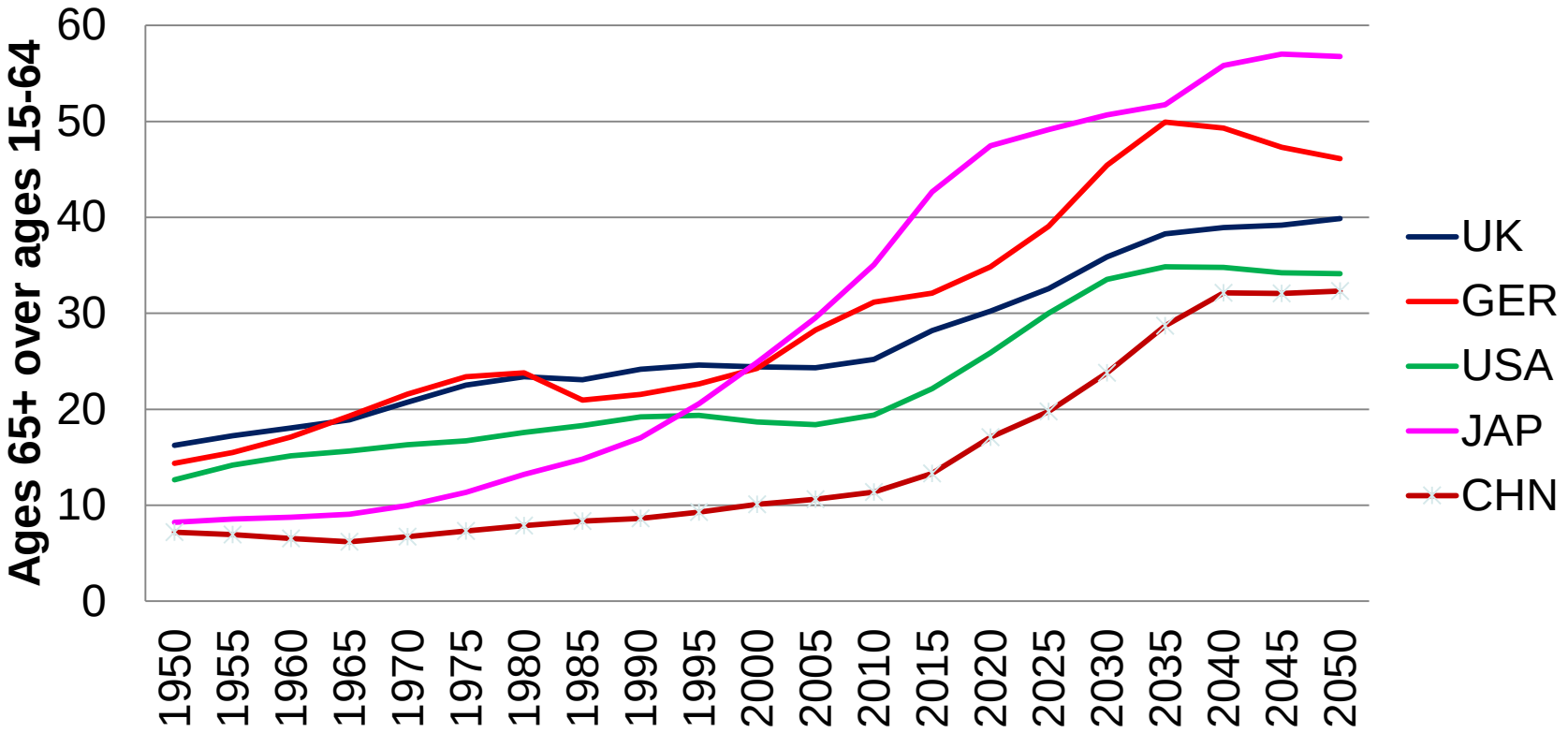
Health and care cross-country differences

- There are 10 percentage points of employment difference between Greece/Poland and Scandinavian countries.
- Scandinavians have highest share of state employment in this sector in OECD – Greece one of the lowest
- Expansion in this sector alone could close large parts of the gaps created by job destruction due to robotics

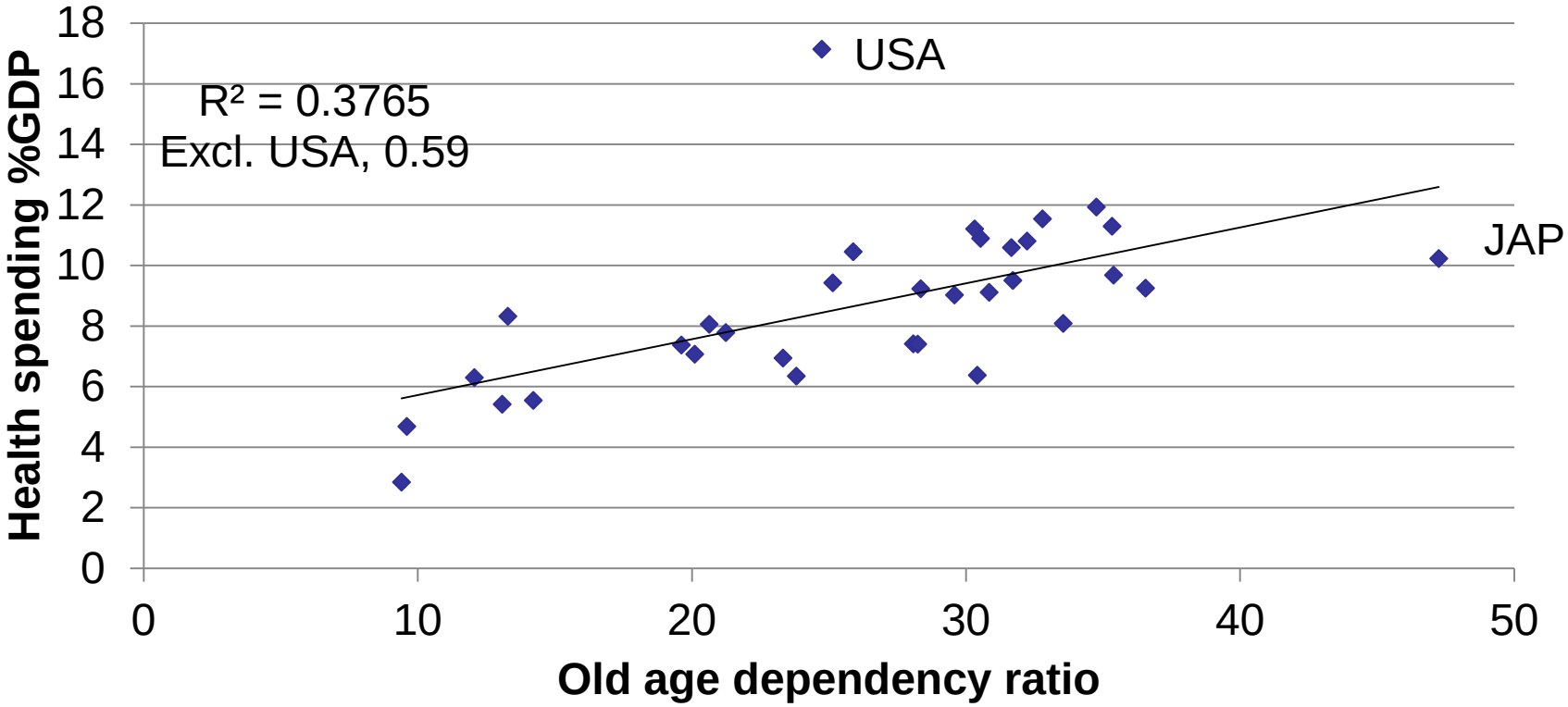
Ageing populations

- In addition, populations are ageing everywhere and older people demand more health services
- It is also important that most ageing people are relatively well off (especially in the advanced countries) as they have not experienced major recessions or wars in their lifetime, unlike their parents' generations

Ageing populations: old-age dependency ratio in major economies



Old age dependency ratio and health spending, major economies, 2015



6. How can policy help?

Education

- Key challenge is the transition to new jobs – new jobs likely to be more skilled than destroyed ones
- Loads of education in technical skills and management will help people participate in the new economy (STEM)
- Add arts for the leisure industry (STEAM)
- Person-to-person skills need to be better developed at high school level, for sectors requiring social skills

Job creation support policies

- More support for SMEs needed with initial finance, tax incentives and administrative simplicity
- Legal procedures need to be speeded up and simplified and bankruptcy laws reformed to avoid stigmatising failures
- Social policies are needed to provide a cushion of income when workers lose their jobs to new technologies
- Policy can help create and support leading research universities – Stanford and MIT in the US and Cambridge in England have been instrumental in the development of AI

Inequality

- It is a lot more difficult to deal with the disruption in labour markets and inequality through government because of aversion to taxation and fears that high taxes will push best workers out of the country
- But if societies truly dislike inequality and want to tackle it they have to accept redistributive taxation of some kind
- E.g., of the Scandinavian type, where taxes are raised from higher incomes to provide services to all

Perceptions of jobs

- But as important, perceptions of service jobs have to change to make them more respectable and more attractive
- Usually this comes with better pay
- Good example is how cooking staff relabelled from “cooks” to “chefs”; car drivers from “drivers” to “chauffer's”; personal trainers are now regarded as highly skilled qualified people with high rewards; footballers are media stars
- The reason is that wealthy societies enjoy good quality from these jobs and pay huge rewards to the best performers

Conclusions

- The automation of industry will raise productivity, make society wealthier and bring about a change in the structure of jobs
- The working week will be cut (people take more leisure) but there will also be new job creation, especially in industries that involve human contact
- New analytical and empirical framework needed to study these changes
- One based on “tasks” seems most promising

Thank you for listening
(if you still are…)