



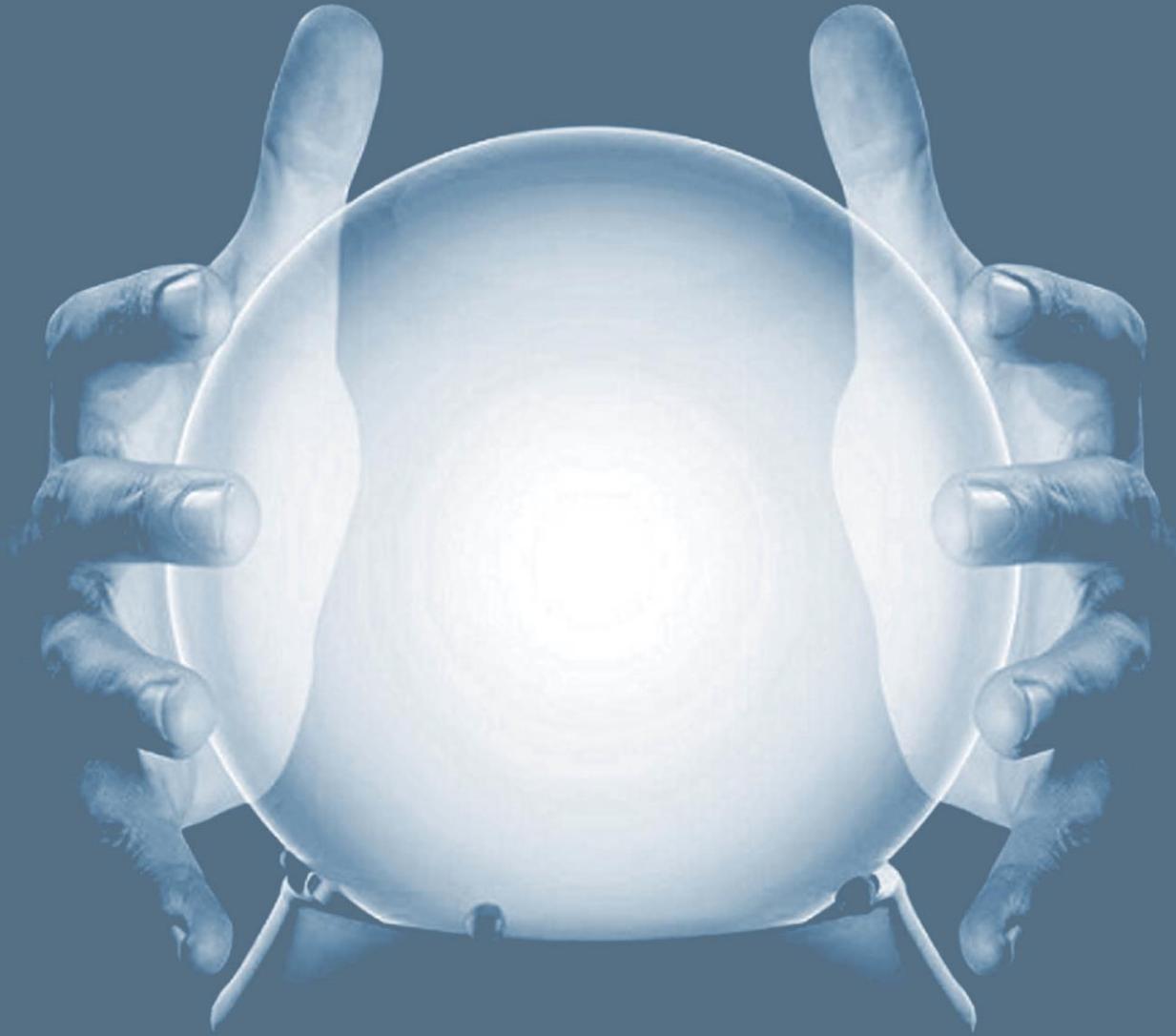
The  
**FUTURE** | **Implications for**  
of **WORK** | **Equity and Growth**  
**in Europe**

Nicolò Dalvit, Rafael de Hoyos, Leonardo Iacovone,  
Ioanna Pantelaiou, Aleksandra Peeva, and Iván Torre



Launch of the Report  
Athens, December 14, 2023





## Computational capacity of the fastest supercomputers

The number of floating-point operations<sup>1</sup> carried out per second by the fastest supercomputer in any given year. This is expressed in gigaFLOPS, equivalent to 10<sup>9</sup> floating-point operations per second.

Our World in Data



Source: TOP500 Supercomputer Database (2023)

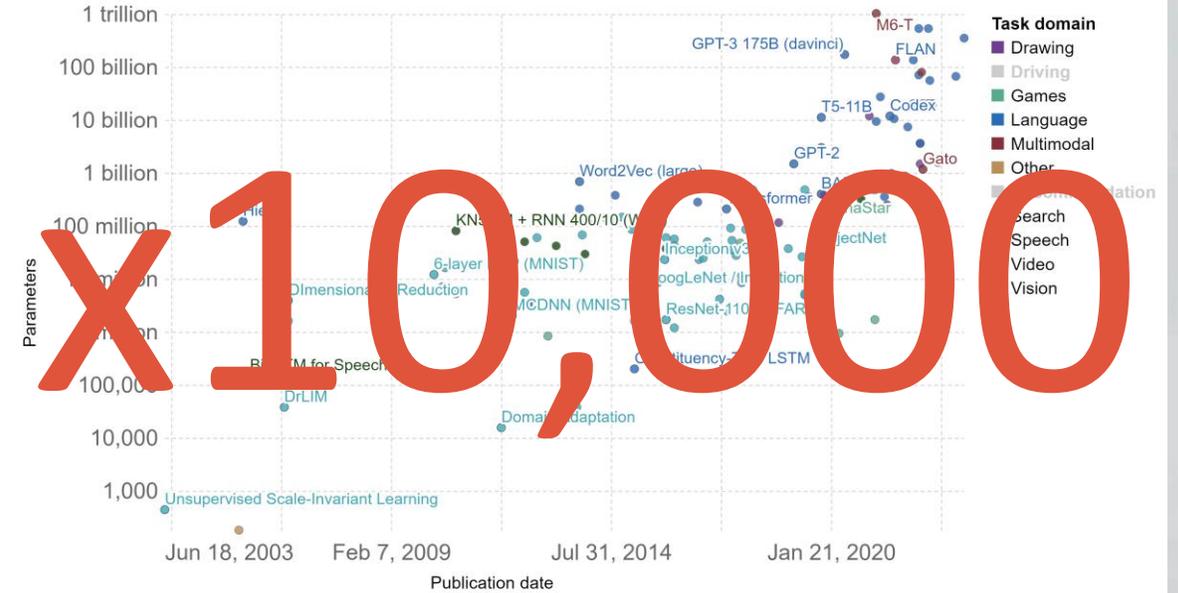
OurWorldInData.org/technological-change • CC BY

1. **Floating-point operation:** A floating-point operation (FLOP) is a type of computer operation. One FLOP is equivalent to one addition, subtraction, multiplication, or division of two decimal numbers.

## Number of parameters in notable artificial intelligence systems

Parameters are variables in an AI system whose values are adjusted during training to establish how input data gets transformed into the desired output; for example, the connection weights in an artificial neural network.

Our World in Data



Source: Sevilla et al. (2023)

OurWorldInData.org/artificial-intelligence • CC BY

Note: Parameters are estimated based on published results in the AI literature and come with some uncertainty. The authors expect the estimates to be correct within a factor of 10.



Janus, God of Duality

Technology is a transition, the abandonment of old ways to give rise to new ones.

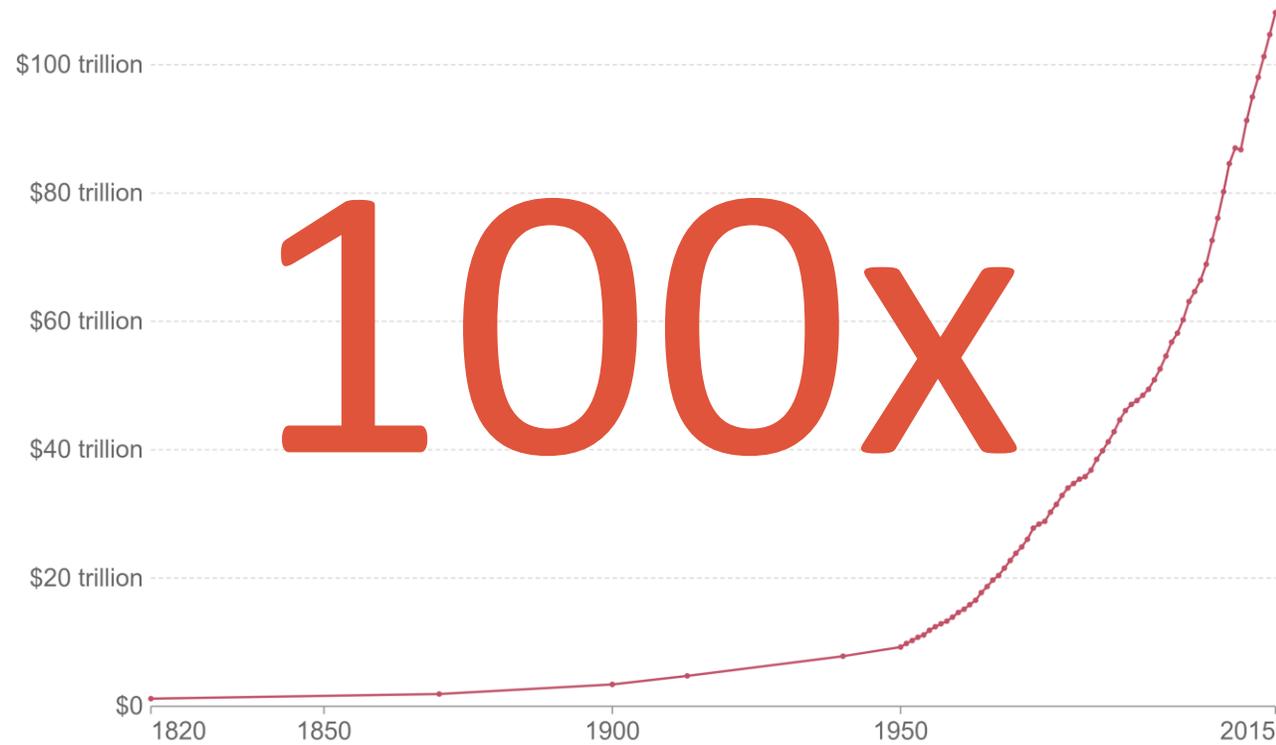
A process of **creative destruction**



Technology has two faces

## World GDP Since the Industrial Revolution

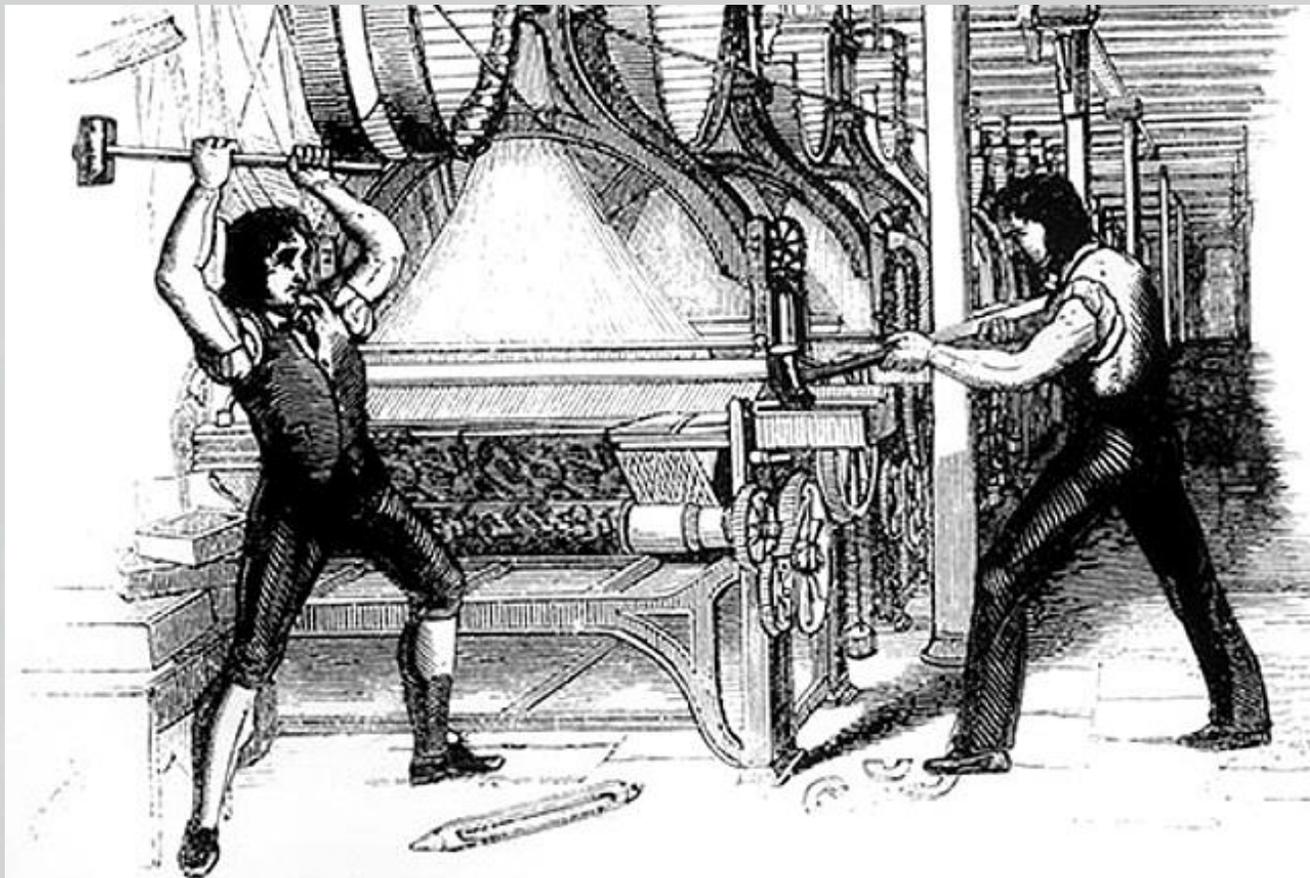
Our World  
in Data



Source: World GDP - Our World In Data based on World Bank & Maddison (2017)

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**TECHNOLOGY** has delivered  
**PROSPERITY**



Rage against the machine

But also lead to exclusion and  
benefits for few

Is technology *increasing productivity* but  
*raising income disparities* in the EU?



**Exposure to technological change**  
(exogenous to firm)

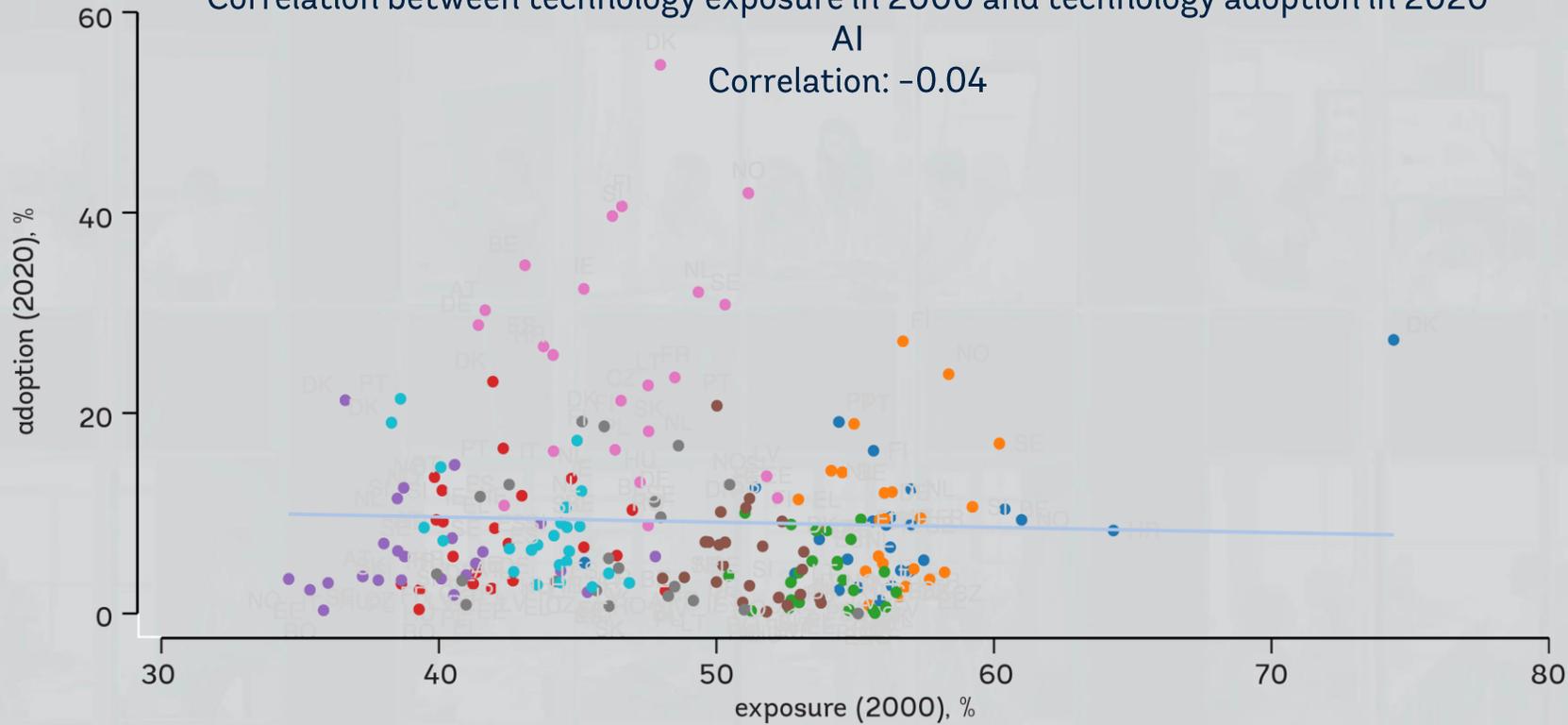


**Adoption**

**FIRMS**

**Firms mediate the impact of  
technological progress on inequality.**

Correlation between technology exposure in 2000 and technology adoption in 2020



## Enablers of technology adoption

1. Access to finance
2. Business environment
3. Human capital
4. Managerial practices

- Manufacturing
- Electricity, gas, steam, and water
- Construction
- Wholesale trade
- Transportation and storage
- Accommodation and food service
- Information and communication
- Real estate
- Professional, scientific, and technical activities
- Administrative and support activities
- Fitted values

# Exposure does not translate into adoption

Exposure to technological change  
(exogenous to firm)



Adoption

FIRMS

(reoptimize the production process)

Once firms adopt new technologies, they re-optimize their production function

# Technology Adoption



**Firms-level data shows that adopting technology increases productivity and total sales**

Large and more  
productive firms adopt  
more technology

Technology adoption  
increases productivity  
and firm size.

↑ Capital “K”



Labor “L”

Exposure to technological change  
(exogenous to firm)



Adoption

**FIRMS**  
(reoptimize the production process)



*Change Tasks*

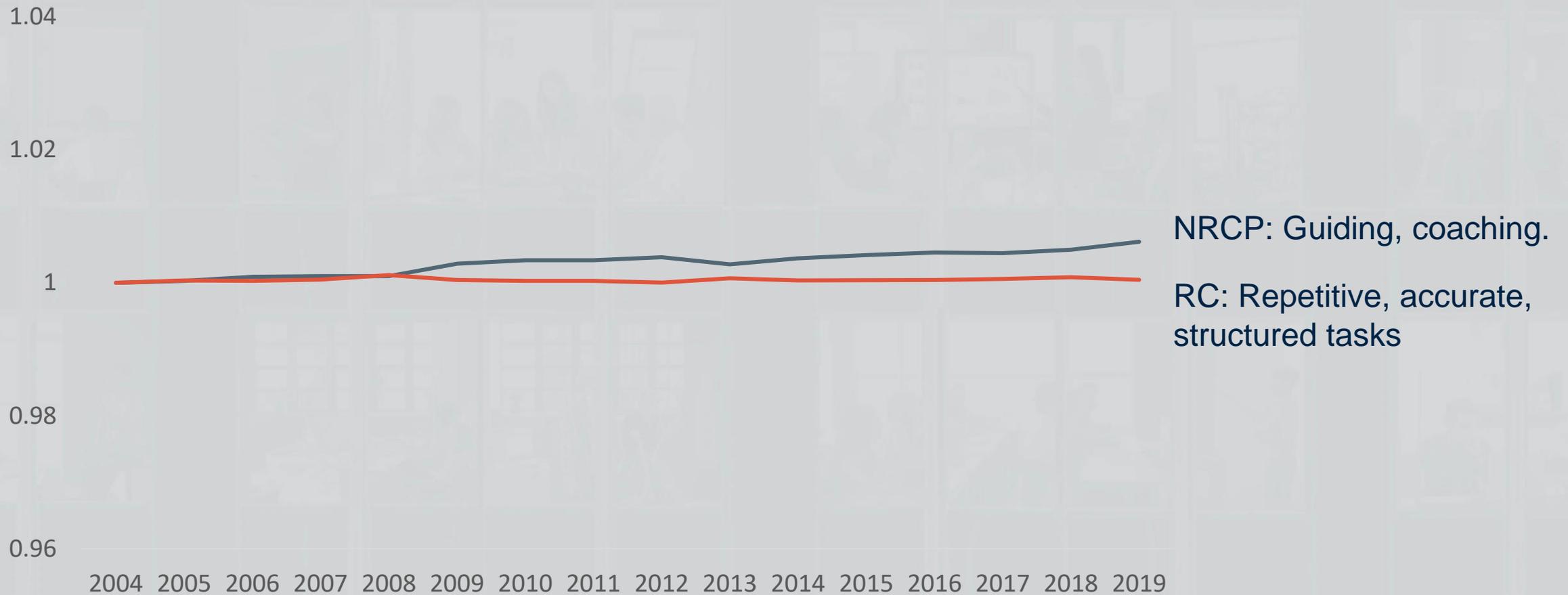
*Destroy / create Tasks*



Change in demand for  
different skills

Firms adopting new technology,  
change tasks, and demand for skills

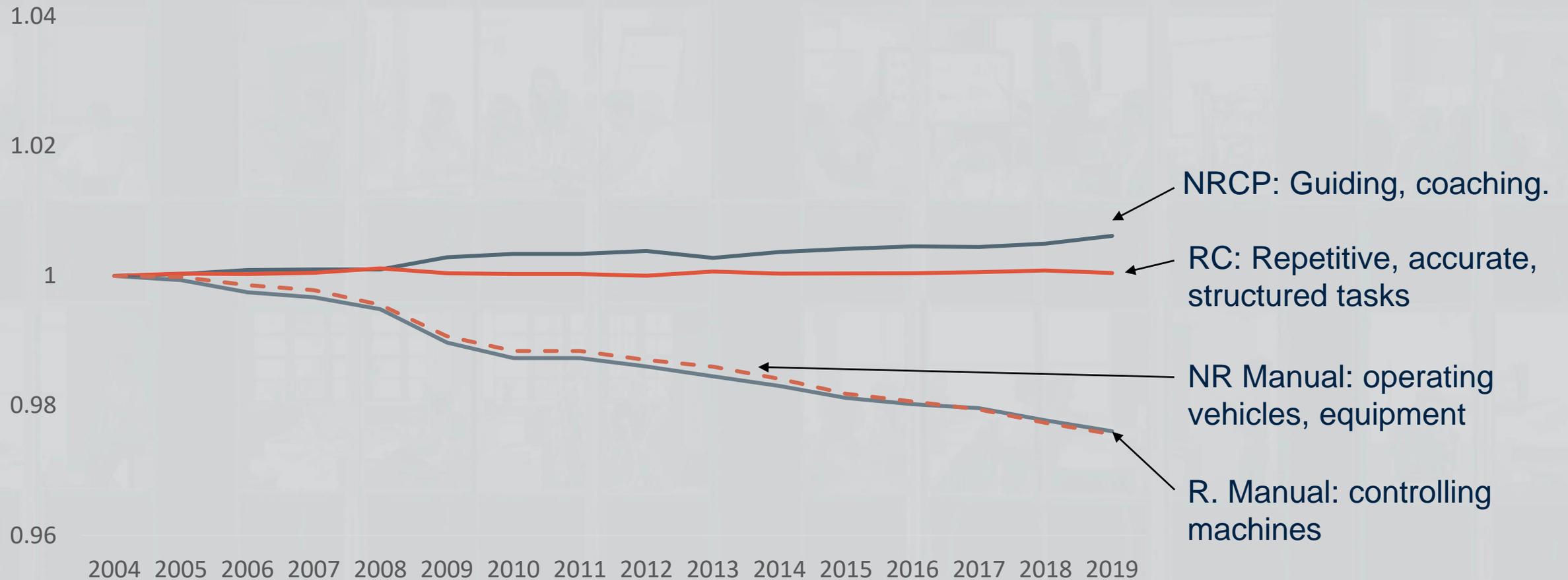
## Overall employment - all age groups



Source: "The future of work: Implications for Equity and Growth in Europe", forthcoming, The World Bank

The task content of jobs in the EU-27 has changed over the last 20 years.

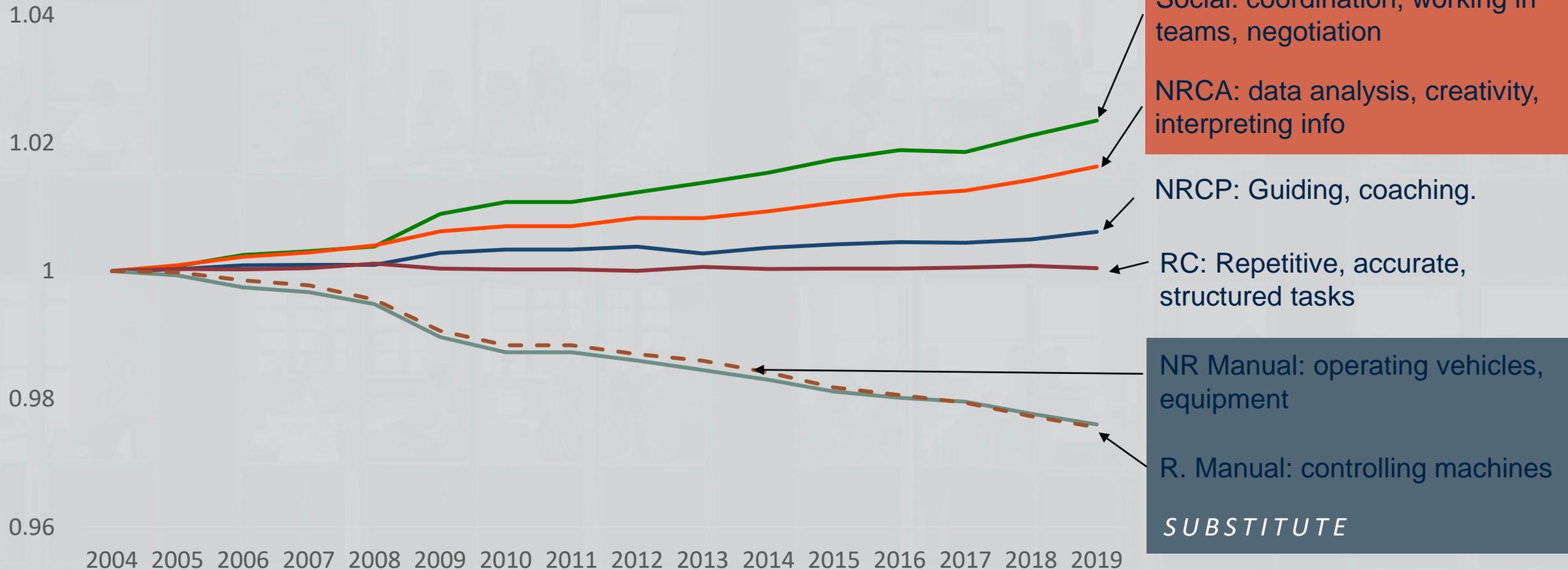
## Overall employment - all age groups



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The task content of jobs in the EU-27 has changed over the last 20 years.

## Overall employment - all age groups



### COMPLEMENT

Social: coordination, working in teams, negotiation

NRCA: data analysis, creativity, interpreting info

NRCP: Guiding, coaching.

RC: Repetitive, accurate, structured tasks

NR Manual: operating vehicles, equipment

R. Manual: controlling machines

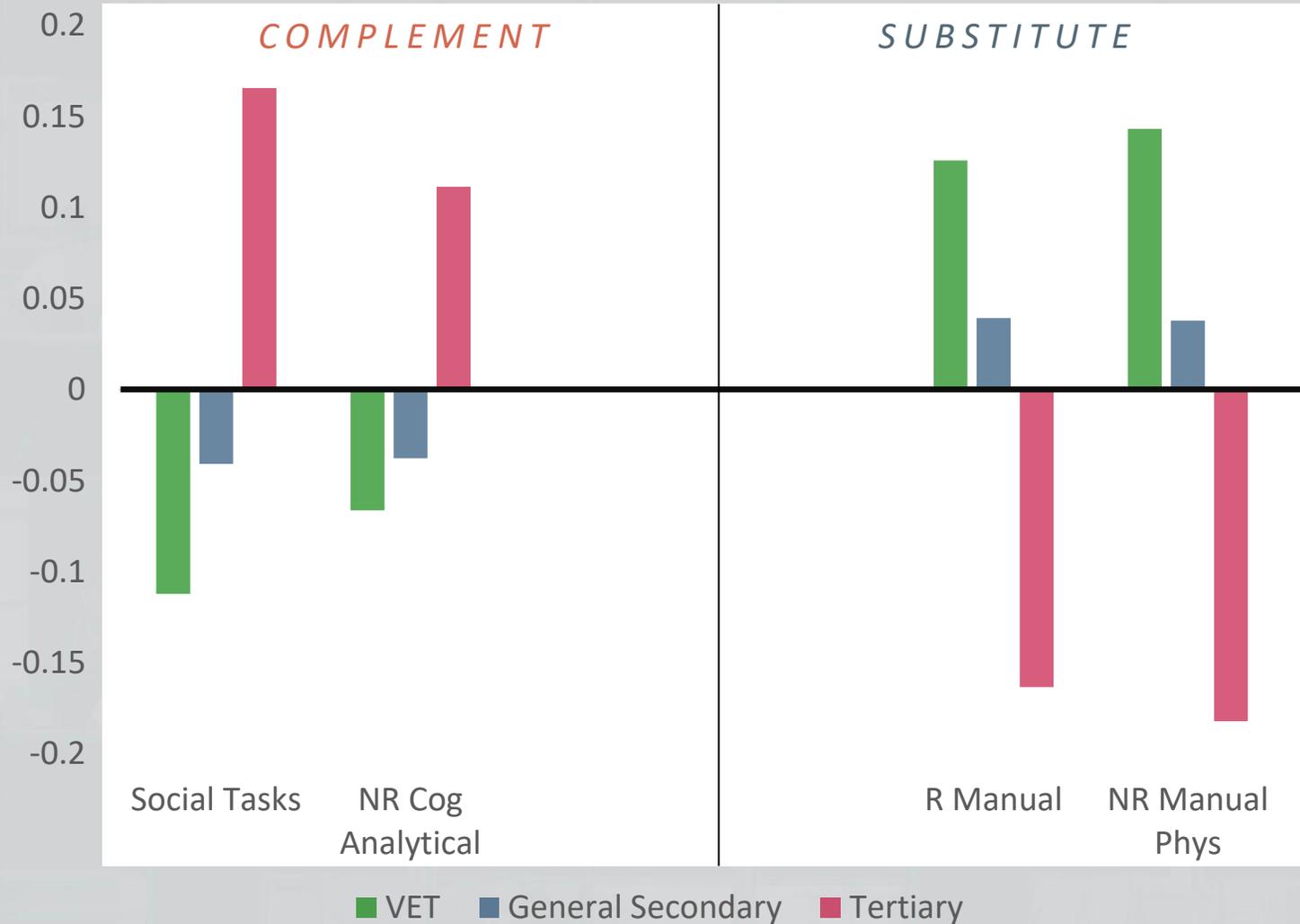
### SUBSTITUTE

2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

Source: "The future of work: Implications for Equity and Growth in Europe", forthcoming, The World Bank

# The task content of jobs in the EU-27 has changed over the last 20 years.

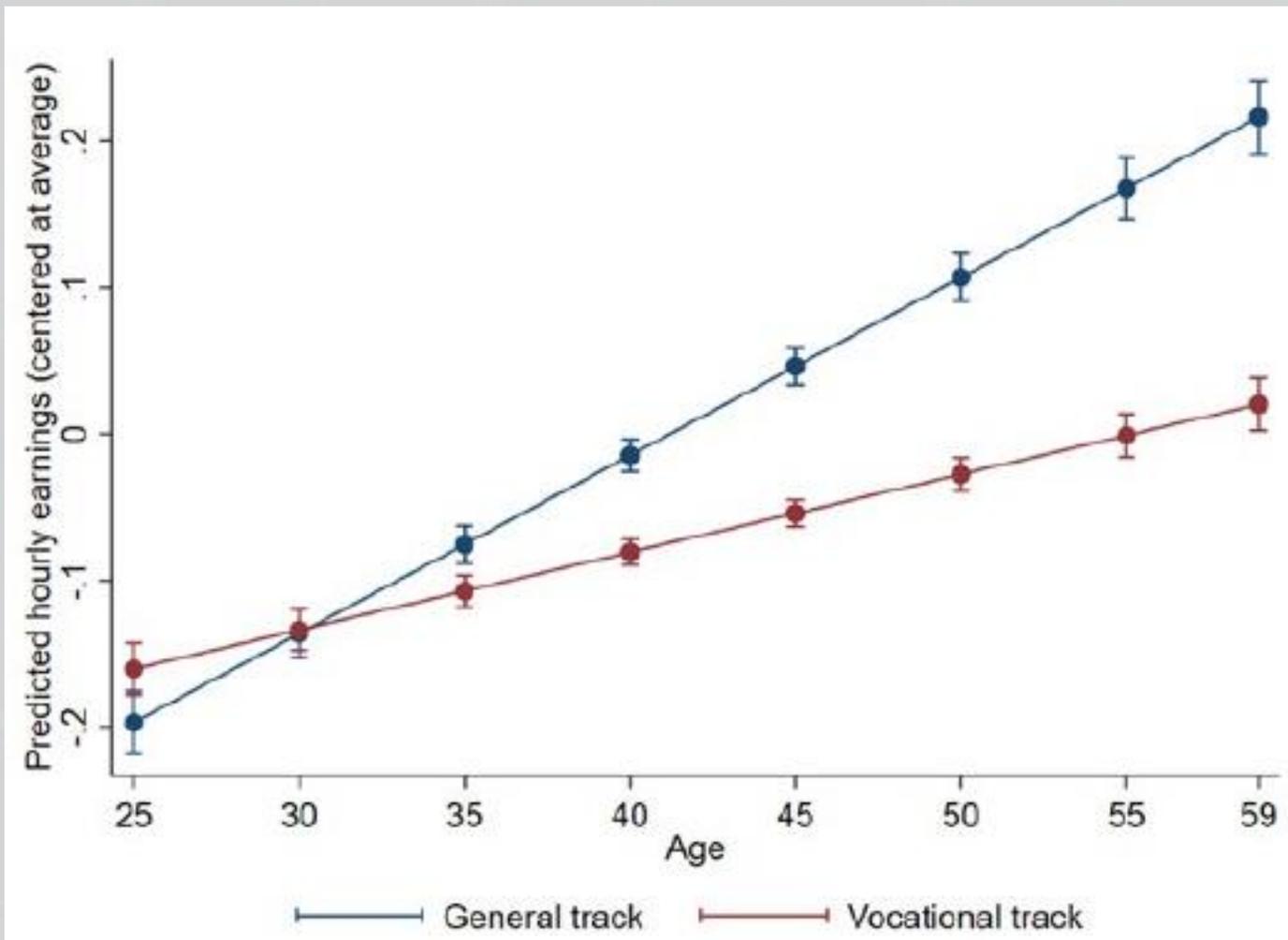
Task intensity of jobs performed by different educational groups,  
19 EU countries, 2019



University graduates perform tasks that complement technology

VET graduates don't seem to perform technology-driven tasks.

Workers with a university degree in EU-27 have skills that allow them to perform tasks that complement technology



Source: author's estimations using data from PIAAC

VET graduates enjoy a labor market advantage vs general secondary graduates, but it reverses after a few years.



Workers with higher education degrees

Technology Adoption



Workers lower levels of skills

Technology increases labor market disparities

Technology adoption increases non-routine cognitive tasks and the demand for skills



Technological progress increases GDP  
but exacerbates “distributional tensions”

Can we **benefit from technology** and avoid (or at least mitigate) the adverse **distributional effects**?

Large and more  
productive firms adopt  
more technology

Promote technology  
adoption, especially  
among smaller firms

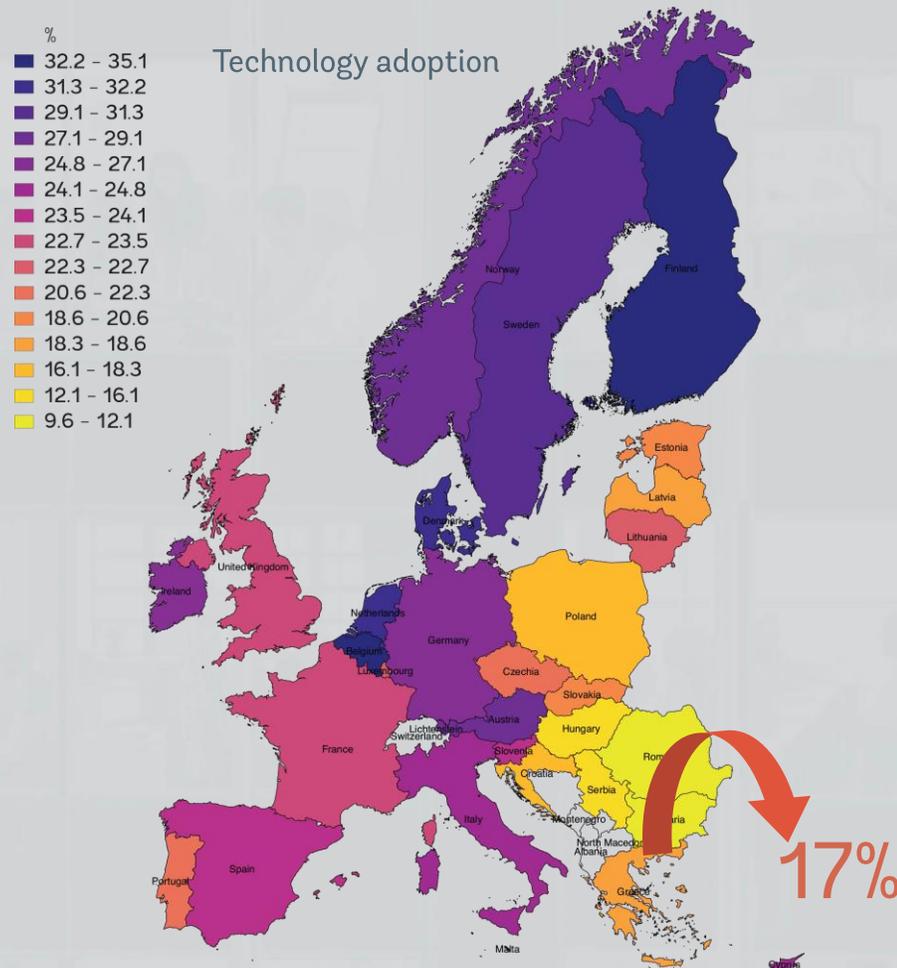
Technology adoption  
increases productivity  
and firm size.

**Human Capital**

**Managerial Skills**

**Access to finance**

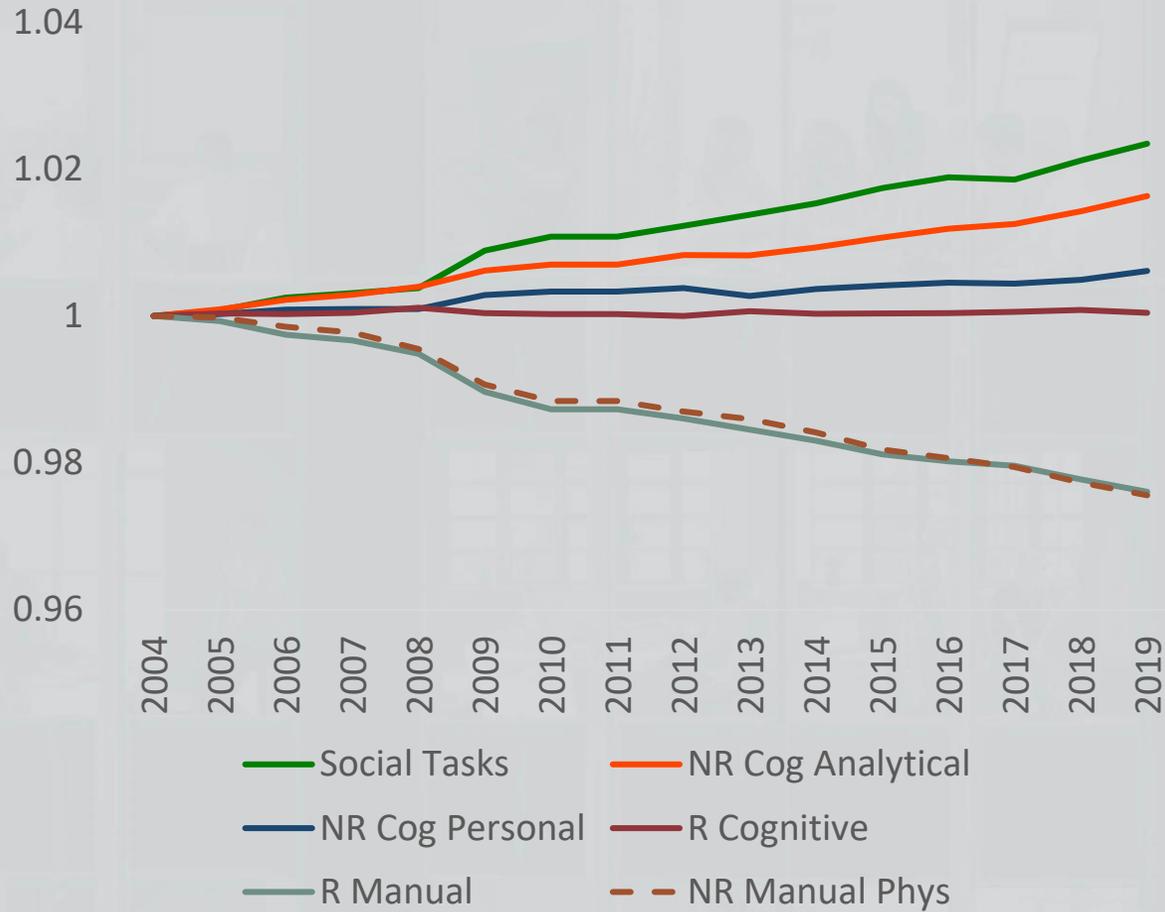
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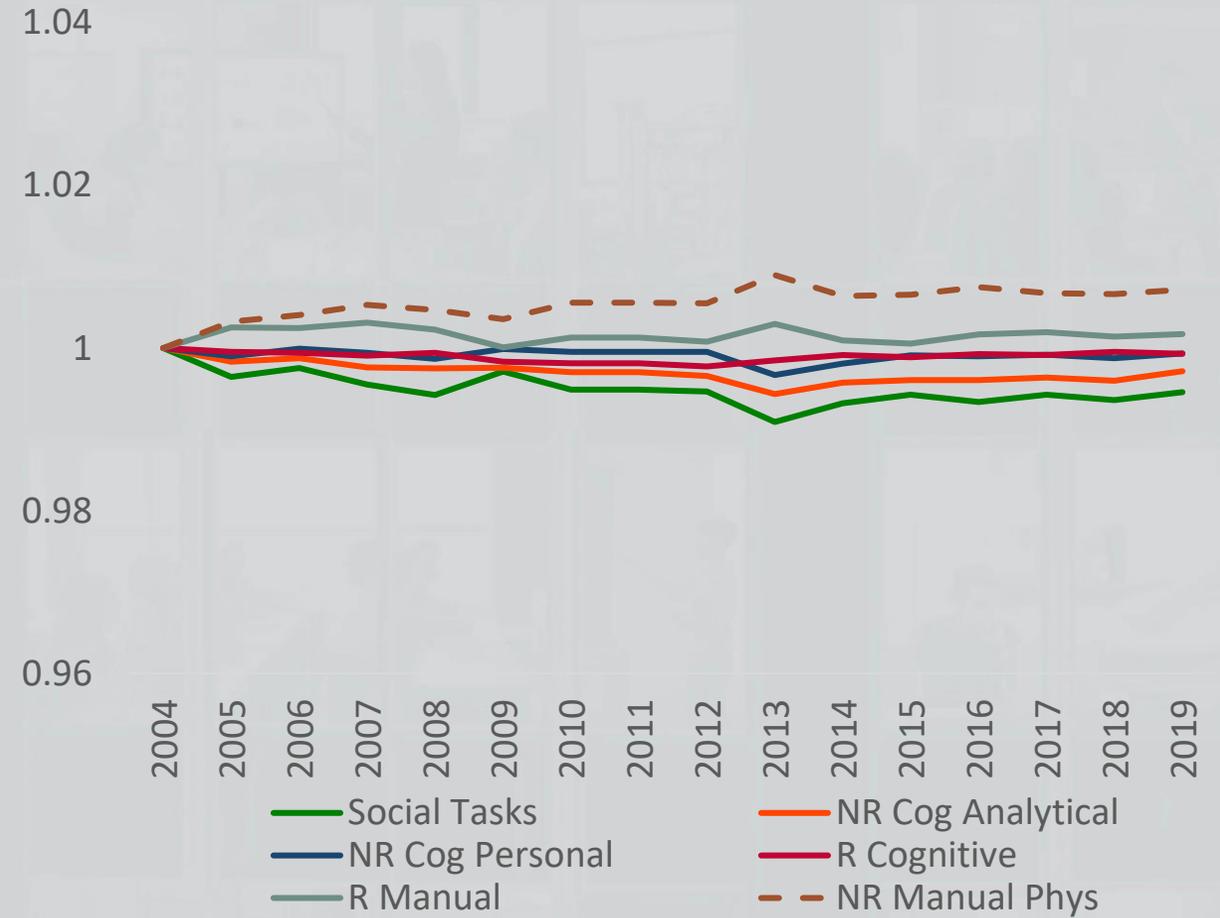
Source: “The future of work: Implications for Equity and Growth in Europe”, forthcoming, The World Bank

The EU has ample space for **increasing productivity** through **technology adoption**

Overall employment - all age groups



VET graduates - all age groups



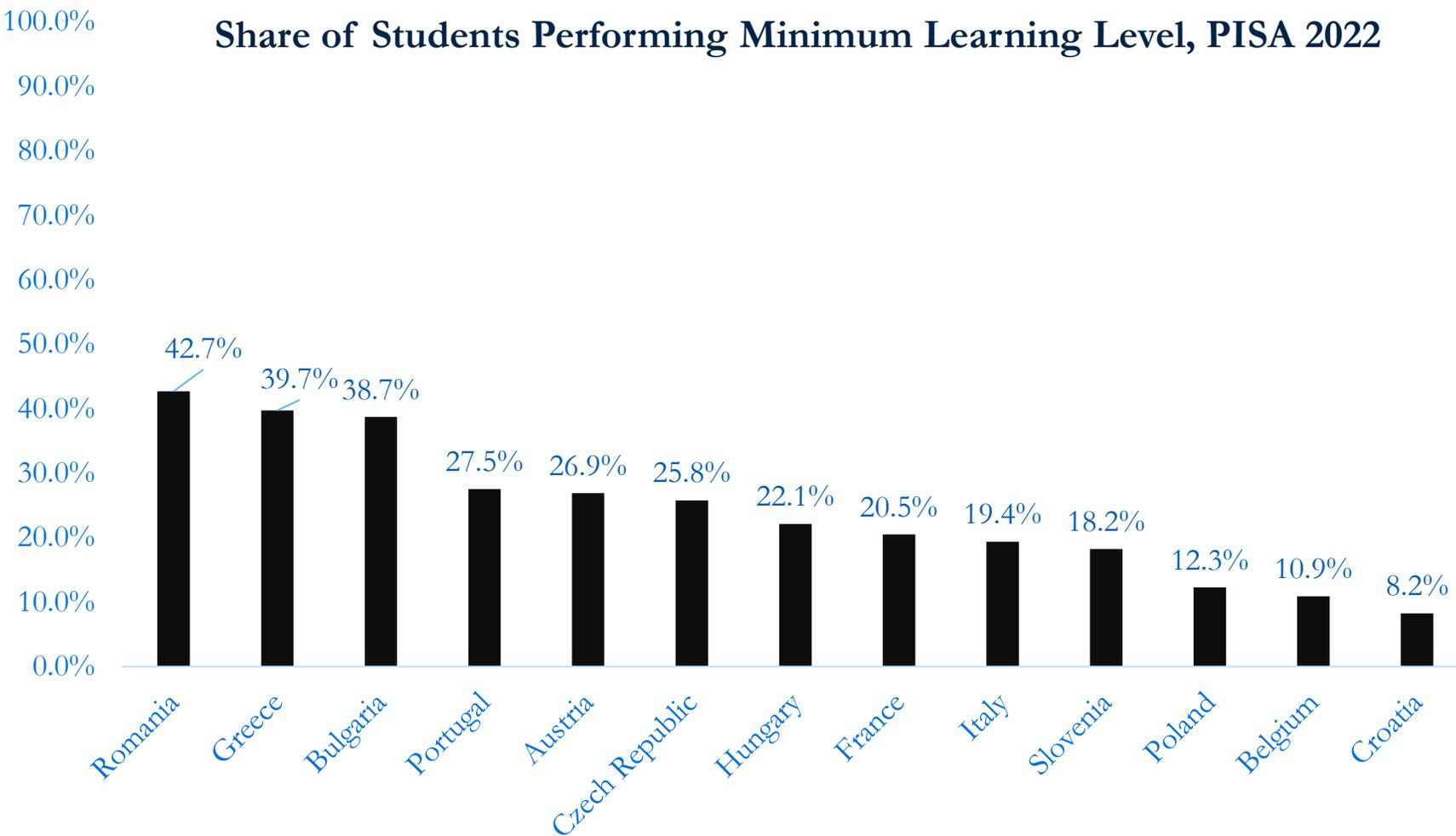
The task content of jobs among VET graduates have not changed much in the last 20 years

Top performers in numeracy and literacy do more social and non-routine tasks.



This is partly explained by VET graduates' low numeracy and literacy skills.

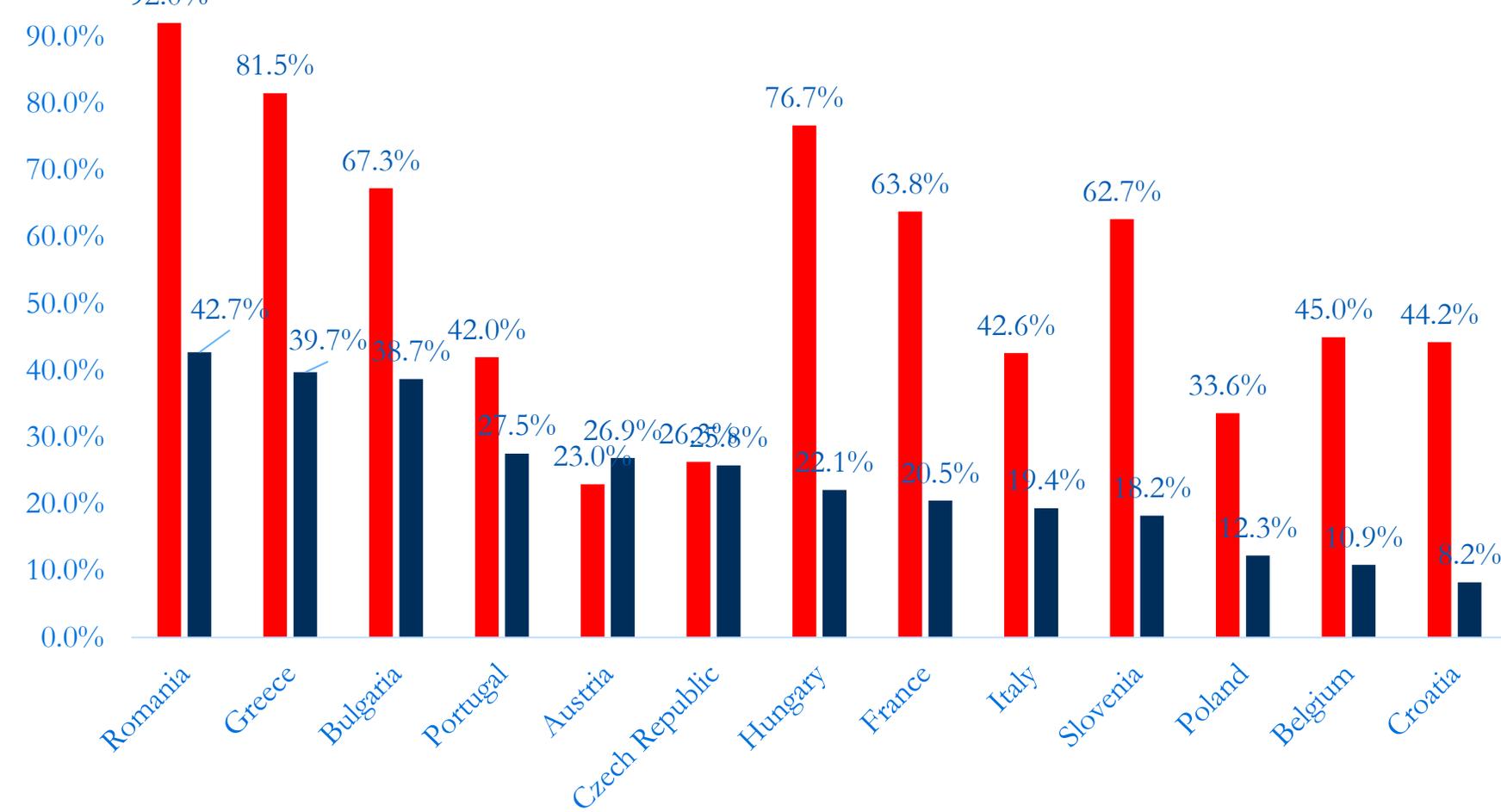
## Share of Students Performing Minimum Learning Level, PISA 2022



General Secondary

Ensuring minimum foundational skills—including social skills—is a critical challenge to promote technology adoption and equity.

## Share of Students Performing Minimum Learning Level, PISA 2022



Eliminating these shares would promote technology adoption, enhance productivity, and reduce income disparities.

**General Secondary**

**Vocational Secondary**

Ensuring minimum foundational skills—including social skills—is a critical challenge to promote technology adoption and equity.

“In order to keep up with the world of 2050, you will need not merely to invent new ideas and products – you will above all need to reinvent yourself again and again.”

Yuval Noah Harari

# The need to rethink VET systems

- More dynamic labor markets
- New occupations and jobs
- Shorter job tenures

The “future of work” is about reinventing oneself, and for this, foundational skills (including soft skills) are critical

From “**creative destruction**” to  
“**inclusive innovation**”

*“The notion of thinking about the future as a prediction exercise neglects the fact that the future is a creative exercise—it is something that we are building.”*

David Autor



# Thanks!



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