



# A green industrial revolution is coming

Many question the usefulness of economic growth, concerned about the environment. Alessio Terzi believes the green transition can usher in prosperity for people and the planet

Pressing social and environmental concerns are leading many to question the usefulness of economic growth. This column argues that there is nothing intrinsic in the concept of growth that makes it incompatible with environmental protection. Growth and technological progress are two sides of the same coin. The green transition can contribute to the creation of 'good jobs' that are less prone to geographical concentration, dehumanising repetitive tasks, and automation or delocalisation. It can usher in prosperity for the combined benefit of people and planet.

As humanity grapples with the existential challenge of climate change, what will happen to the size of the economy? This question is not only being asked by heterodox scholars belonging to the 'degrowth movement', who see shrinking incomes and consumption as instrumental to reaching climate targets (Hickel 2020, Jackson 2021).

Within the mainstream economic profession as well, the idea that decarbonisation will fail to stimulate growth and jobs, contrary to the promises of plans such as Build Back Better or the European Green Deal, has some notable patrons (Claeys *et al* 2019, Pisani-Ferry 2021).

Macroeconomic modellers have tried to quantify the impact of the green transition and concluded that overall aggregate benefits in terms of GDP impact and net jobs created will be muted, oscillating between marginally positive to marginally negative depending on the assumptions used (European Commission 2020, IMF 2020, OECD 2017). Econometricians have teased out the effect of past carbon-pricing exercises to conclude likewise that the impact on GDP and jobs is limited (Metcalf and Stock 2020, Yamazaki 2017).

In a new book, *Growth for good: Reshaping capitalism to save humanity from climate catastrophe*, I come to radically different conclusions. All these modelling approaches take too narrow a perspective to appropriately answer questions on long-term economic growth in the era of climate change.

For starters, most of the economics literature has concentrated its efforts on carbon pricing, generally reducing climate mitigation and adaptation packages to a mere shift in taxation away from labour income and towards carbon emissions.

On the other hand, 'green deals' will push early adopting countries towards developing a comparative advantage in advanced green technologies. Mastering technological knowhow in the production methods of the future will inevitably have important rebalancing effects on competitiveness across the globe (Lund and Bughin 2019).

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Another way of putting it is that climate mitigation agendas will radically modify production and the very structure of the economy, making standard macroeconomic models poor tools to assess their overall impact. In jargon, this would be a green version of the famous 'Lucas critique'.

Empirical evaluations based on past moderate attempts at introducing some form of carbon pricing are unlikely to be of great help when trying to predict the economic consequences of fully-fledged green deal packages. Aghion *et al* (2021) laid out the properties of technological revolutions.

These are characterised by a fundamental innovation, which (i) has scope for improvement, implying a sustained cost reduction; (ii) is pervasive, spreading to all sectors in the economy; and (iii) spawns successive waves of secondary innovation, as the original technology gets adapted in the various sectors.

Given the wide-reaching implications for production, consumption, energy, agriculture, housing, and transport, the green transition is probably closer to a technological and industrial revolution than some isolated public policy to be evaluated linearly through marginal effects.

### **The Adam Smith fallacy**

When taking this view, extrapolating empirical estimates of past mild exercises of carbon pricing to conclude that the green transition will have muted economic impacts is a mistaken approach.

It would be like observing limited productivity gains in firms adopting the early mechanisation of cotton spinning in England in the second half of the 18<sup>th</sup> century and concluding that the First Industrial Revolution would have muted effects on the economy.

We could call this the 'Adam Smith fallacy', as the founding father of classical economics entirely failed to see the crucial repercussions that the then-nascent mechanised cotton spinning and steam engine technology would soon have on the wealth of nations (Wrigley 2011).

This oversight can be entirely justified by the fact that in the early stages of an industrial revolution, the economic impact of novel technologies is indeed rather muted (Pezzoni *et al* 2019). Juhász *et al* (2020) show how 'trial and error' with mechanisation in the 18<sup>th</sup> century initially led to widely dispersed productivity draws and low initial average productivity.

Only in the subsequent decades was high productivity growth observed, as new entrants adopted improved methods of production and organisation. When electricity first reached companies during the Second Industrial Revolution, a similarly muted initial economic impact was encountered until the benefits of electrification could be leveraged fully in assembly-line production, abolishing the older line-shaft system (Aghion *et al* 2021, McAfee 2019, Smil 2017).

Fast-forwarding to the 21<sup>st</sup> century, as companies start innovating through technological diffusion, inventing new solutions to adapt their business lines to the changing (green) economic landscape, we are likely to observe significant productivity boosts.

This is a possibility because – in contrast to mature technologies like hydropower or fossil fuels – green technologies are likely to have still a long way to go in cost reduction. Renewable energies could easily become by far the cheapest energy source in history (International Energy Agency 2020), leading to a generalised productivity boost across the economy. In the words of Stern and Stiglitz (2021: 61):

*For two hundred years, technologies based on fossil fuel have been explored. Diminishing returns may have set in. Climate change has induced new searches in other parts of the technology frontier. [...] the green economy may usher in a new era of high productivity growth.*

### **Good green jobs**

In the initial phase, green deals will be characterised by large investment programmes on infrastructure, climate adaptation, renewable energy installations and renovations throughout the national territory. Most of these activities are expected to boost the construction sector – one of the most labour-intensive sectors in the economy.

Following the early construction wave, renewable energy sources are expected to require regular maintenance services, which need to be carried out in situ and can therefore hardly be relocated abroad.

While some reskilling will be needed, several studies point to the fact that most green professions will not necessarily require completely different levels of schooling or skills. As such, much of the retooling of vocational skills could probably happen through on-the-job retraining, making the odds of a seamless job transition much higher than for other economic transformations, such as the Digital Revolution (Bowen *et al* 2018).

Several recent studies have suggested how these occupations tend to require less repetitive tasks and more interpersonal skills, implying a limited risk of automation in the near future (Consoli *et al* 2016, Vona *et al* 2018). Early evidence from green pioneering countries like the UK also suggests that the job creation potential is spread, including outside cities and in poorer regions (Martin *et al* 2020).

The twists and turns of an incipient industrial revolution are hard to foresee with precision in its early stages. However, the current evidence suggests that the green transition will not only contribute to the creation of jobs,

but specifically 'good jobs' that are less prone to geographical concentration, less characterised by dehumanising repetitive tasks, and less likely to undergo automation or delocalisation (Rodrik and Sabel 2019).

### **Winners and losers**

As a result of changing production and consumption patterns, green deals will redraw completely the map of trade and investment relations between countries, influence geopolitics, and redefine economic winners and losers (Leonard *et al* 2021).

For instance, countries specialising predominantly in fossil-fuel exports, like Russia or OPEC members, will likely be on the losing end unless they manage to diversify their economic model (Gustafson 2021, IMF 2020).

As production and consumption change, comparative advantages shift, and the wealth of nations will be defined and contended on this new technological terrain.

Knowing all this, two conclusions are evident. First, accelerating the green transition makes economic and strategic sense, even without climate considerations. Countries have a strong (self-interested) incentive to fast-track the adoption of these new technologies to gain an edge in what will be the energy and production system of the future.

By so doing, they will be capturing network effects and setting regulatory and technological standards, effectively shaping the very course of future innovation (Aiginger 2020).

Second, this fast economic transformation at the global level will leave some countries behind, notably those that refuse (or are too slow) to adapt to this technological shift. Aware of all this, policymakers should not be deceived

by current estimations of muted economic impacts and fall into complacency. The green industrial revolution is upon us. ■

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