Productivity opportunities and risks in a transformative, low-carbon and digital age

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Executive Summary

- This paper sets out the opportunities, risks and barriers for productivity, jobs and the distribution of the gains emerging from digital transformation and green growth.
- These transitions will require transformative changes in business models, skill needs, infrastructure, regulatory policies and markets.
- Low-carbon and digital transitions are poised to define the economy of the next half century, with significant ramifications for productivity. The far-reaching implications of the changes mean that a cost-benefit approach should be replaced by a risk and opportunity-based process. Therefore, a study of systemic change must acknowledge and confront barriers to change, not only technological and economic, but also political, behavioural and institutional.
- Governments seeking to boost productivity sustainably must strategically design and steer, rather than passively forecast, the future.

Research theme:
Social, environmental and technological transitions

Productivity Opportunities

- **Learning effects:** expanding deployment of low-carbon technology has sharply reduced costs for solar, wind and batteries through learning-by-doing and experience curves.
- **Economies of scale in production and distribution:** larger networks bring down the unit costs, which encourages increased output.
- **Network and coordination effects:** with more economic agents taking similar actions, greater productivity advantages can be gleaned from moving in tandem. Transitions in process technologies, such as robots and AI, could transform production, while changes in end-use technologies, like self-driving cars and tele-working, could alter socio-economic situations.
- **Sector spill-overs:** sustainable technologies have positive productivity spill-overs into other sectors of the economy. Spill-overs from low-carbon innovations are more than 40% greater than conventional technologies in energy production and transportation.
- **Evolution of consumer behaviour**: consumer taste can be critical in the diffusion of innovations, technologies and practices, with adoption following s-shaped patterns from pioneers and early adopters, through the majority, before reaching laggards.
- **Social and institutional feedbacks:** popular support can help formal institutions to enforce collectively desirable outcomes, with social feedbacks aiding in making norms self-enforcing.

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The Productivity Institute is a UK-wide research organisation exploring what productivity means for business, for workers and for communities, with funding from the Economic and Social Research Council

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Risks and Barriers

- **High switching costs:** green energy is capital-intensive, meaning financing the shift from dirty to clean technologies may require direct policy intervention. Switching from natural gas to hydrogen and from gas boilers to heat pumps will be expensive.
- **Monopolistic network dominance:** digitalisation of manufacturing is predicted to increase servitisation. The increased costs associated with this process sometimes lead to short-term performance decline; coupled with higher initial investment costs, this means it will favour existing, large businesses that can absorb that financial hit.
- **Dynamic market failures:** factors like network externalities suggest that the private sector will underinvest in the assets necessary for high productivity growth.
- **Systemic lock-in:** existing systems pose a difficulty for transitions, due to inertia, which could significantly delay critical reorientations. Many low-carbon technologies require wider system and infrastructure changes, presenting the possibility that productivity growth slows or stagnates during the transitional period.
- **Global standards for investments:** securing agreed global standards for new generations of investment is a key barrier to investment in smart connectivity networks.
- **Disruption from automation**: the high potential of automation to replace workers is a substantial barrier to implementation due to under-qualified workers' resistance to change.
- **Solow Paradox:** the digital age is now surrounding us, but it is not yet visible in the productivity statistics, mimicking the same phenomenon that was experienced in the 1980s.
- **Uncertainty over future risks:** concerns over privacy and data security, standardisation, interoperability and compatibility of networks, digital skills shortage and disruption to existing jobs all act as hurdles to investment.

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Overcoming Barriers

- **Forward-looking expectations can overcome inertia:** for instance, the perception that 'green' conflicts with growth has now been turned on its head. Acemoglu et al. (2012) say that policy to support clean innovation can be temporary, because once the initial investment has been made, it can be more innovative and productive than the conventional alternative, with a positive impact on GDP levels and growth.
- **Tipping points:** research on low-carbon and digital transitions should, therefore, investigate the interactions of techno-economic and actor-related processes and feedback loops that lead to tipping points.
- **Public policies:** to encourage these tipping points, public policies should go beyond carbon pricing and R&D subsidies to include direct infrastructure investments, phase-out policies and loans or capital grants, alongside the introduction of standards, regulations, targets and institutional reforms. Investment in the right assets generates value and productivity growth.
- **New platforms:** the creation of platforms to enhance coordination between industry, policy and academia should also be considered. Such clear policy making and early action to support new technologies would steer innovation and could help to overcome dynamic market failures.
- **Political economy considerations:** these transitions have the potential to upend some of the most powerful industries in the world. Ensuring just transitions will be vital for social cohesion and economic justice. Consequently, greater interaction between industry and education and training institutions could be necessary to safeguard against people being left behind.

Future Focus

- **Comparative empirical research:** along with lessons from previous waves of technological change and productivity, we must examine productivity effects, scaling-up, transition strategies, policy and financial issues in different sectors.
- **Policy and governance:** we need to understand how this affects low-carbon and digital transitions and their productivity effects by way of cross country and historical comparisons to help counter inevitable conflicts and power struggles.
- **Analytical tools:** we should create a richer and more valuable understanding with which to guide decision-makers in policy making. Modelling, psychology dynamics and spatial approaches will be necessary, as well as interdisciplinary analysis.

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