How does climate policy relate to productivity stagnation?

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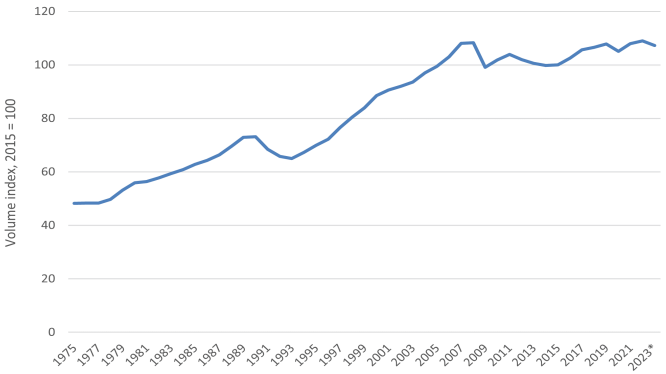
Stagnation in Finland

- Finland's economic growth has stagnated since the 2008 financial crisis.



Gross domestic product per capita (Index, 2015 = 100). Source: Statistics Finland.

Stagnation in Western countries

- Decline in business dynamism (e.g., new firms, job turnover)
  - Decker et al. (2016) AER, Grossman et al. (2017) NBER
- Rising markups and market concentration
  - De Loecker et al. (2020) QJE
- Misallocation of resources
  - Dai et al. (2022) VNTEAS.
- New ideas getting harder to find
  - Gordon (2012) NBER, Bloom et al. (2020) AER
- Measurement problems (digital services, free goods)
  - Brynjolfsson et al. (2021)

Are we forgetting the Kyoto Protocol?

- Temporary association: First commitment period 2008–2012, Doha Amendment 2012–2020
- In the late 1990s, the Kyoto Protocol was criticized as highly cost-ineffective
  - Nordhaus & Boyer (1999): The net present value of total cost is \$716 billion US dollars (1990 prices), 7 times higher than the benefit
  - Murkowski (2000): Average cost for a US household could reach \$2,728 per year, leading to the loss of 2.4 million jobs
  - Note: EU implemented, USA never ratified

Mismeasurement of productivity during the green transition

- Mechanism:
  - Significant R&D and capital investments in greenhouse gas (GHG) emissions' abatement
  - Conventional productivity measures, such as labor productivity and total factor productivity (TFP), include labor and capital resources allocated to GHG abatement but do not account for GHG reductions or their associated benefits
  - This causes a downward bias in conventional productivity measures, as they ignore the benefits of GHG reductions

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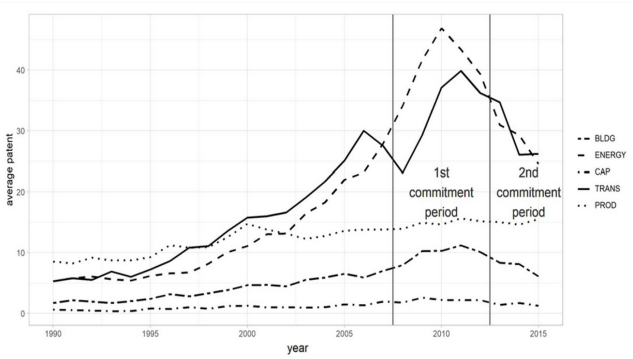

Historical trend of specific fields of selected patents: Climate change mitigation technologies related to buildings (BLDG), energy generation, transmission, or distribution (ENERGY), capture, storage, sequestration, or disposal of GHGs (CAP), transportation (TRANS), and the production or processing of goods (PROD). Source: Kim, Y. (2021). Technological innovation, the Kyoto protocol, and open innovation. *Journal of Open Innovation: Technology, Market, and Complexity* 7(3).

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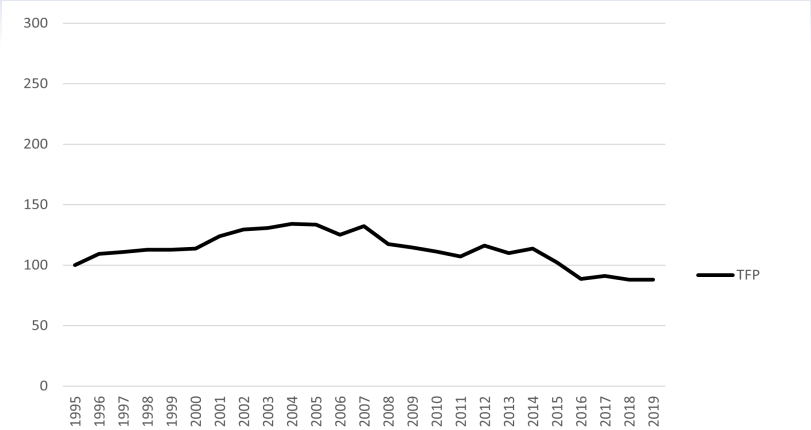
- Alternative Green TFP measures adjust the TFP for changes in GHG emissions

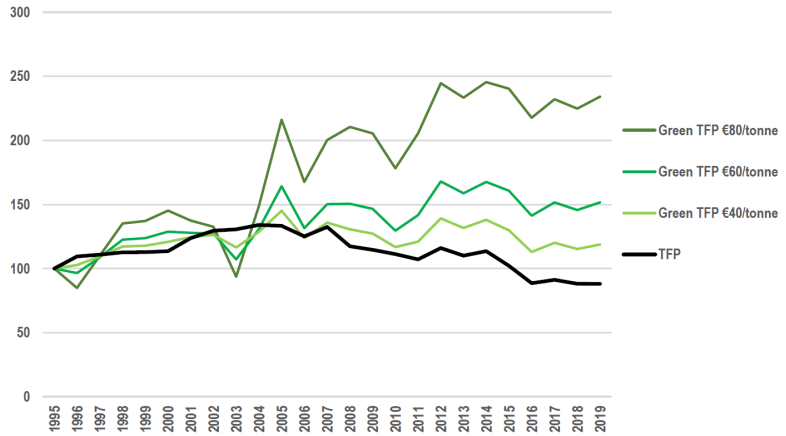
Conventional and Green TFP in Finland's energy industry (D)



Source: Dai et al. (2023). Can omitted carbon abatement explain productivity stagnation? Quantile shadow-price Fisher index applied to OECD countries.

Conventional and Green TFP in Finland's energy industry (D)

- The price of CO_2 is set at 0, 40, 60, 80 €/tonne, index 1995=100



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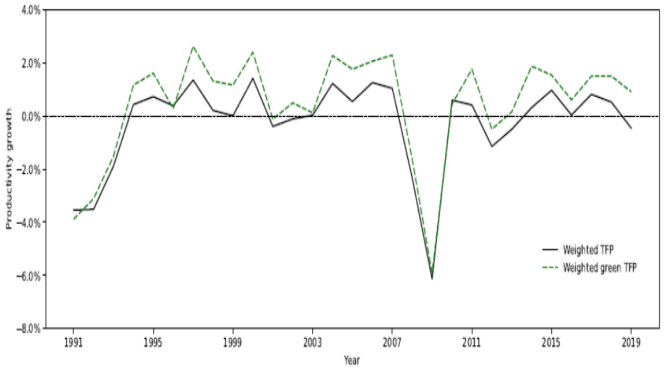
TFP and Green TFP in OECD countries, 1990–2019

- Yearly growth of TFP and Green TFP in the OECD countries.



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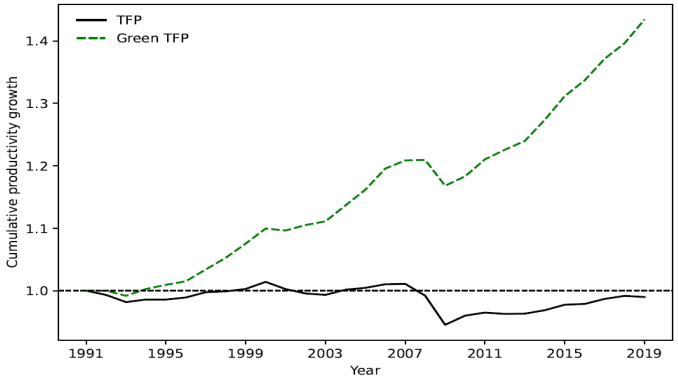
TFP and Green TFP in OECD countries, 1990–2019

- The cumulative TFP and Green TFP measures.



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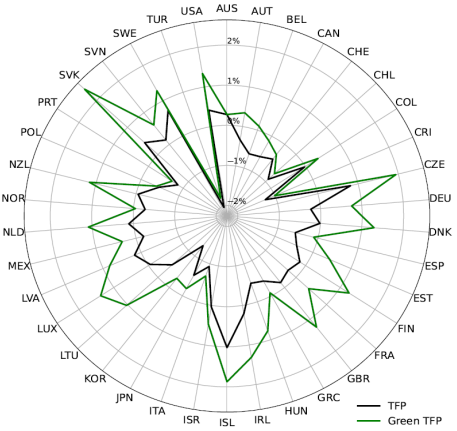
Green TFP in OECD countries, 1990–2019

- Average TFP and Green TFP growth by country.



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Conclusions

- Conventional productivity measures overlook technological advancements related to carbon emission reduction.
- Significant growth in Green TFP across OECD countries, while conventional TFP has stagnated.
- During the transition towards carbon neutrality, it is crucial to complement conventional productivity metrics with measures that account for environmental benefits.
- Finland's path to net zero emissions by 2035 requires sustained investment in green technologies and innovation, which could unlock future productivity gains.
- The green transition is a temporary but transformative phase that will generate long-term environmental and economic benefits.