FISCAL AFFAIRS

Expanding Frontiers: Fiscal Policies for Innovation and Technology Diffusion

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Era Dabla-Norris

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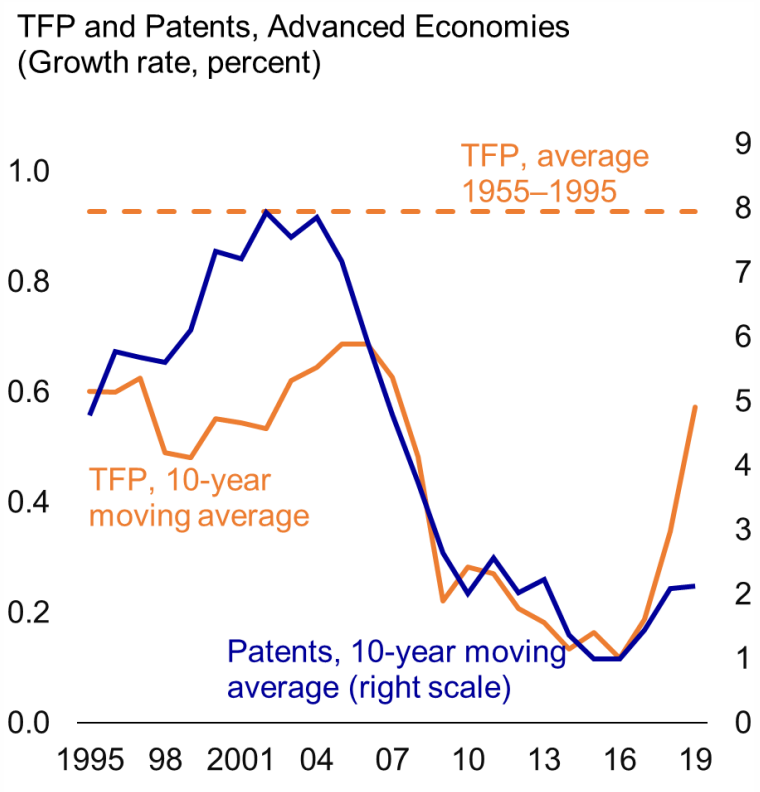
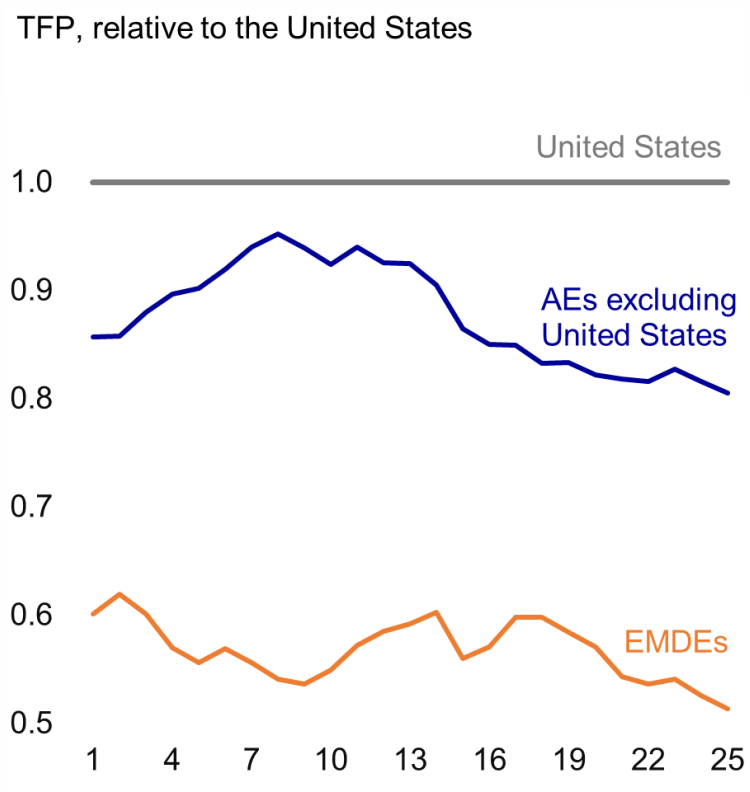
Bruegel

Motivation (I): need to lift pace of and broaden gains from innovation

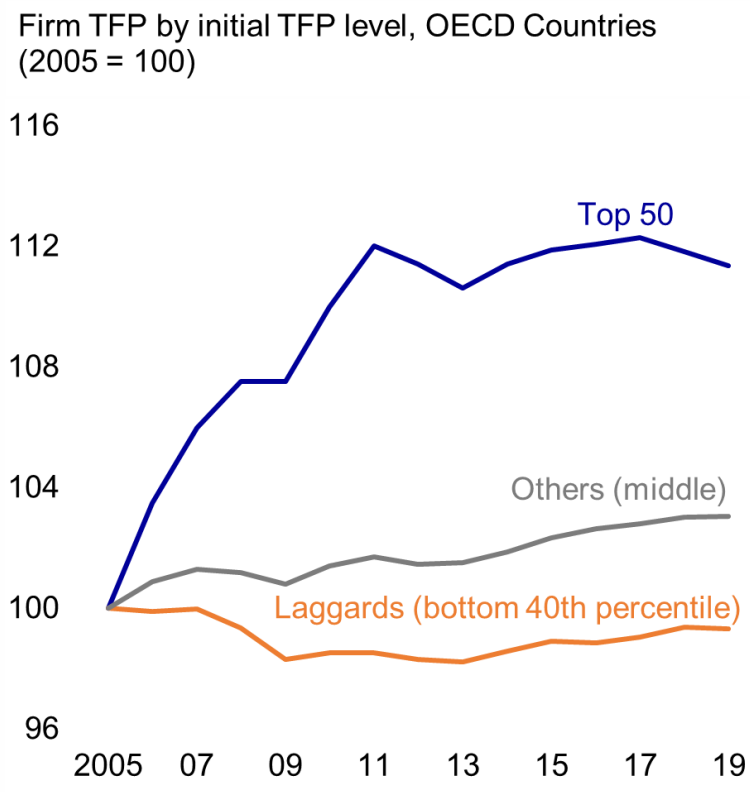
Withering TFP growth and innovation.



Large technology gaps across countries…



…and growing across firms.

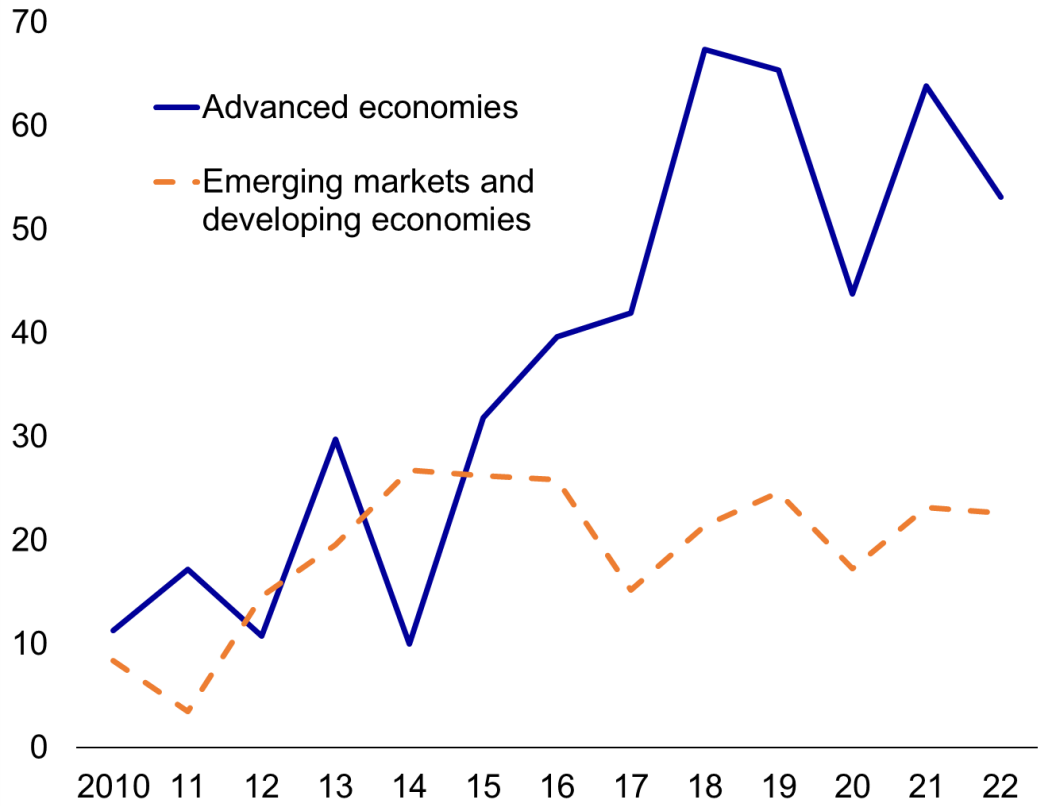


Sources: European Patent Office, PATSTAT; Penn World Tables; and IMF staff estimates.

Motivation (II): Increasing use of industrial policies for innovation

Industrial Policies on the rise…

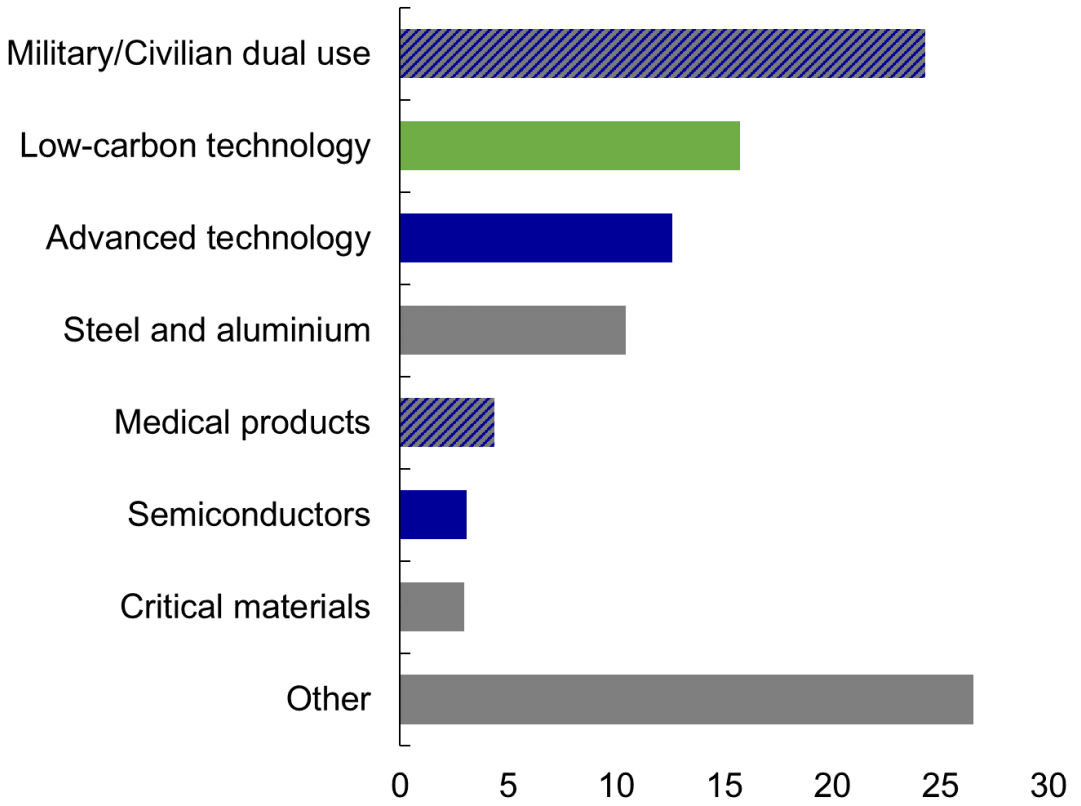
Share of Industrial Policies
(Percent of total trade policies)



Sources: Global Trade Alert database; Juhász and others 2022; and authors' calculations.

… with a focus on digital and high-tech sectors.

Industrial Policies by Sector, 2023
(Percent)



Sources: Evenett and others 2024; and IMF staff estimates.

Key Questions

1. When should governments **direct innovation** to specific sectors, and how?

2. What are the most cost-effective fiscal policies to **promote innovation** at the technology frontier?

3. How can governments facilitate **technology diffusion** to countries and firms below the frontier?

Model Costs and Benefits of Industrial Policy for Innovation

- Model of endogenous innovation with a sectoral network structure (Liu and Ma 2023)
  - Key feature: innovation in each sector produces heterogeneous spillovers to other sectors

  → Optimal to allocate relatively more innovation to "central" sectors

- Model considers:

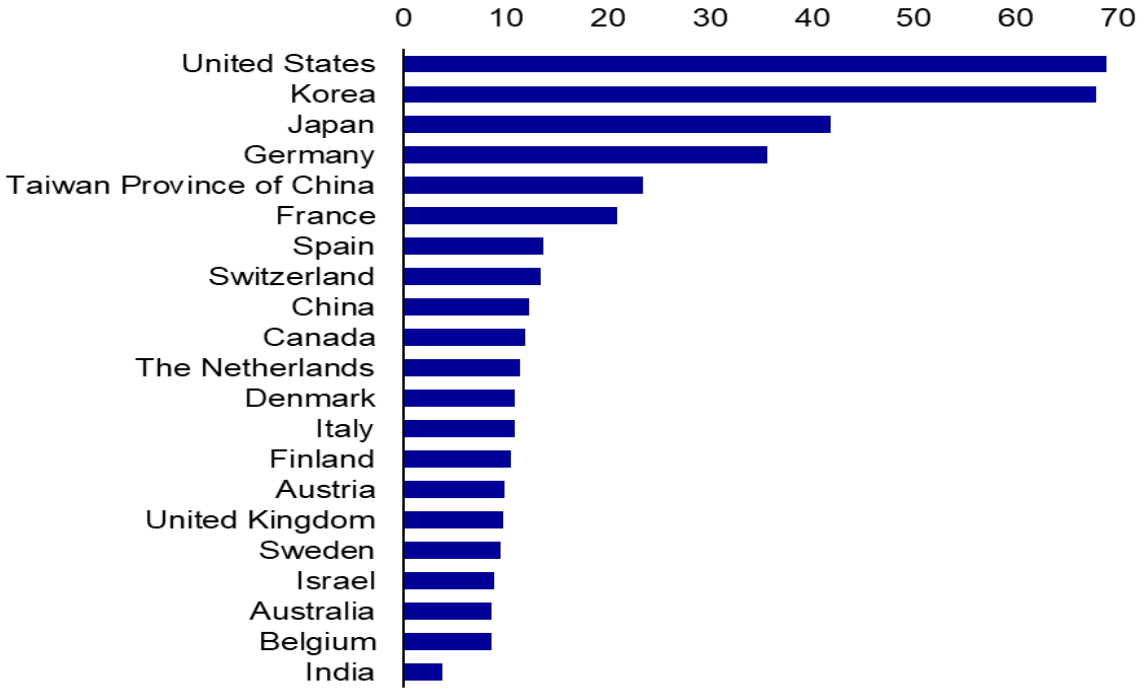
  1) Implementation frictions: governments deviate from the optimal allocation
     - Misallocation towards politically connected sectors
     - Random policy mistakes

  2) Alternative policy goals: government values other goals (e.g., emission reductions)

Knowledge spillovers across sectors and countries matter

Some sectors generate more knowledge spillovers to others but spillovers also come from abroad

Domestic Knowledge Spillovers, Select Economies
(Patent citations from own country, percent of total)



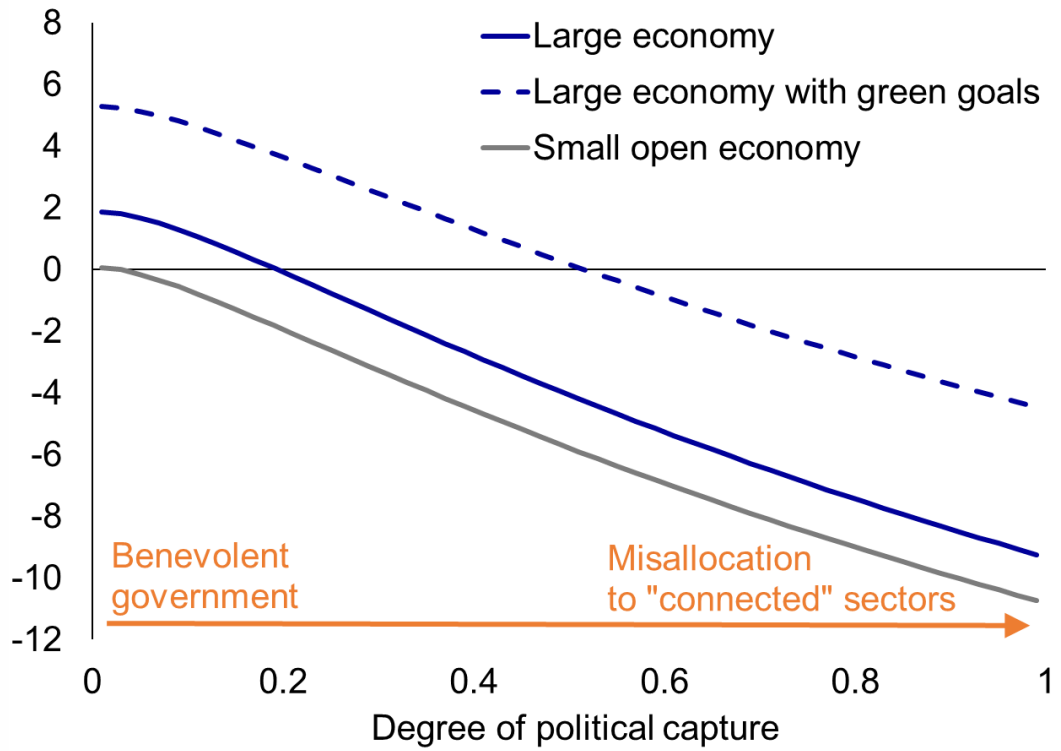
Sources: European Patent Office, PATSTAT; and IMF staff estimates.
Note: Within-country average of domestic patent citations across all sectors. Patents are attributed to countries based on the location of their inventors.

Should governments direct innovation to specific sectors?

- Targeting R&D subsidies to specific sectors only beneficial if:
  - Sector externalities are clearly identified
    - E.g., research spillovers, emission reductions
  - Domestic knowledge spillovers are high
  - Government capacity is strong
    - To avoid political capture by connected sectors
  - Policies do not discriminate foreign firms

- Considering emission reduction goals can make industrial policy more beneficial
  - Reallocate innovation to greener sectors

Net Gains from Sector-Specific R&D Subsidies, AEs
(Welfare change relative to uniform subsidy, percent)

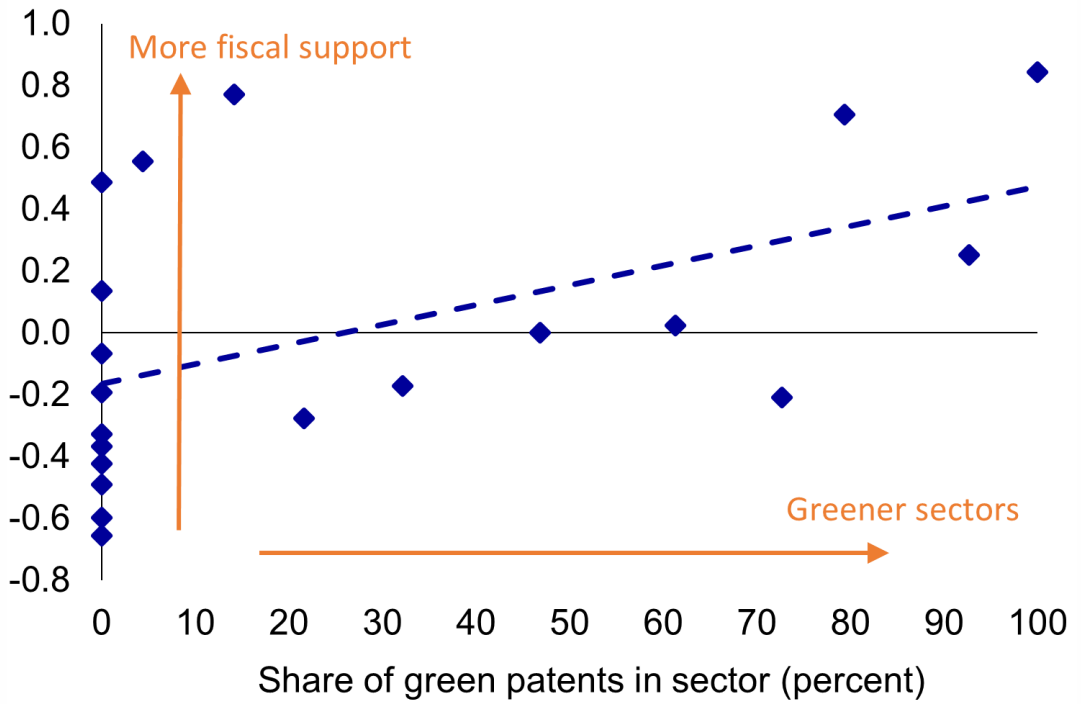


Sources: Díez, Fan, and Villegas-Sánchez (2021); European Patent Office, PATSTAT; Liu and Ma (2023); World Intellectual Property Organization, Green Inventory; and IMF staff simulations.
Notes: Endogenous innovation model with a sectoral network. The government chooses sectoral R&D subsidies to capture cross-sector knowledge spillovers (measured with patent citation linkages) and (in dashed line) emission reduction goals but may favor politically connected sectors (proxied by sector markups).

Implementation of industrial policy is complex and carries risks

Optimal distribution is complex: more weight for greener sectors, but relationship far from linear

Optimal R&D support by sector
(Change relative to no industrial policy, logs)



Sources: Díez, Fan, and Villegas-Sánchez 2021; European Patent Office, PATSTAT; Liu and Ma 2023; World Intellectual Property Organization, Green Inventory; and IMF staff simulations.
Notes: Sectors are aggregated into 20 bins (shown in dots), and the y-axis is rescaled to a zero mean.

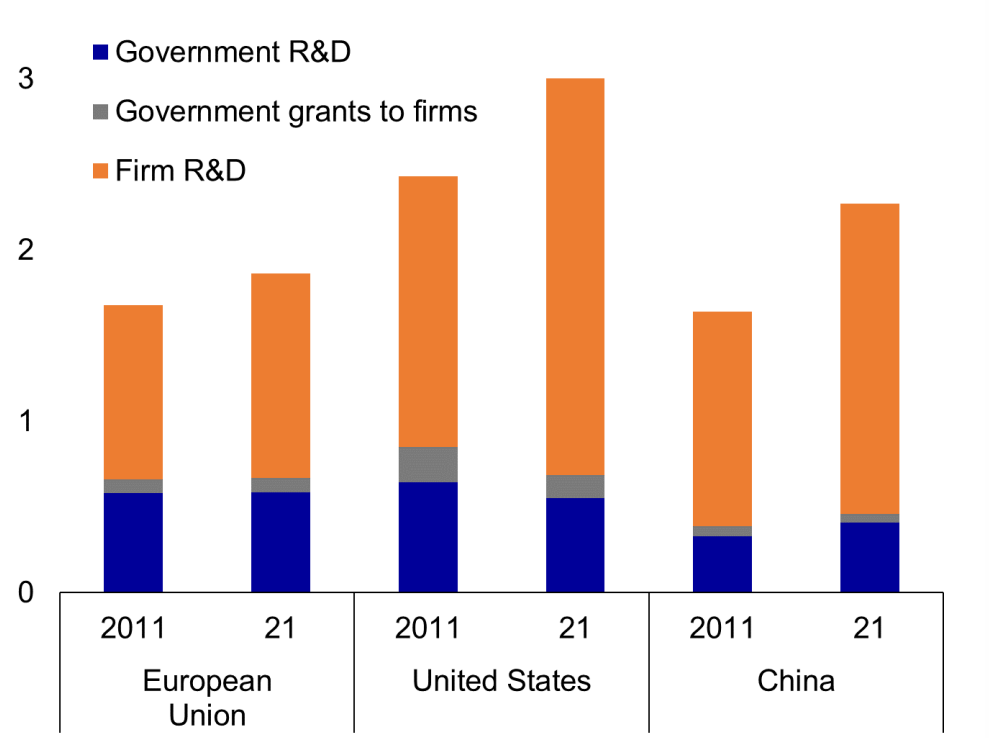
Historical experience highlights risks

- Case studies with varied outcomes:
  - Airbus in EU
  - Electric Vehicles in China
  - Abandoned projects in FRA, JAP, USA.
- Some cases transformed industries, but issues include:
  - hard to pick sectors
  - elevated fiscal costs
  - risk of cross-border spillovers

Governments shifting support towards corporate R&D

Growing share of corporate R&D…

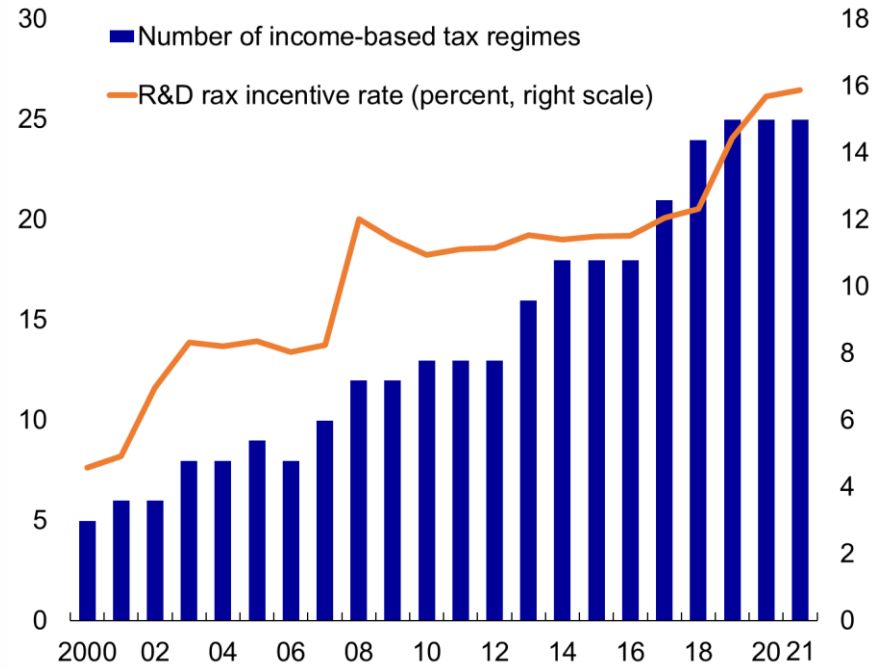
R&D Expenditure by Source
(Percent of GDP, aggregate)



Sources: OECD and IMF staff calculations.
Notes: Firm R&D includes that which is financed by firms (potentially supported by tax incentives but excluding government grants to firms). Government R&D excludes grants to firms.

…with more generous tax incentives.

Innovation Tax Incentives in Advanced and Emerging Economies



Sources: González Cabral and others 2023; OECD; and IMF staff calculations.
Notes: The R&D tax incentive rate is based on implicit effective subsidies. Income-based tax regimes include patent boxes, among other instruments. The right panel sample consists of 40 countries including OECD economies plus China, Romania, Russia, and South Africa.

Promoting innovation with the right fiscal tools can boost output

Instrument	Impact on Total R&D per Dollar Spent		Policy Guidelines
	IMF Staff Estimates*	Literature	
R&D tax incentives	[0.7,0.9]	[0.2,1.5]	• Better for mature firms and for horizontal support • Preferable if tax credit is refundable
Patent boxes (intellectual property regimes)	Small	~0	• Induce profit-shifting/excessive patenting • BEPS Action 5 reform effect still uncertain
R&D grants	n.a.	[0.5,1.5]	• Better for younger firms and for targeting sectors with high social returns
Public R&D	[1.2, 1.5]	>1	• Better for fundamental research and for targeting sectors with high social returns
Moonshot projects	n.a.	Inconclusive	• Can have strong relocation effects

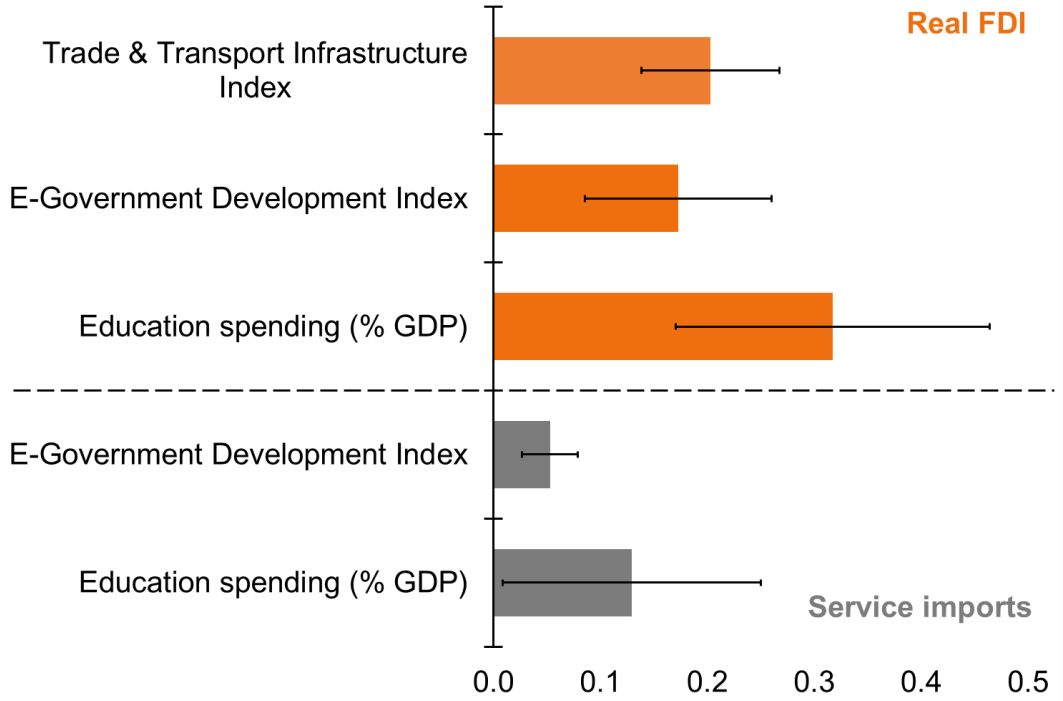
Increasing spending on a mix of these policies by 0.5 ppt of GDP could raise GDP by up to 2 percent

*Staff estimates are based on an OLS panel regression with country and year fixed effects, controlling for macroeconomic factors and corporate income tax rates. The sample includes 40 OECD economies plus CHN, ROM, RUS, ZAF over 2000-21. All coefficients in the table are statistically significant at the 95-percent confidence level.

Investing in public and human capital can accelerate diffusion

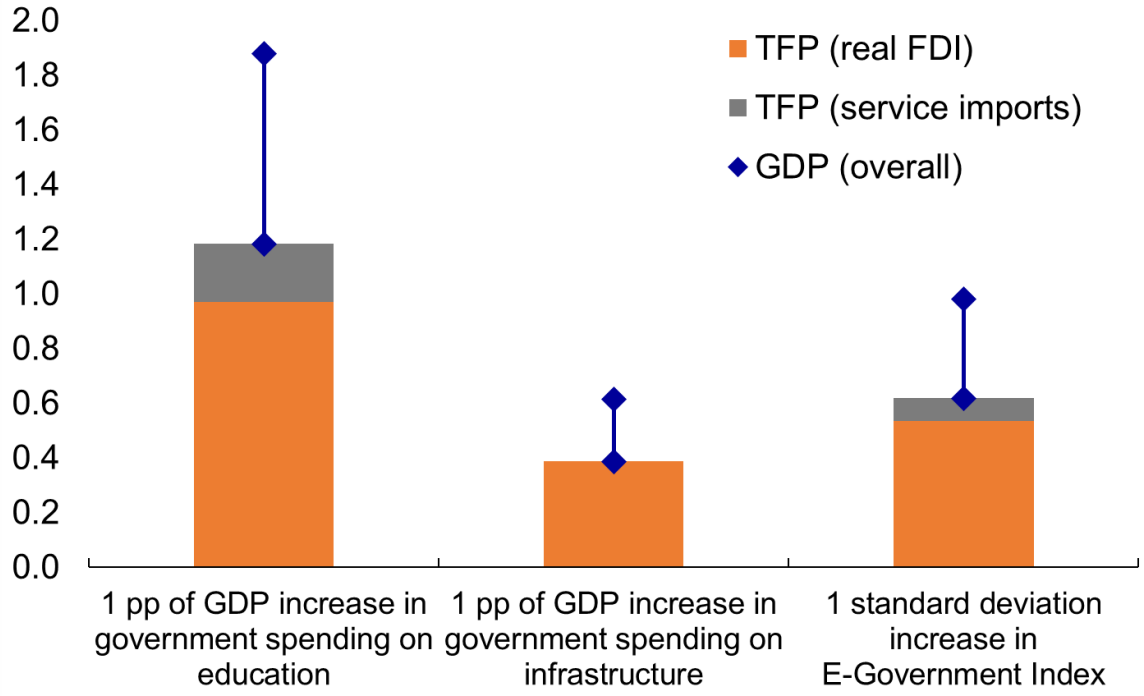
Policies to attract service imports and real FDI in developing economies…

Determinants of service imports and real FDI, Spending
(Percent)



…can boost productivity and GDP

Effect of public investment on Productivity and GDP
(Percentage point change)

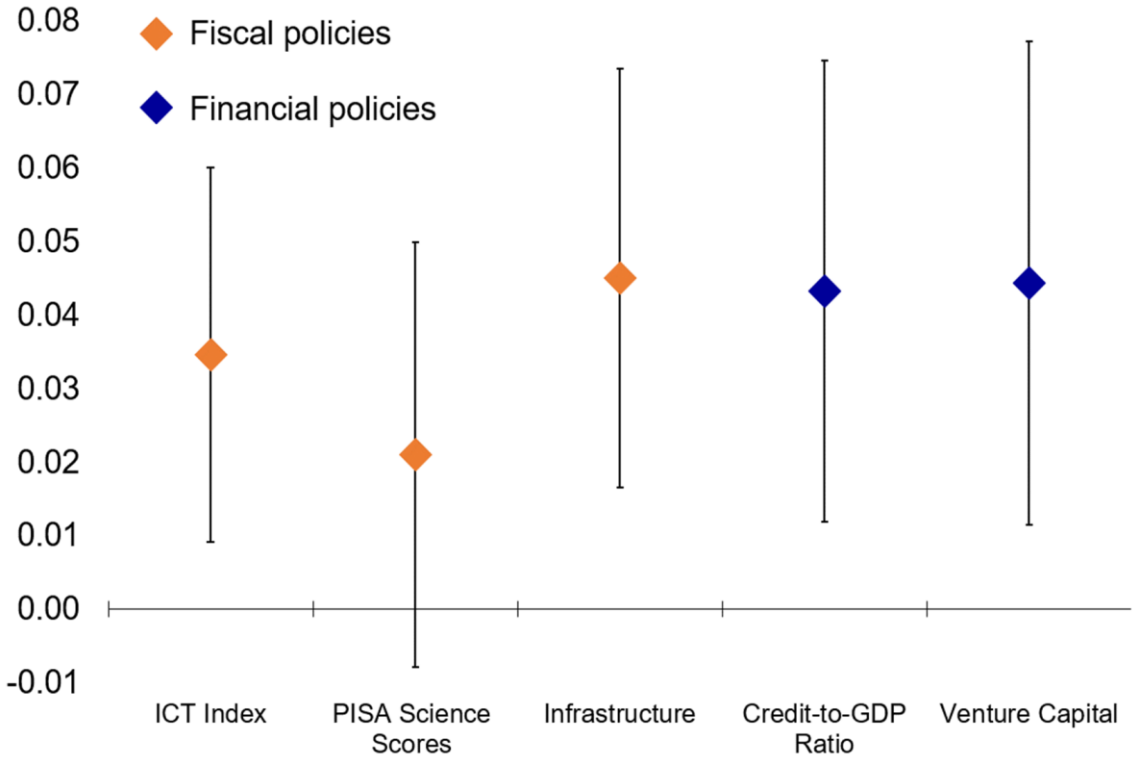


Sources: CEPII, Damgaard, Elkjaer, and Johannesen 2024; IMF, April 2023 World Economic Outlook; OECD, WTO Balanced Trade in Services database; Penn World Tables; UN; World Bank; and IMF staff calculations.
Notes: Left: Estimated coefficients from a panel augmented gravity model for 21 EMDEs over 2009-2017. Whiskers indicate 90-percent confidence intervals. All indexes are standardized. Right: Estimated impact of corresponding policy changes on growth in TFP and GDP in EMDEs.

Fiscal and financial policies can also improve diffusion *across firms*

- Firm-level estimation for AEs and EMs
  - Diffusion = impact of global patent growth on TFP growth of domestic firms in the same industry.
- Public investment in infrastructure and connectivity accelerates diffusion to laggards
  - One-standard-deviation improvement in policy index doubles diffusion rate
- Together with adequate financing policies

Impact of Policies on Technology Diffusion to Laggard Firms
(TFP impact after 1% increase in industry patents, ppt change if policies increase by one standard deviation)



Sources: European Patent Office, PATSTAT; IMF, Financial Development Index; IMF, October 2023 World Economic Outlook; Orbis; World Economic Forum 2019; and IMF staff estimates.
Notes: Panel regression estimates of increase in firm-level TFP after 1% increase in industry-level global patents (lagged), interacted with a 1 SD increase in each policy in 35 countries over 2005-20. Laggards defined as bottom 40th percentile of TFP by country, industry, and year. Whiskers indicate 90-percent CIs.

Key Takeaways

1. Countries should avoid **targeting specific sectors** – unless social gains are clear and capacity is strong.

2. **Countries at the technology frontier** should promote innovation more broadly by increasing public investment in fundamental research and incentivizing R&D across firms.

3. **Countries below the frontier** should focus on technology adoption, by investing in physical, digital, and human capital – and tax efficiently to facilitate trade and investment while raising revenue

4. **International collaboration** is critical for innovation and technology diffusion. Resist pressures for inward-looking industrial policies.

Thank you