

BANK OF ENGLAND

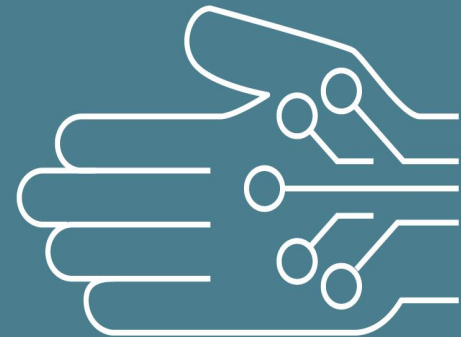
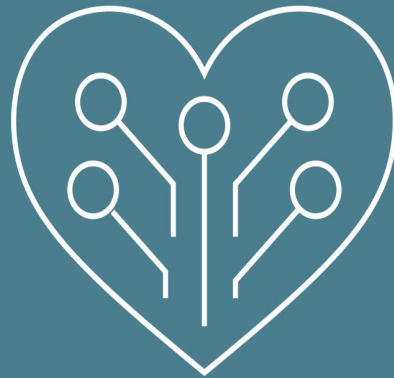
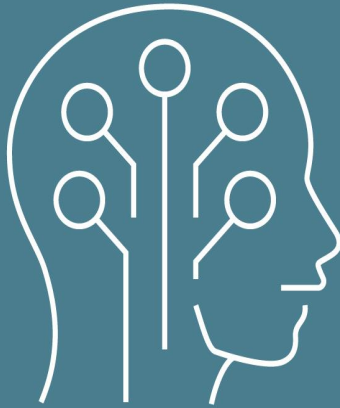
AI and the Global Economy

Machine Learning and the Market for Intelligence Conference
Rotman School of Management, University of Toronto

Mark Carney
Governor, Bank of England

23 October 2018

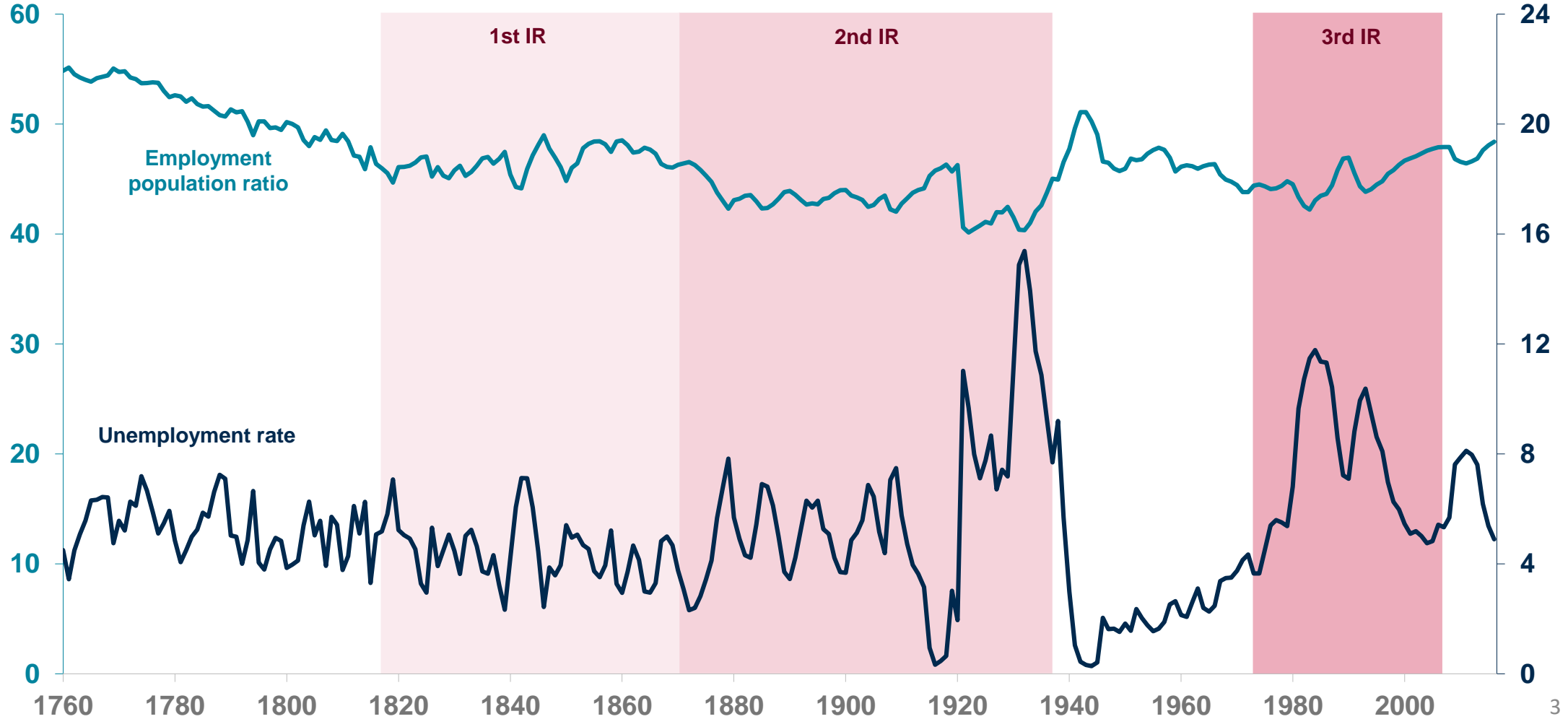
Potential Macro Impacts of AI



Little evidence of technological unemployment over long term

Employment population ratio
(per cent)

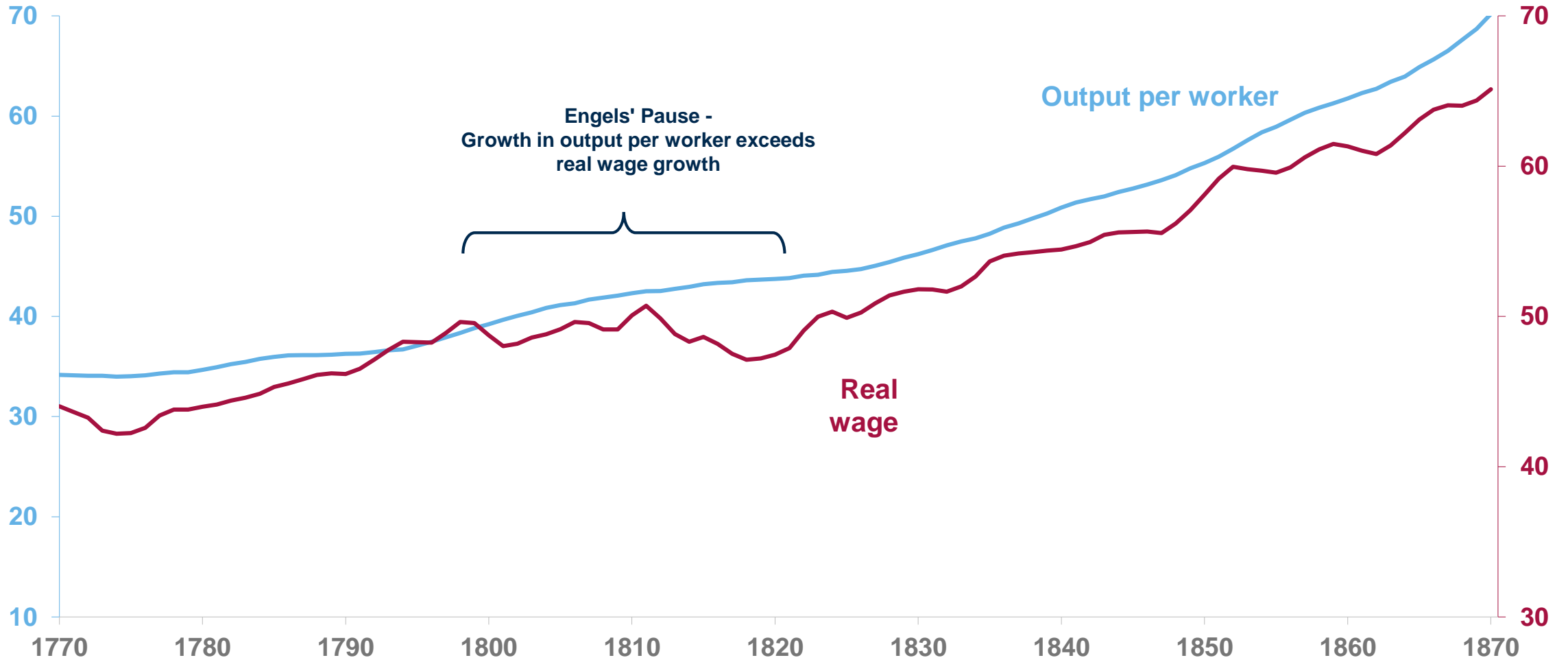
Unemployment rate
(per cent)



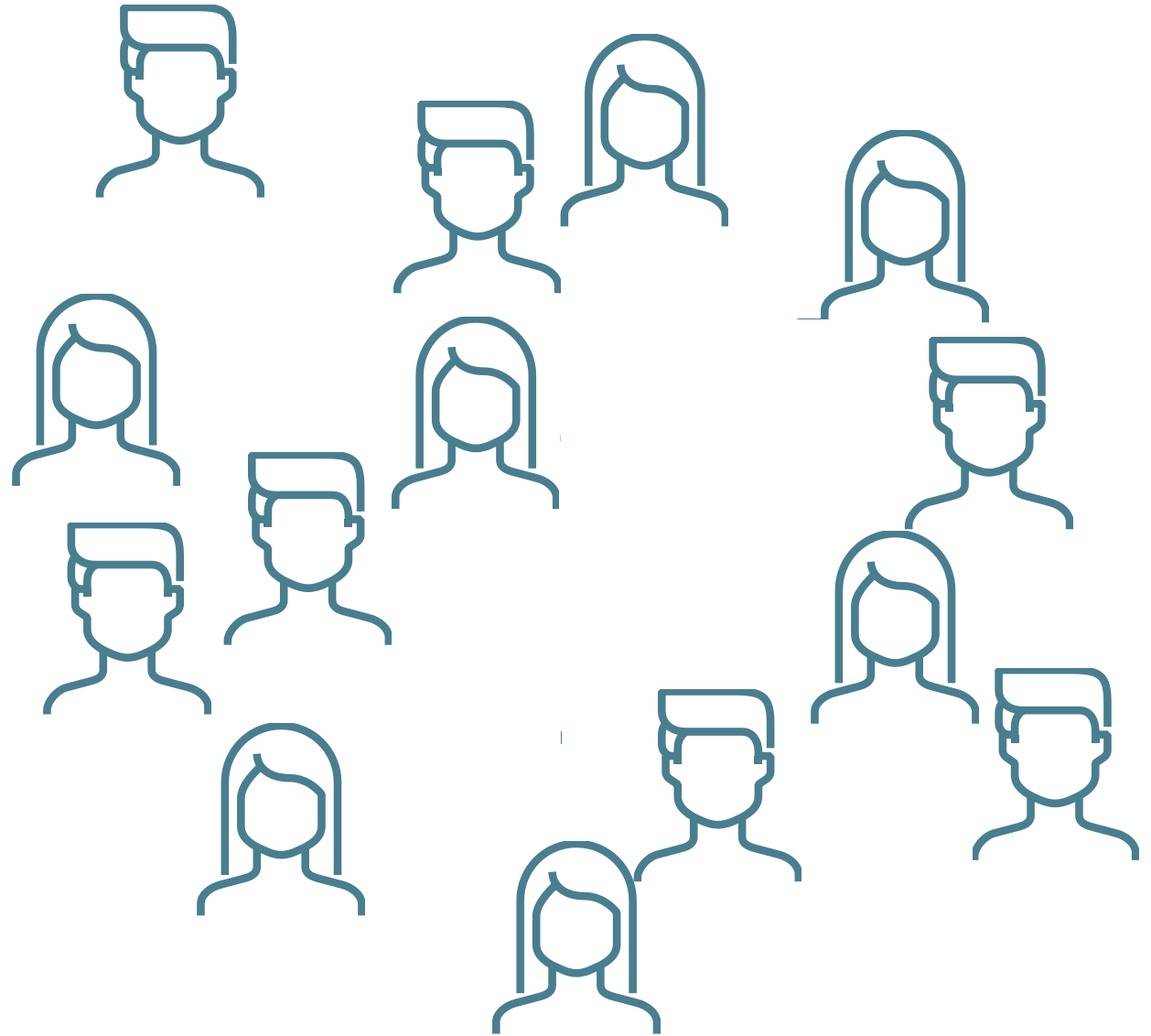
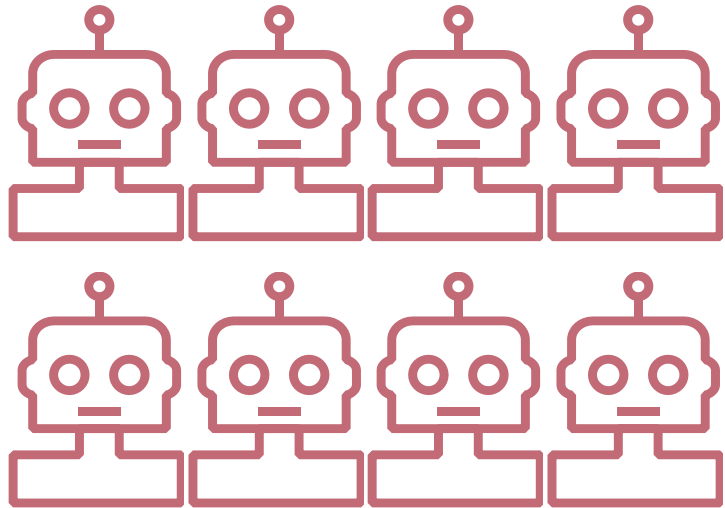
But pickup in real wages lagged productivity during 1st IR

Output per worker
(Index: 1900 = 100)

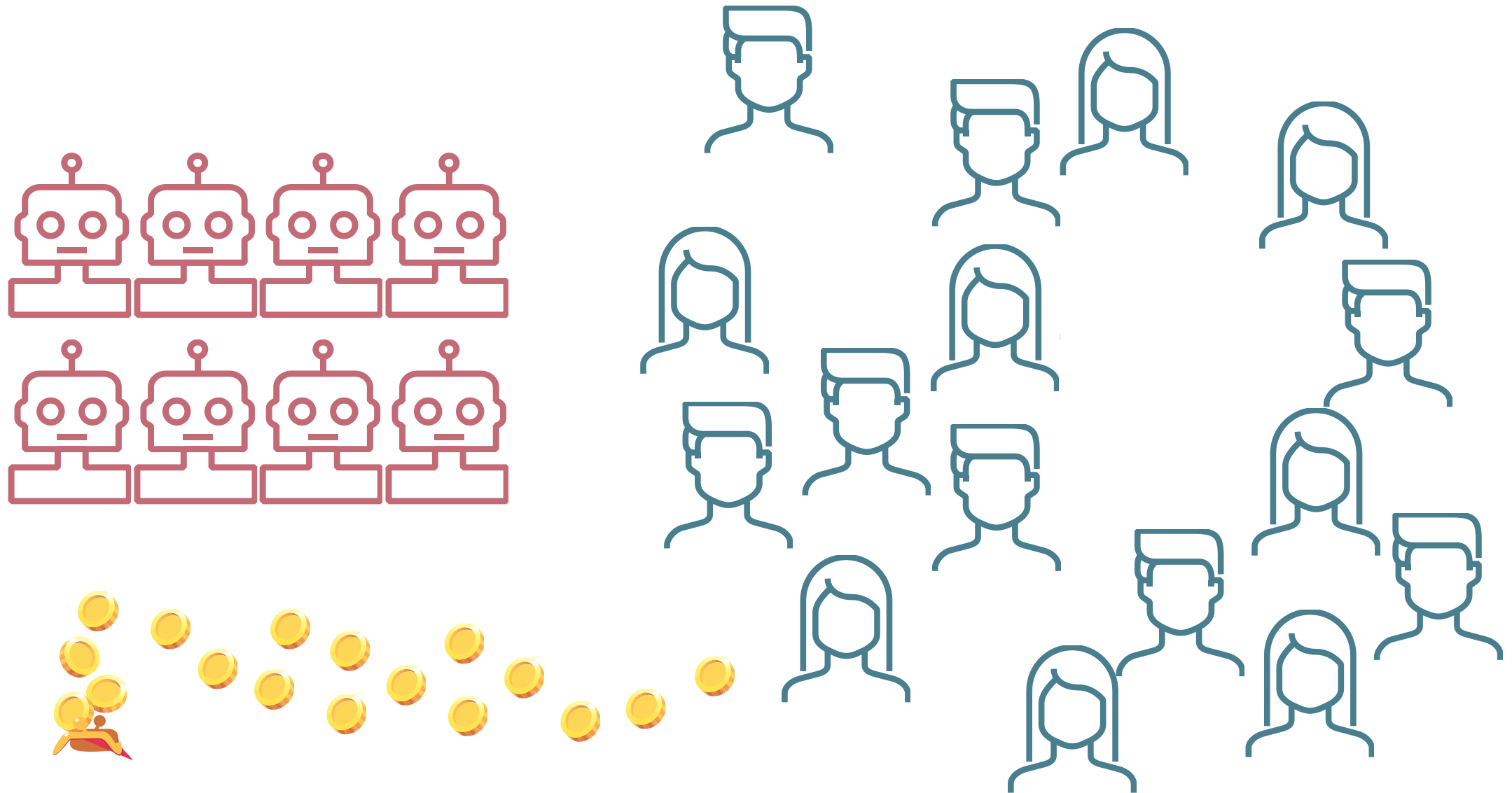
Real wage
(Index: 1900 = 100)



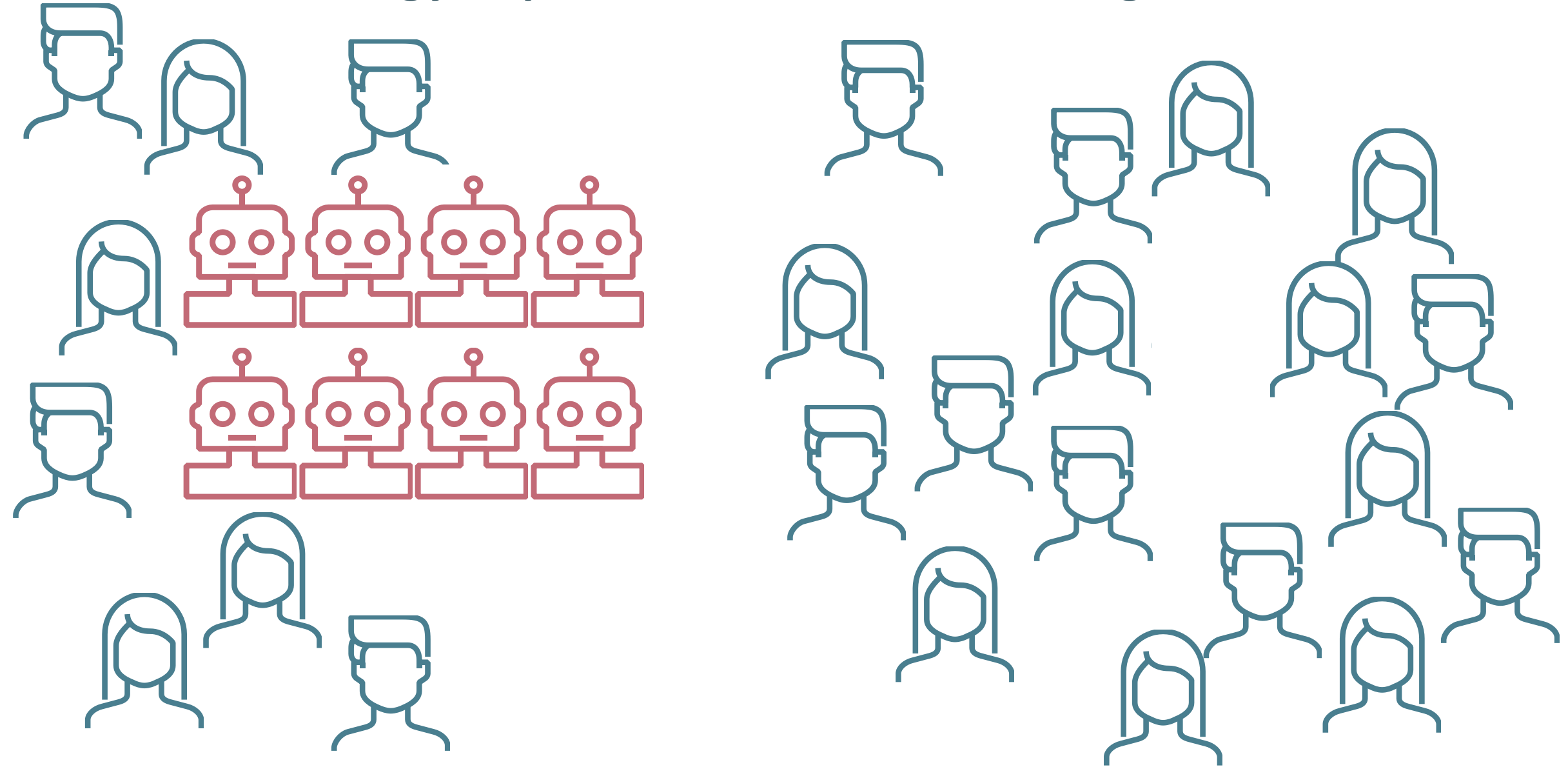
Technology affects labour market through **destruction...**



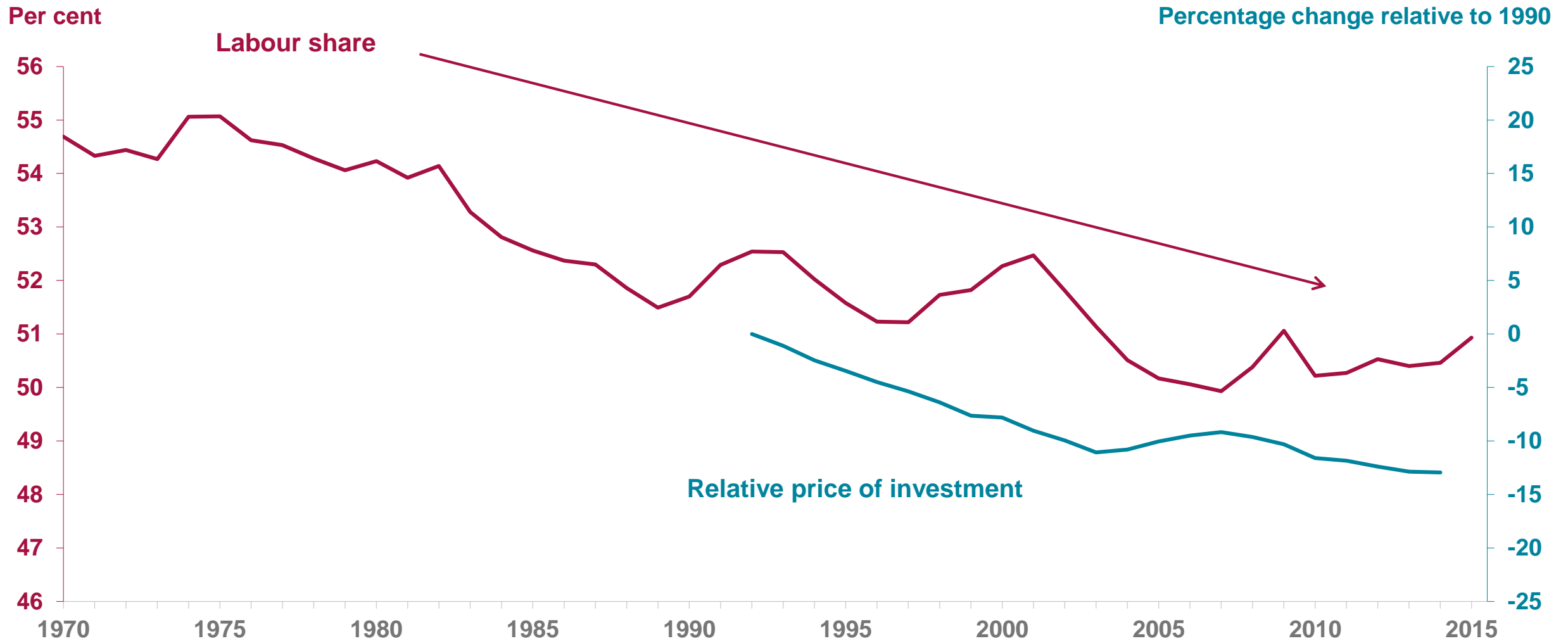
Technology affects labour market through productivity...



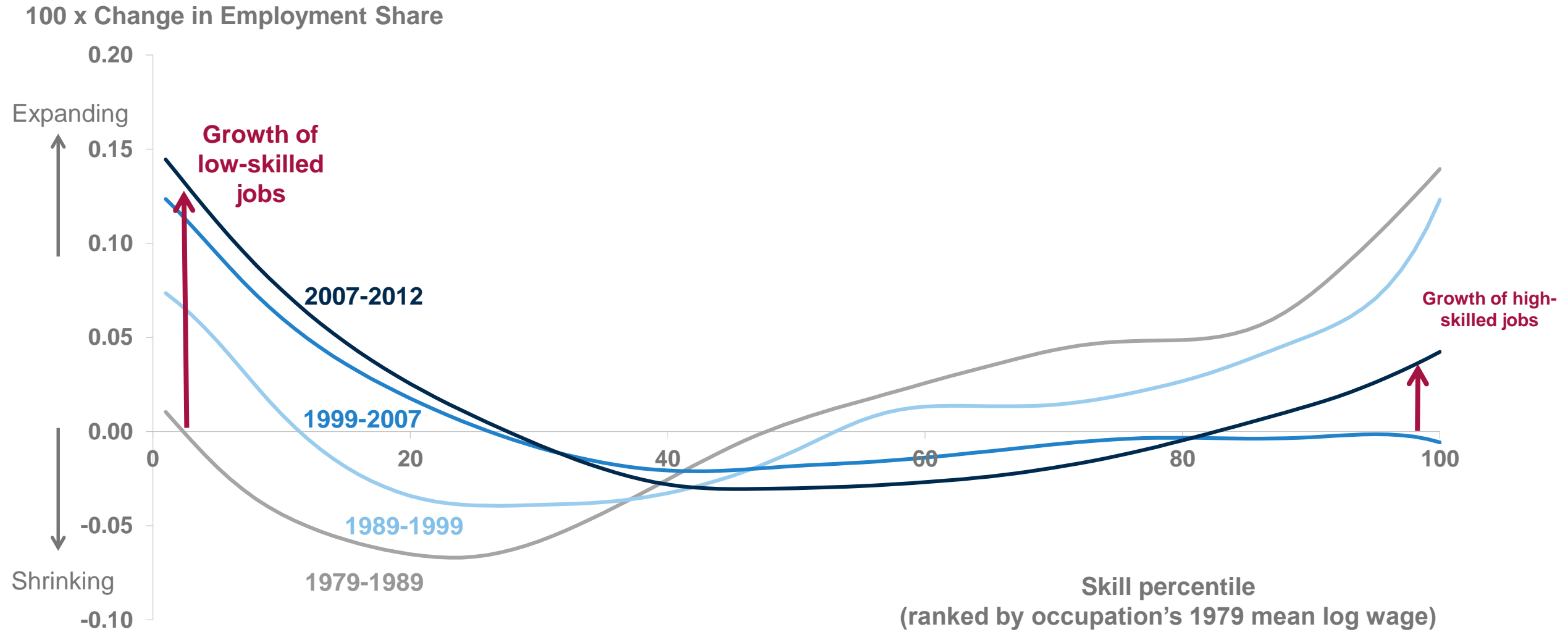
Technology impacts labour market through **creation...**



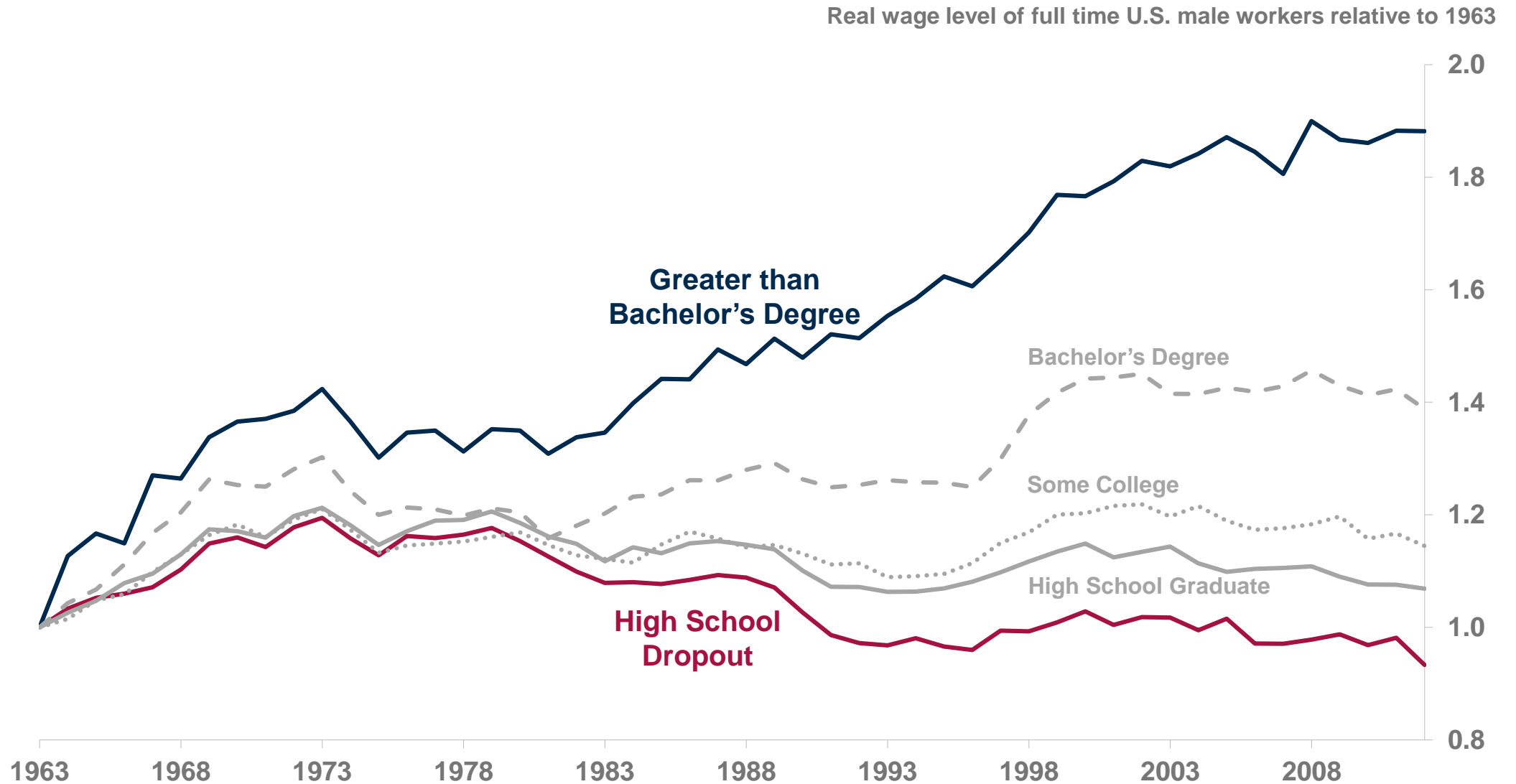
Technology drove labour share down globally during 3rd IR



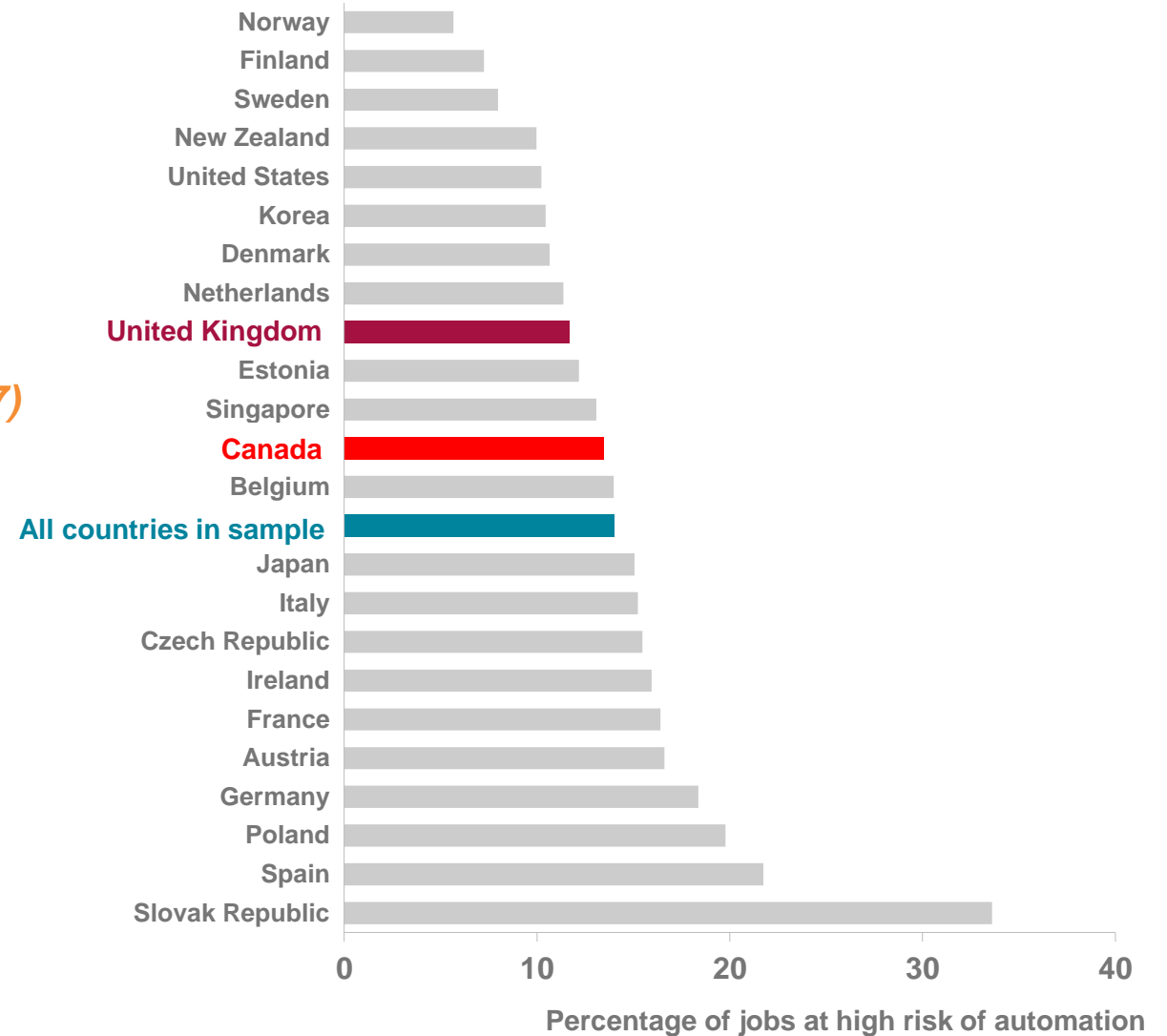
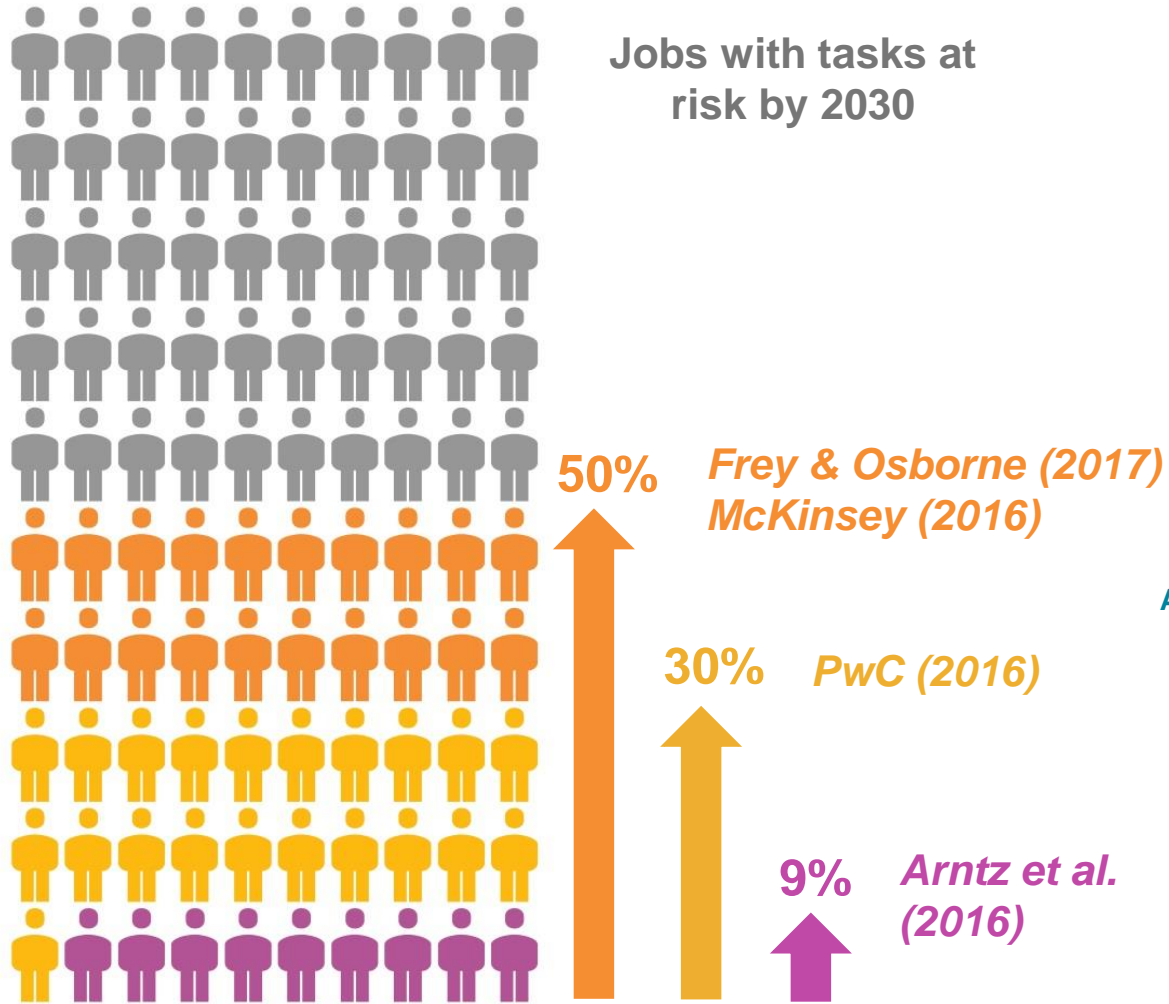
Technology polarising labour market



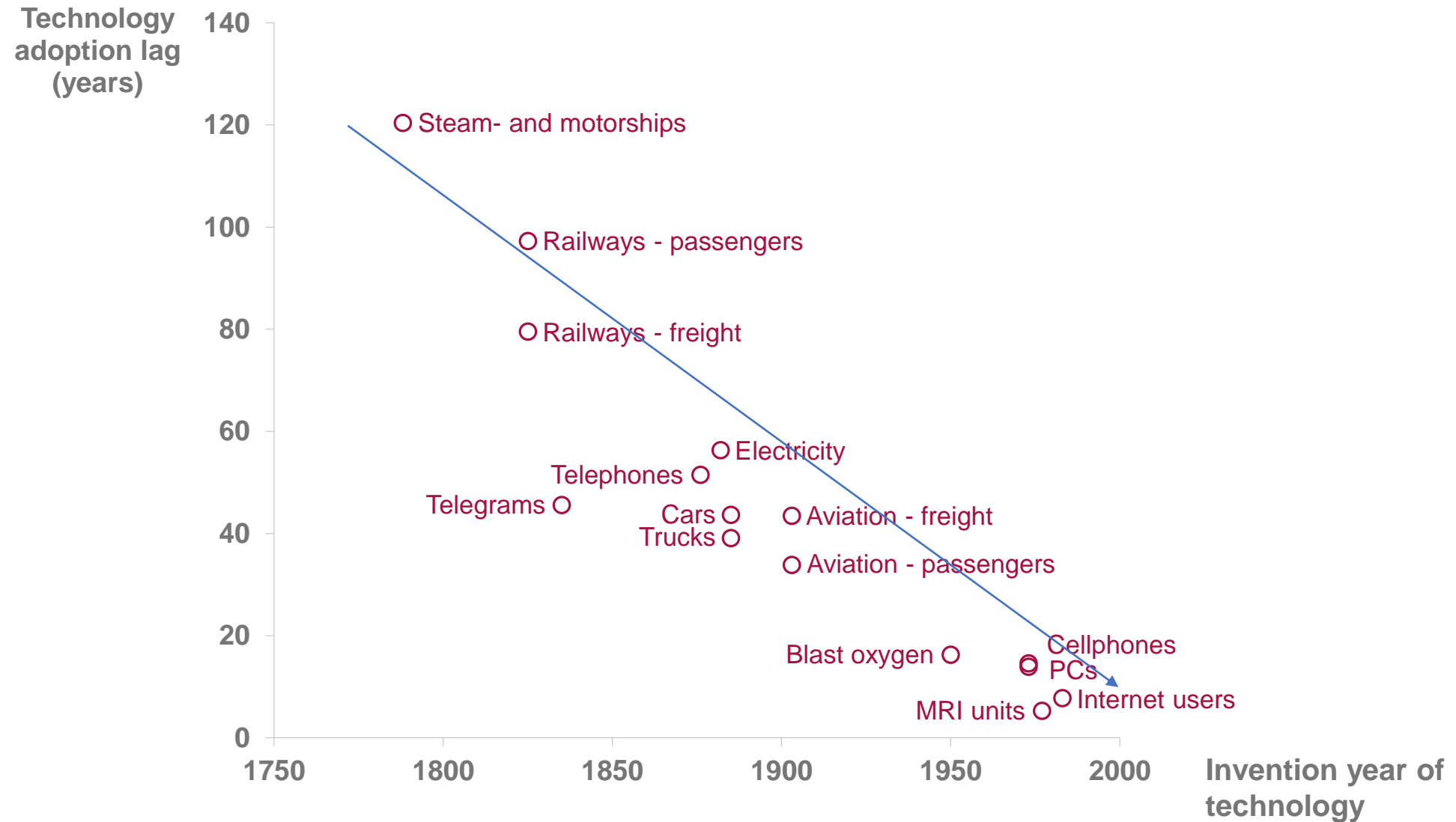
Technology polarising labour market



Jobs with tasks at risk of automation: huge range of estimates



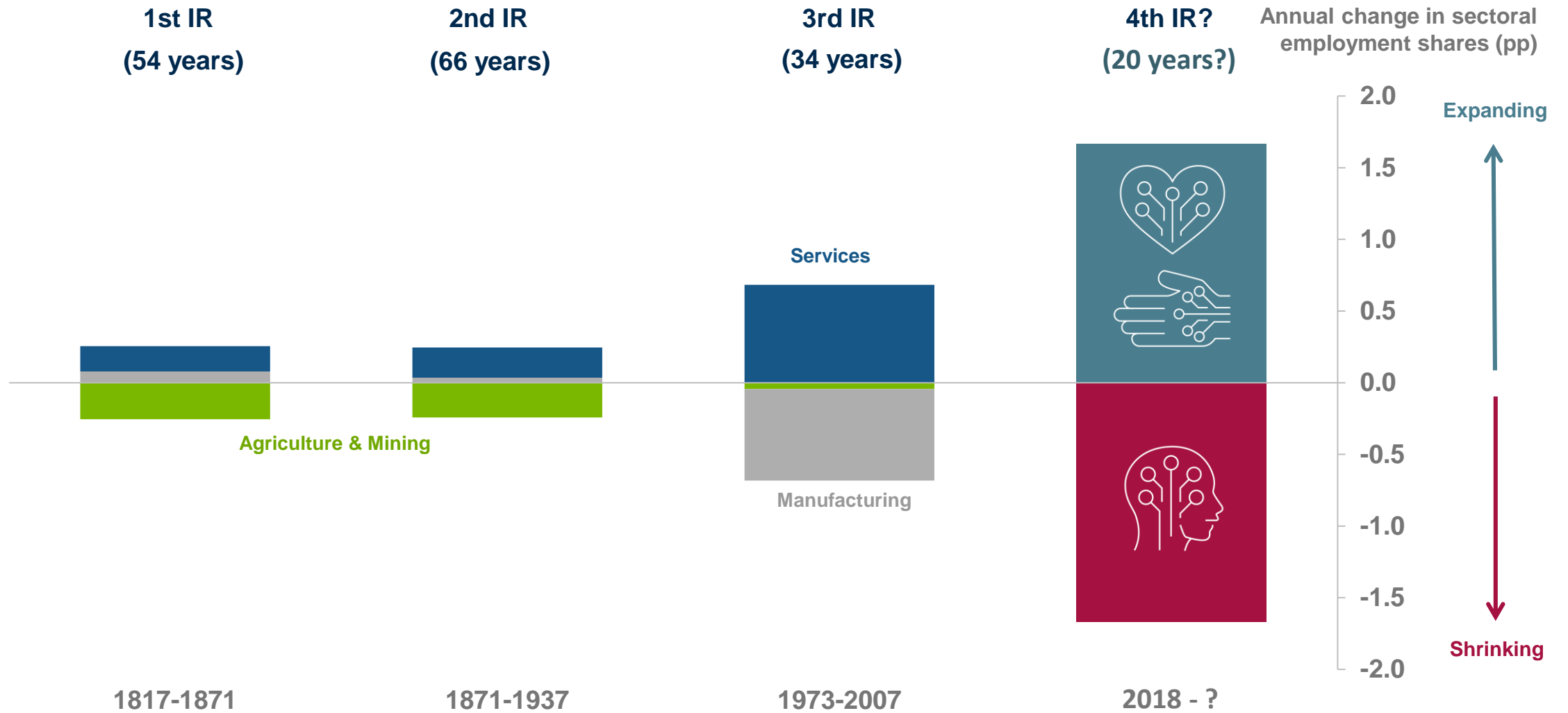
Technology adoption accelerating



Notes: Technology adoption lag is a mean estimated lag in cross-country technology diffusion.

Source: Comin, D and Hobijn, B (2010), 'An exploration of technology diffusion', *American Economic Review*, Vol. 100, No. 5, pp2031-59.

This time it's faster?



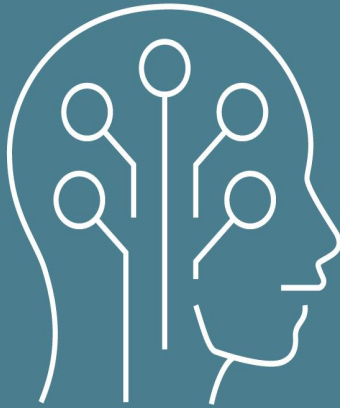
What has been done in previous Industrial Revolutions

Institution	Effect	Examples
Enabling institutions	Transform the skill base of workers	Spread of primary, secondary, tertiary and technical education
New insurance institutions	Support those displaced	Unemployment insurance, universal healthcare, state pensions, child benefit
Labour market institutions	Provide income support and share out the surplus	Friendly Societies, Trade Unions, Co-operatives, minimum wages
Employers	Create environments to help employees thrive	“Model Villages” (providing housing, schooling and recreation), higher pay (Ford’s \$5 initiative), occupational pensions

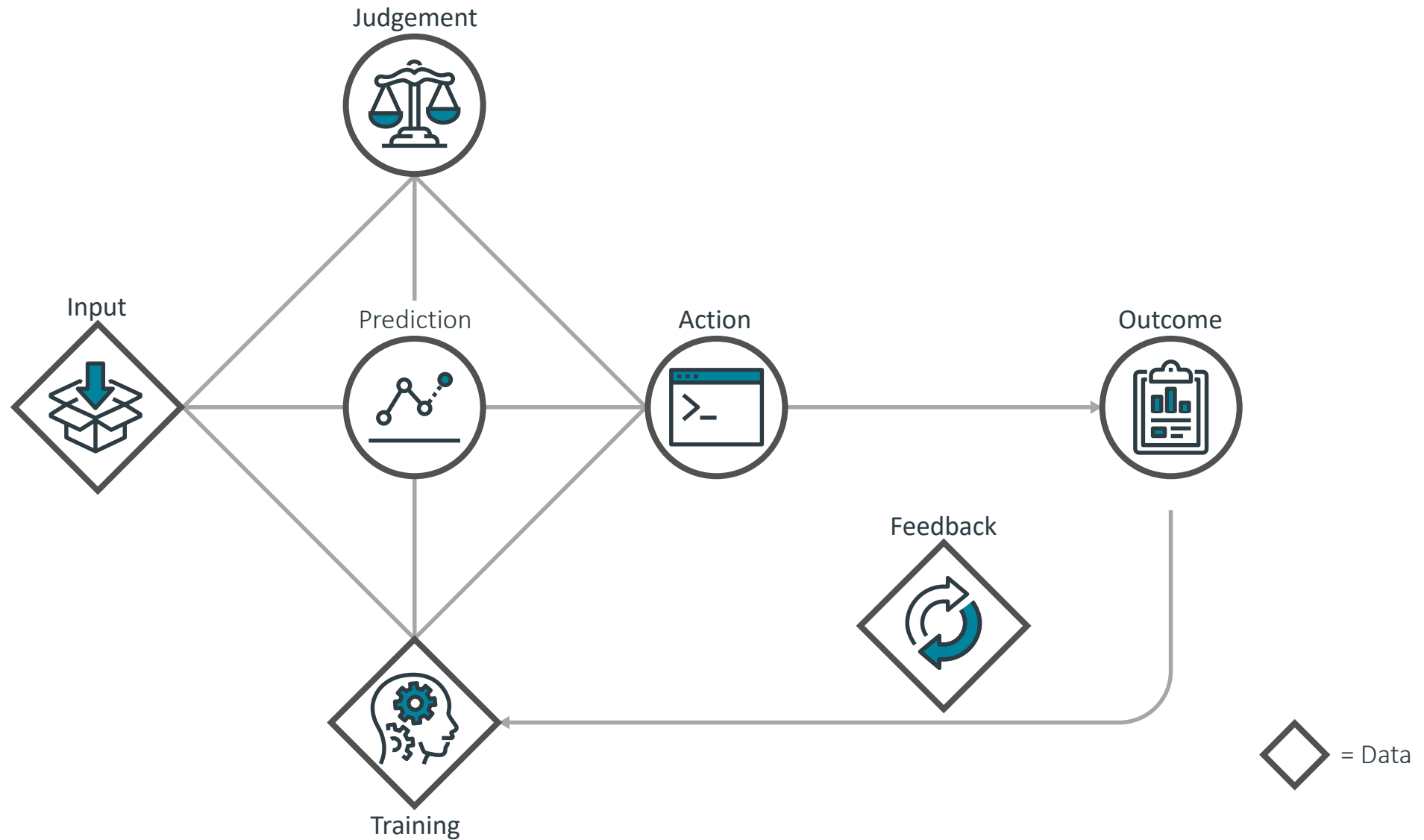
What could be done in the 4th IR

Institution	Solution
Business	<ul style="list-style-type: none">• Identify skills mismatches, adopt anticipatory talent management to train workers• Explore opportunities to maximise job-creating, augmented intelligence
Labour market institutions	<ul style="list-style-type: none">• Balance labour mobility with protections of workers in new, non-standard jobs• Establish new class of “dependent contractor” for platform-based workers• Utilise tech solutions to match and bridge skills gaps• Make data portable (including reputational history of platform-based workers)
Enabling institutions	<ul style="list-style-type: none">• Quaternary education (mid-career, integrated with social welfare system)• Universal support schemes for retraining (UK’s Flexible Learning Fund)
Finance	<p>AI could potentially:</p> <ul style="list-style-type: none">• Improve customer choice, services and pricing• Increase access to credit for households and SMEs• Substantially lower cross border transaction costs• Improve diversity and resilience of the system

AI in finance

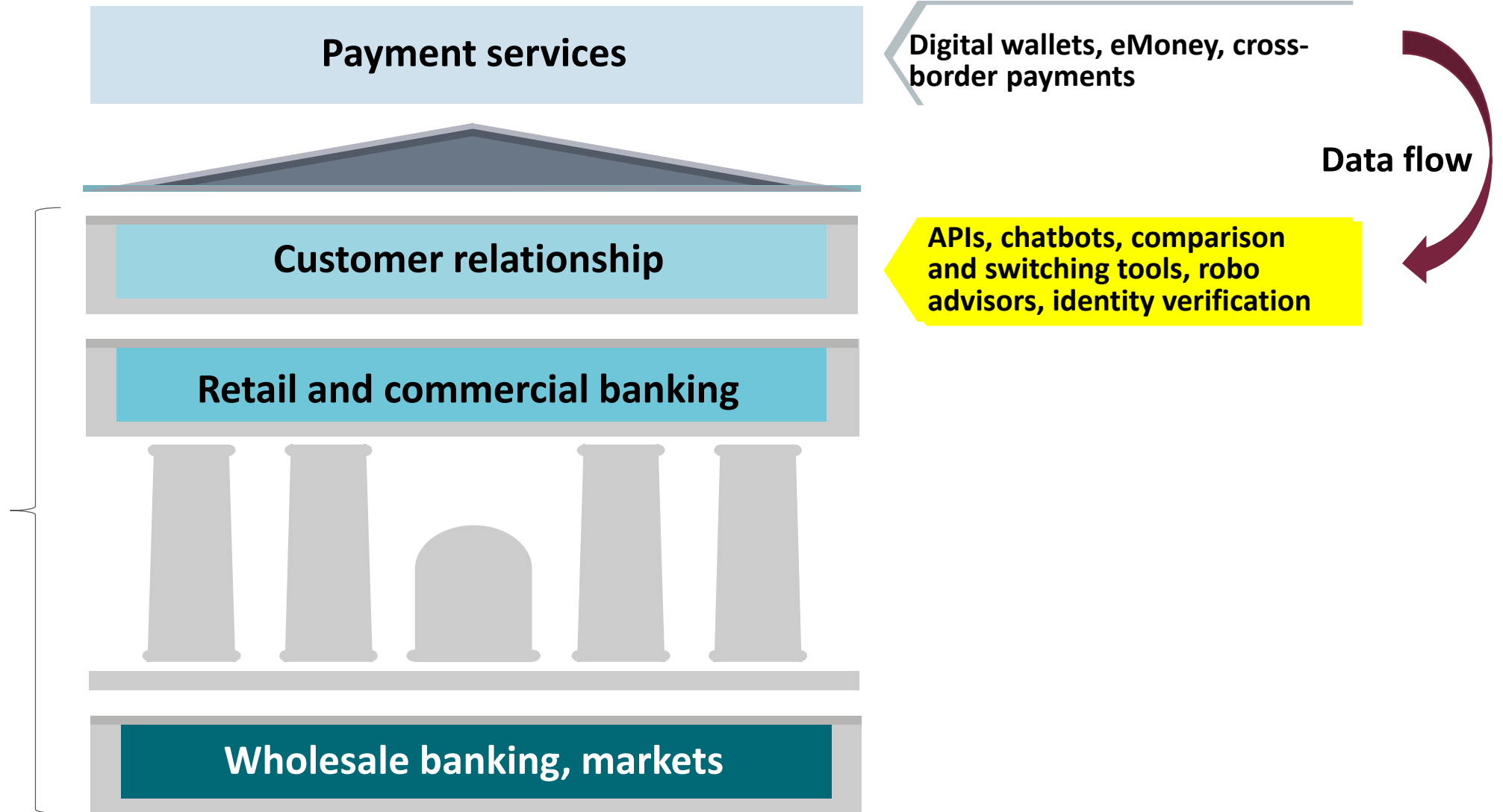


The anatomy of a task



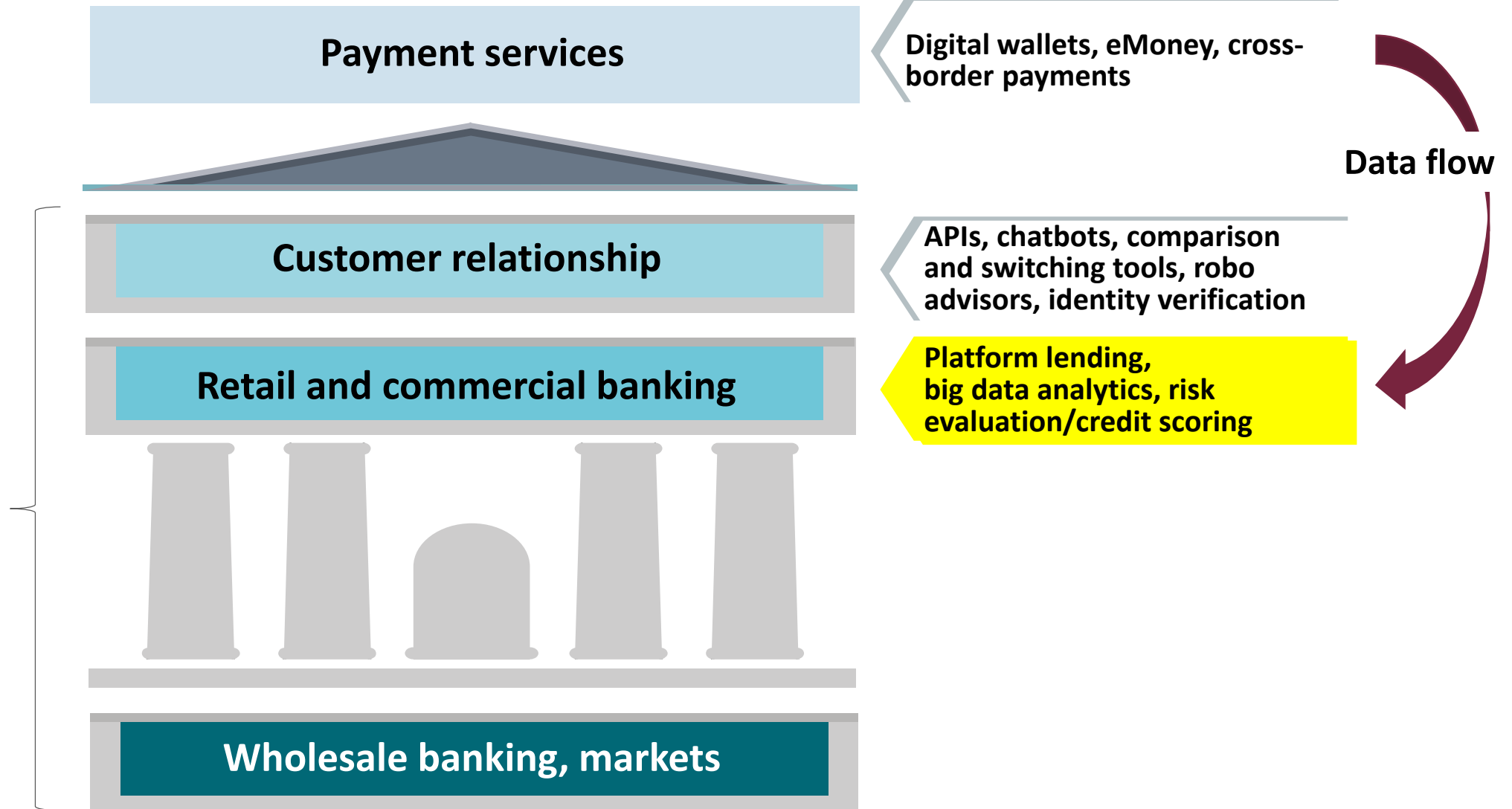
The financial value chain

Universal Bank



The financial value chain

Universal Bank



SME finance: current challenges

£22bn

the estimated
funding
shortfall for UK
SMEs

45%

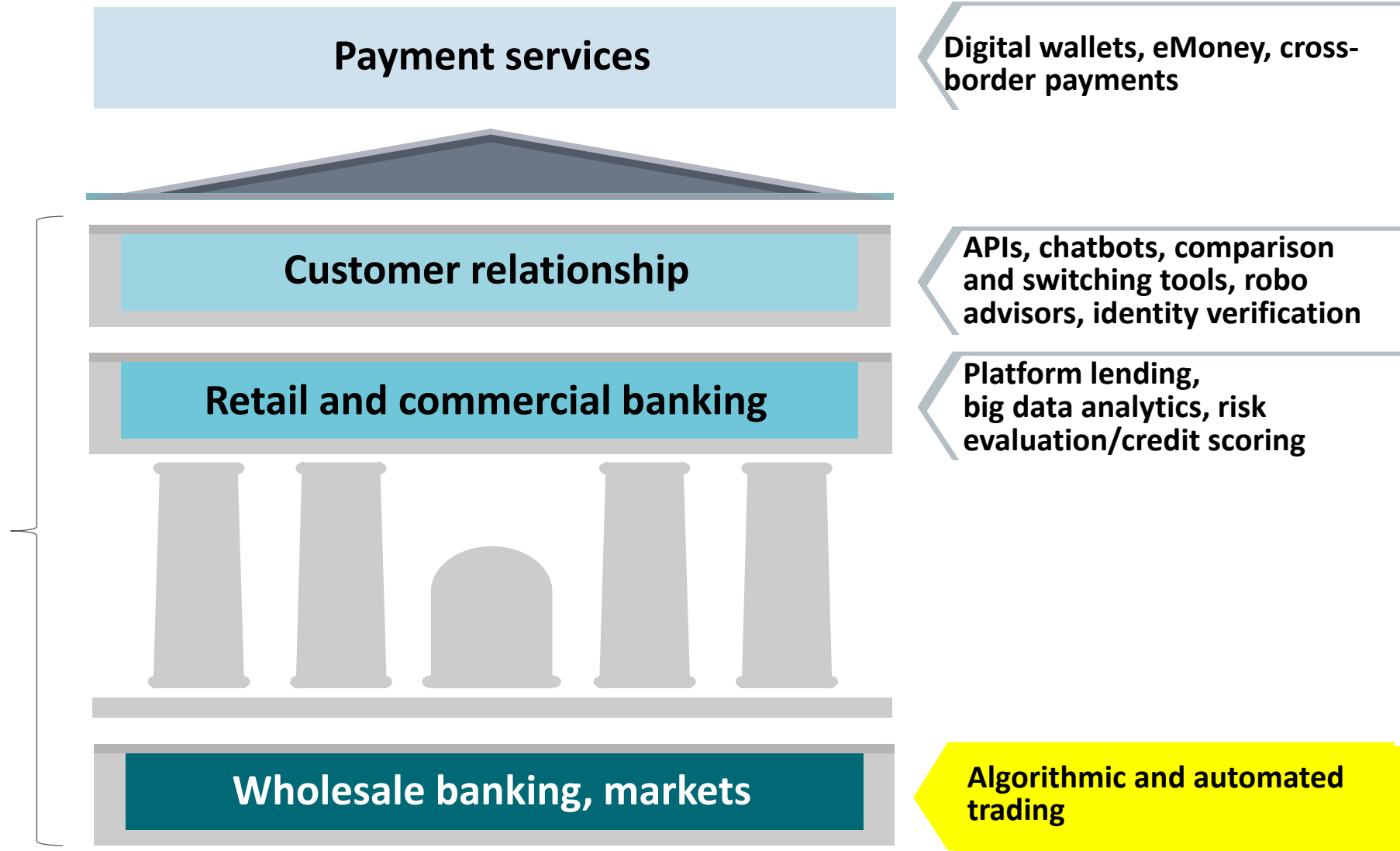
of SMEs do
not use or
plan to use
external
finance

2/5ths

of SME loan
applicants are
rejected

The financial value chain

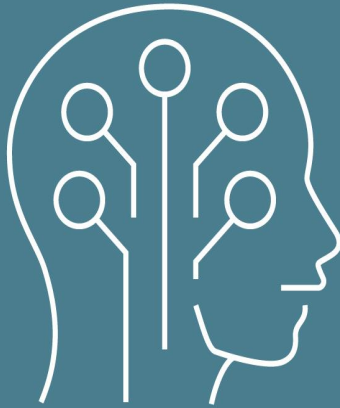
Universal Bank



Electronification and automation in financial markets

Market	Electronification (as share of overall mkt size)	Principle trading firm presence	Automated trading?
Futures	90%	High	Yes, incl AI
US equities	80%	High	Yes, incl AI
Spot foreign exchange	65%	High	Yes, incl AI
US government bonds	60-80% (90%+ for on-the-run)	High	Some
European government bonds	60%	Low	Little
US high-yield bonds	25%	Low	Little

Policy agenda



AI does well in finance when...

- There are known knowns with a clearly defined question, the future is expected to behave like the past, and sufficient past data to infer conclusions (for example, fraud detection, AML/CFT and insurance underwriting)
- Markets have set rules such that speed, consistency and efficiency favour disciplined arbitrage (e.g. index rebalancing, mean reversion)
- It provides an initial prediction that humans can combine with their assessments or a second opinion to prompt further review (credit and compliance assessments)
- It overcomes human biases such as loss aversion or hyperbolic discounting

AI for inclusive growth

Embrace the promise of fintech for households and SMEs

- greater financial inclusion
- more tailored products
- keener pricing
- more diverse sources of credit

Empower new providers to promote competition

- lower barriers to entry through proportionate supervision
- level the playing field to allow new players to access hard infrastructure (e.g. Non-bank PSPs)

Enable new technologies by developing

- hard infrastructure - such as large value payments systems, RTGS
- soft infrastructure, including rules and regulations, and capturing data in a consistent and useable form (LEI)

The right hard infrastructure....

Universal Bank

Payment services

Digital wallets, eMoney, cross-border payments

Customer relationship

APIs, chatbots, comparison and switching tools, robo advisors, identity verification

Retail and commercial banking

Platform lending, big data analytics, risk evaluation/credit scoring



Wholesale banking, markets

Algorithmic and automated trading

Wholesale payments, clearing and settlement infrastructure

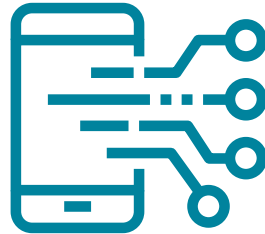
RTGS

...and soft infrastructure for innovation

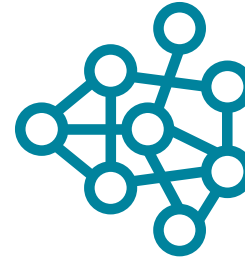


**Best in class
messaging standards**
ISO 20022 and
Legal Entity Identifiers

**Non-bank
RTGS access**
Admitting
innovative
payment
providers



RTGS

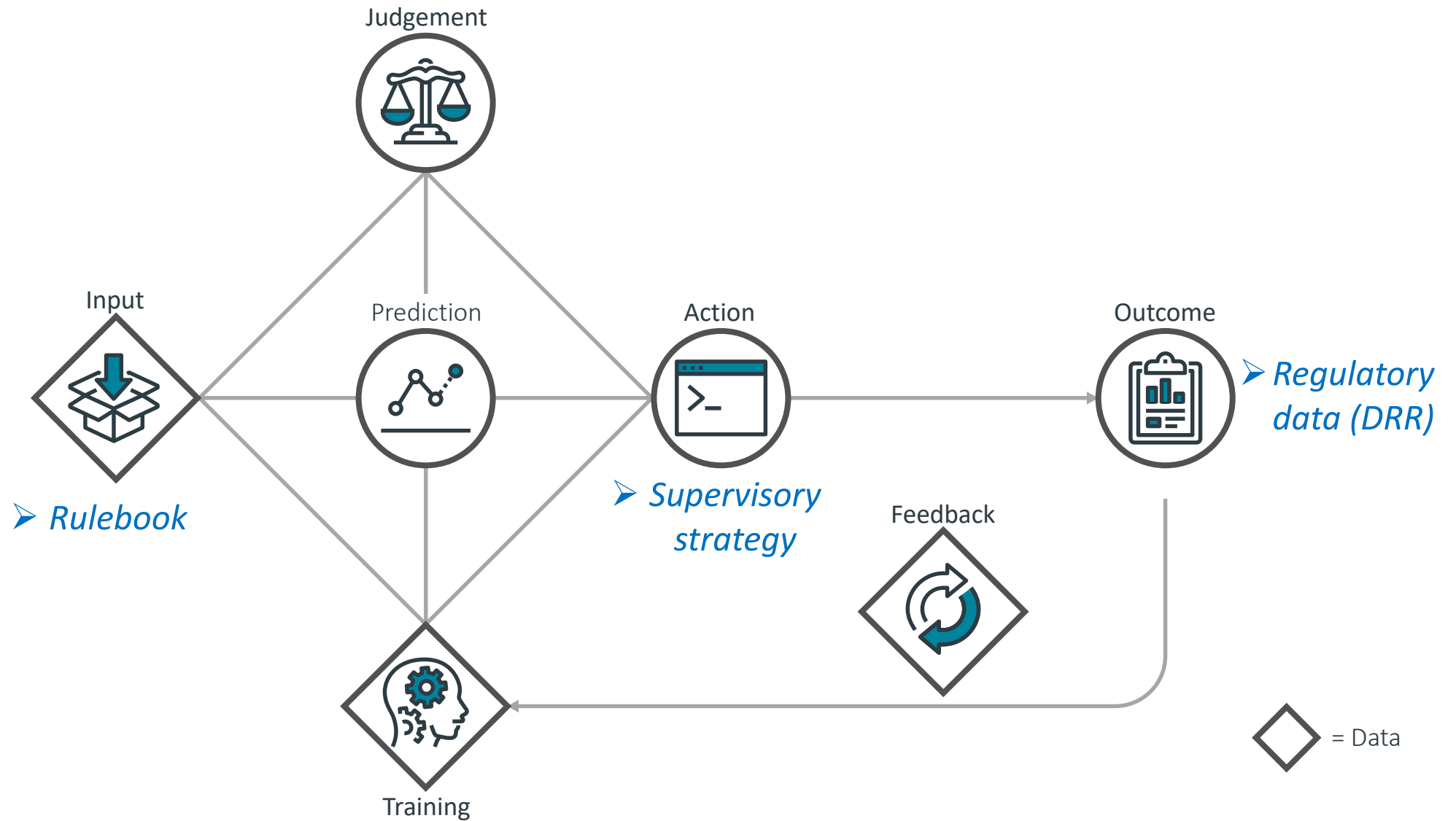


**DLT plug and play
with RTGS**
Future proofing so that
DLT payments systems
can plug into RTGS



Synchronisation
Exploring how to synchronise
with other systems for
efficiency and connectivity

AI in Prudential Regulation



AI in finance is challenged by...

- The implications of structural shifts and long-term value drivers (like demographics, climate change and AI itself!)
- Too little data (known unknowns—Knightian uncertainty)
- The auditability and interpretability of black box algorithms
- Increased dependency on third parties, single points of failure outside regulatory perimeter
- Bias in data and increased interconnections could lead to potentially pro-cyclical behaviour
- Fundamental trade-offs between innovation and competition and performance and privacy

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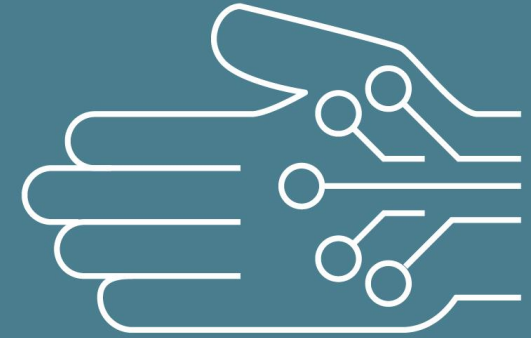
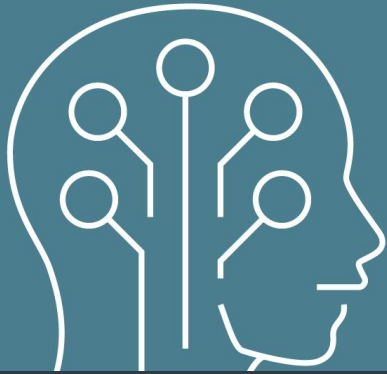
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Ensure fintech develops in a way that maximises the opportunities and minimises the risks for society



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