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Industrial and innovation policies in times of crisis: a widening technological divide?

THE REVIVAL AND CHANGING NATURE OF INDUSTRIAL POLICY

Industrial policies are gaining increasing relevance, becoming centrepieces of many government policy agendas. These policies aim at changing the structure or sectoral composition of the economy in line with strategic and medium-term goals, such as export diversification, technology upgrading and industrialisation. As such, industrial policies include a broad range of issues, including "infant industry" support, science, technology and innovation (STI) policies, trade and foreign direct investments policies and intellectual property rights, public procurement policies, and policies shaping the allocation of financial resources (Chang, 2010).

Despite the ongoing revival, industrial policies have for several decades been strongly criticised. In fact, since the 1980s, under the neoliberal and mainstream view in international organisations and most of academia, there were strong pressures on developing countries towards the implementation of the "good policies" and "good institutions" in line with the so-called Washington Consensus. This included trade liberalization, deregulation of markets, price flexibility and privatisation of state-owned companies. This strategy downplayed the government's role in the process of technological learning and economic growth. As such, industrial policies were rejected, even though many developed economies, including the United States, Japan and Germany, were very active in implementing them in their early industrialisation stages (Chang, 2002). Crucial arguments against industrial policies were information shortcomings ("*governments cannot correct market failures*") and political capture ("*governments cannot pick winners*").

The resurgence of industrial policies is not new; it began about two decades ago as neoliberal policy prescriptions proved inadequate to foster structural and technological change and support the green energy transition. On the one hand, there was a rising recognition in the medium-term benefits of industrial policies (Cimoli, Dosi and Stiglitz, 2009; Juhász, Lane and Rodrik, 2023), and the pervasiveness of market failures, including externalities, information asymmetries, transaction costs, and appropriability problems. For example, the experiences of several East Asian economies illustrated how industrial policies played a crucial role in promoting structural change and technological upgrading. On the other hand, there was a growing recognition of the need for addressing the challenges in industrial policies themselves, including government failures, the problem of cherry-picking, political capture, and rent-seeking activities. Thus, the debate in academia, international organisations, as well as among policymakers, became less ideological and moved away from "why" to focus on "what" and "how" in the real world (Chang, 2010). As such, the prevalence and scope of industrial policies expanded during the 2010s (figure 1).

Since 2020, multiple and over-lapping crises battering the world economy have significantly underscored the need for industrial policies, particularly policies for strengthening innovation and supporting productive

KEY MESSAGES

- Industrial and innovation policies are gaining additional traction, becoming crucial aspects of many governments' toolkits to support innovation, build resilience, and accelerate the green energy transition. There are, however, enormous disparities across economies in their capacity to implement industrial policies, particularly those to support science, technology and innovation.
- Most developed countries – and some that are developing – are implementing bold, ambitious, and long-term innovation policies towards strengthening technological capabilities, bolstering R&D investments, and supporting advanced manufacturing and green energies. Amid lack of fiscal space and vulnerable fiscal frameworks, institutional deficiencies, and weak innovation ecosystems, developing countries –particularly in Africa and Latin America and the Caribbean – face enormous challenges in implementing strategic innovation policies.
- Under the current economic, financing, and institutional conditions and policy trends, the technological divide across economies could widen even further in the coming years, limiting the progress of developing countries towards the Sustainable Development Goals and leaving many of them further behind.

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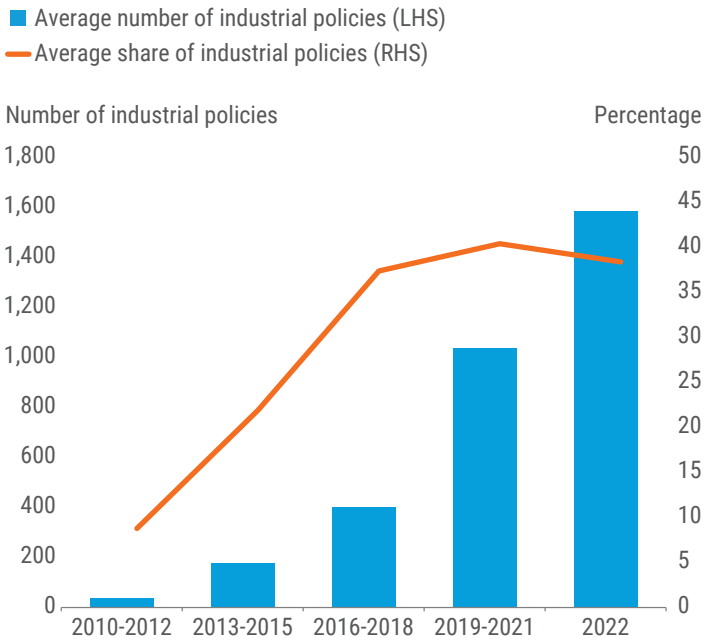
and technological capacities. For example, the COVID-19 pandemic and the war in Ukraine uncovered critical supply chain weaknesses and productive vulnerabilities, underscoring domestic resilience and national security issues over cost efficiency considerations. Growing geopolitical rivalries are also prompting the United States, China, and countries in the European Union (EU) to expand their industrial and innovation policies to retain or enhance competitive advantages. As such, fostering productive capabilities and research and development (R&D) investments – a crucial input for innovation – have become a top policy priority. In some cases, increasing geopolitical concerns have also led to an increase in R&D investments in defence and to policies aiming at reducing technological interdependencies (OECD, 2023). The rising impacts of the climate crisis, particularly in developing economies, also call for stronger policies that can accelerate the green energy transition.

Against this backdrop, many governments are increasingly promoting domestic R&D activities and subsidising manufacturing, particularly in high-tech sectors such as semiconductors, as well as supporting low-carbon innovations and public and private investments to advance the green energy transition. In 2022, estimates show that global R&D investments reached a record of $2.5 trillion, mainly due to an increase in economies that more intensively invest in R&D, including China, Germany, Japan, the Republic of Korea, and the United States (R&D World, 2023). Collectively, these five economies account for about 73 per cent of total R&D expenditures worldwide.

Innovation policies are also gradually shifting, taking a more ambitious, systemic, and strategic approach. As a result of the recent crises, many governments are establishing more direct initiatives (e.g., financing projects that the private sector is not willing to finance, or targeting specific sectors), establishing clear priorities and, in some cases, committing significant amount of financing resources.[1] Thus, innovation policies are gaining greater "directionality". This is going beyond the "fixing market failures" view of innovation policies, allowing a more active participation of the State in creating and shaping markets. The consideration of "goals" for innovation efforts, helps align them with larger priorities such as for sustainable development. Given limited fiscal space, public-private partnerships are also expanding to exploit complementarities and facilitate co-investments in collaborative research programmes and centres, and commercialisation initiatives for emerging technologies.

Figure 1

Number and share of industrial policies at the global level



Source: Rodrik and others (2023).

Note: LHS=left-hand scale; RHS=right-hand scale. The data corresponds to average for each three-year period, except for 2022. The share of industrial policies corresponds to the number of industrial policies among all interventions in the Global Trade Alert. The Global Trade Alert Database provides information on state interventions that are likely to affect foreign trade, including interventions affecting trade, foreign investment and migration (https://www.globaltradealert.org/). Policies are classified as "industrial policies" by a machine learning algorithm at a country-industry-year level. This algorithm classifies industrial policies based on the textual description of the objectives from different policies.

In addition, some governments are increasingly using conditionalities for subsidies, guarantees, grants, loans and other measures to promote socially and environmentally desirable technologies and to maximise public benefits. The use of conditionalities can encompass multiple areas, including firm behaviour, fixed versus negotiable conditions, and risk/reward sharing mechanisms. For example, firm behaviour conditionalities often entail issues of access (ensuring equitable and affordable access to resulting products and services); goals (e.g., net zero emissions); profit-sharing (e.g., through royalties or equity with government) or reinvestment of profits (e.g., reinvestments in worker training or R&D activities) (Mazzucato and Rodrik, 2023).[2]

1 Innovation policies can take direct or indirect approaches (Dosi and others, 2023). Indirect policies ("market friendly") provide monetary incentives to firms through R&D subsidies or tax discounts. Direct policies entail a more active role of the public sector in shaping the intensity and direction of innovative efforts, taking risks that private firms are not willing to take, and pursuing path-breaking technological developments.

2 The use of conditionalities has been emphasised in several successful industrialisation experiences in East Asia. For early works on the importance of conditionalities on implementing industrial policies, see Amsden (1989).

THERE ARE ENORMOUS DISPARITIES ACROSS COUNTRIES

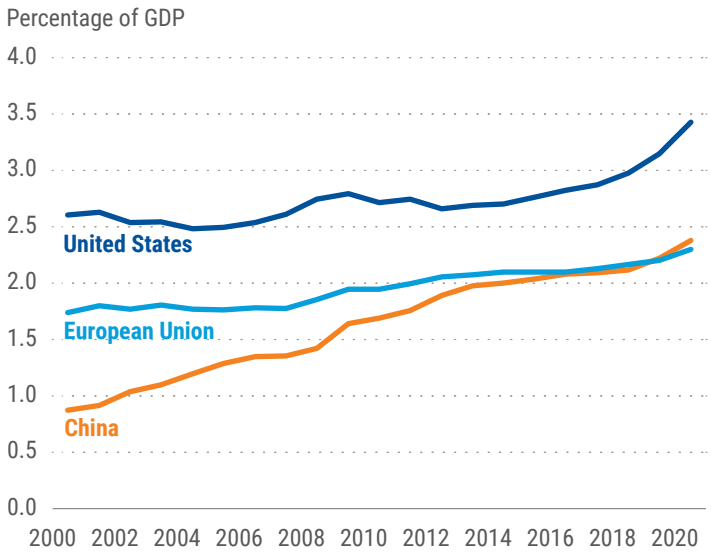
The developed economies, together with China, are targeting their policy initiatives towards advanced technologies and green energy. These initiatives are focusing on crowding-in private investments, fostering R&D investments and supporting domestic manufacturing capacities. In many cases, the initiatives target specific sectors, and secure large financing resources under well-defined strategies. A strong political commitment and ample fiscal space have been critical for achieving this objective. R&D investments showed an unprecedented resilience in the wake of the pandemic, marking the first time that a global recession did not lead to a reduction in R&D investments and becoming a critical aspect of the policy responses to the pandemic crisis (OECD, 2023). Moreover, R&D investments were increasing in developed economies and China even before 2020 (figure 2). This was also supported by public policy efforts. In fact, the public funding for R&D investments between 2015 and 2022 increased significantly in Germany, Japan and the Republic of Korea above 50 per cent. Public budgets for R&D investments in OECD countries expanded by about 37 per cent (OECD, 2023) during the same period.

In the United States, the Inflation Reduction Act (IRA) ($440 billion), Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act ($280 billion) and the Infrastructure Investment and Jobs Act (IIJA) ($550 billion) commit enormous resources to strengthen innovation, promote domestic production and the green transition, and modernise public infrastructure. The IRA is considered one of the most significant climate change legislations in the United States to date, with more than $350 billion dedicated to climate and clean energy programmes. In addition to accelerating investments in domestic manufacturing, it propels R&D and commercialisation of advanced technologies such as carbon capture and storage and clean hydrogen. The CHIPS and the Science Act seek to boost semiconductor R&D investments and production, reducing supply-chain dependencies. These will also channel $200 billion on R&D investments and commercialisation to artificial intelligence, quantum computing and robotics, among others. Notably, by mid-2023, $220 billion in semiconductors and clean technology projects, including electric vehicles, batteries and solar and wind parts, had been announced since the IRA and CHIPS Act were signed into law (Chu, Roeder and Irwin-Hunt, 2023).

China continues to prioritise innovation as a principal component of its development strategy, targeting specific industries. As such, R&D investments, as a percentage of GDP increased rapidly and continuously in the last two decades, from 0.89 in 2000 to 1.71 per cent in 2010 and 2.55 per cent in 2022, surpassing the R&D intensity in the EU (figure 2). The 14th Five-Year Plan seeks to expand R&D by 7 per cent annually between 2021–2025 by escalating the availability and scope of different policy measures in artificial intelligence, quantum computing, and integrated circuits. In addition, the "Made in China 2025" policy promotes domestic manufacturing in aerospace, biotech, information technology and electric vehicles sectors. Also, the government is using public-private investment funds to leverage capital in support of strategic technologies.

Figure 2

R&D investments, major economies



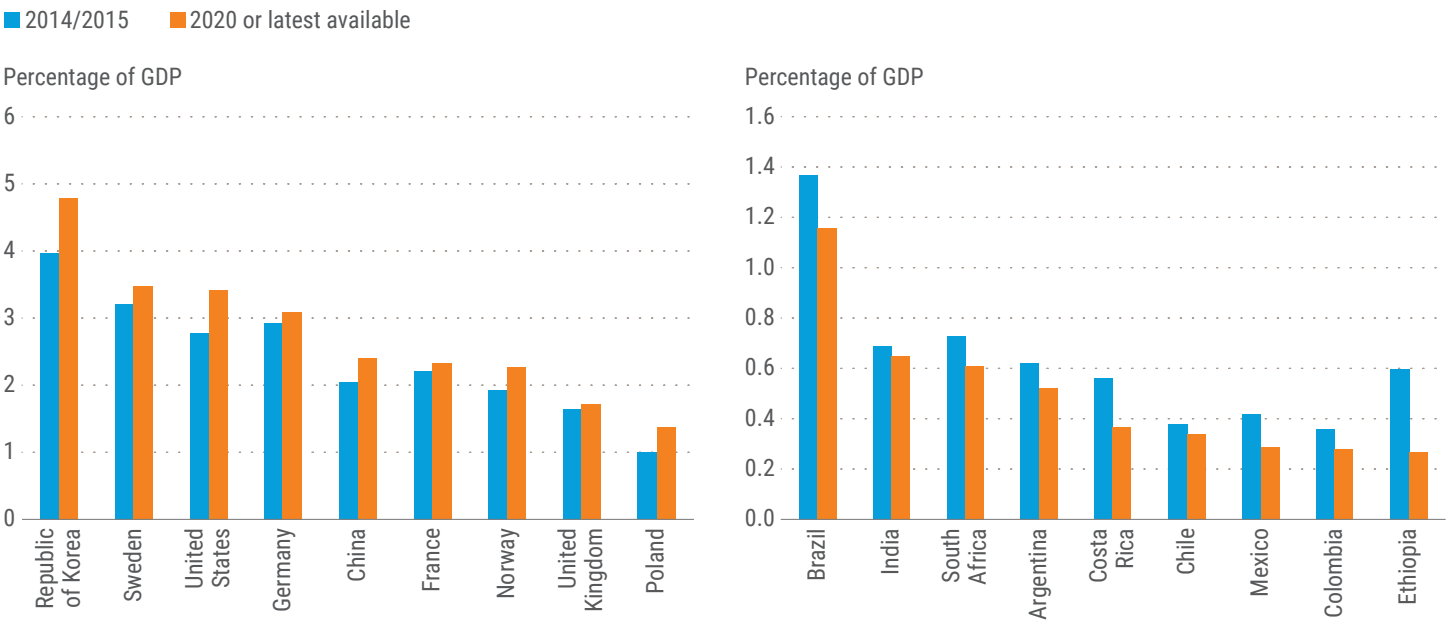
Source: UN DESA, based on data from the UNESCO.

Meanwhile, the European Union introduced "Horizon Europe", a 7-year innovation plan (€95 billion) to augment technological capabilities, R&D investments, and green and digital transitions. In addition, the EU is also fostering key technologies to reduce its main productive dependencies. For example, the "European Chips Act" seeks to propel the semiconductor industry. In the United Kingdom, the latest public budget allocates record levels of public R&D investments, with the aim of investing 2.4 per cent of GDP by 2027. The United Kingdom also recently announced a new "National Semiconductor Strategy", a 20-year plan for boosting the industry and R&D activities. Also, the new "Future Fund: Breakthrough" programme establishes a mechanism so that private investors can co-invest with the government in high growth innovative firms in quantum computing, clean technologies, and other key sectors.

In Japan, public expenditures will also prioritise incentives to promote digitalisation and R&D activities in

Figure 3

R&D investments, by country



Source: UN DESA, based on data from UNESCO.

semiconductors and renewable energies. Other developed countries such as Australia, Finland, Germany, Iceland and Sweden have also recently expanded the policy support for productive capacities and R&D investments.

In contrast, industrial and innovation policy efforts in the developing economies are significantly smaller in scale and scope, largely due to lack of strategies for structural transformation and limited fiscal space.[3] Recent studies confirm that industrial policies, even before the pandemic crisis, were less prevalent in the developing economies (UNIDO, 2023; Juhász, Lane and Rodrik, 2023). Among the developing countries, it is primarily the middle-income economies that use industrial policies. Innovation policies, in particular, are largely constrained in scope, remain subordinated to other policies and social priorities, and lack adequate financing resources and clear medium-term strategies, for example in Latin America and the Caribbean (Peres and Primi, 2019; ECLAC, 2022).

Many large emerging economies experienced weak R&D investment even before the pandemic crisis. Between 2015 and 2020, R&D investments declined in Brazil, India, Mexico, and South Africa, in contrast to the trend observed in developed economies (figure 3). Among developing countries, only a few East Asian economies were able to implement strategic innovation policies in recent decades able to contribute to export diversification and improved participation in global value chains. Currently, Indonesia, Malaysia and Thailand are revamping their policy support towards innovation and R&D in specific sectors, such as semiconductors and electronics.

In some economies of Latin America and the Caribbean, for example, public budgets towards STI are only slowly recovering from substantial cuts due to the global crises.[4] Moreover, for many commodity exporters, innovation budgets suffered expenditure cuts that started in 2015. In Brazil, the federal budget for STI fell by around 30 per cent between 2014 and 2021. In Chile, the public budget for STI fell by 43 per cent between 2018 and 2021. In Africa, public policies for innovation suffer from a structural underfunding, and the recent crises have further limited public budgets. In Kenya, budgetary allocation to innovation and information and communication technologies fell over 50 per cent between 2019 and 2023.

3 The developing countries still have considerable policy space for industrial policies, unless they have signed bilateral agreements with developed economies (Andreoni and Chang, 2020). In fact, many industrial policies are domestic in nature, such as targeted infrastructure investments, subsidies for R&D, government procurement programmes, tax incentives for physical investments, and the strategic use of State-owned enterprises. Also, many industrial policies that are international in nature can still be used, including the use of tariffs. Regarding subsidies, the WTO categorically bans only those for export promotion and those requiring local contents.

4 Science, technology and innovation (STI) policies are government initiatives designed to support basic research, technology development, and innovation commercialisation and adoption.

Most governments in developing economies clearly face enormous fiscal constraints to implement industrial and innovation policies, given elevated levels of debt, rising debt servicing costs and large output losses from the pandemic crisis. More than 50 developing economies spend more than 10 per cent of their revenues on interest payments and 25 countries spend more than 20 per cent. In addition, many economies face rising social and development needs. Thus, most governments lack fiscal space and financing resources for industrial and innovation policies. Low-income countries are in the direst situation, as many of them are in debt distress or at high-risk of debt distress.

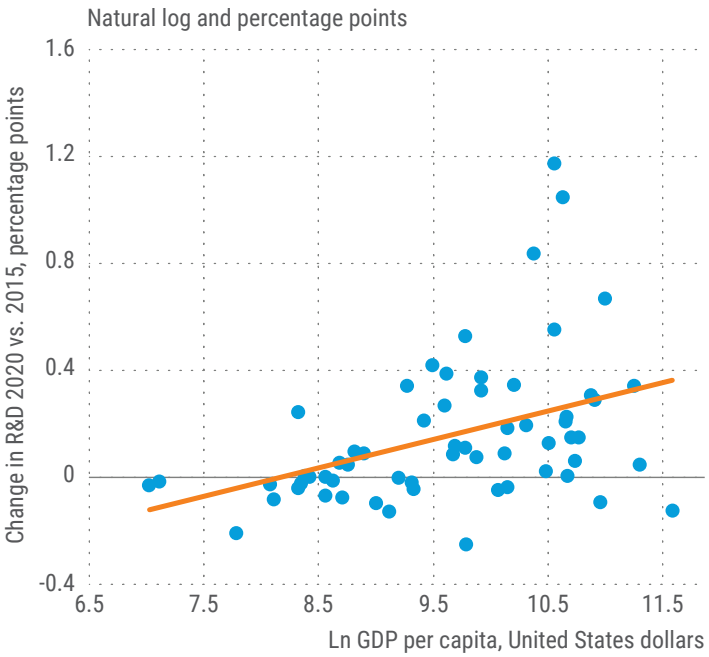
This situation is further compounded by structural factors in developing countries. Institutional capabilities are weak, and innovation policies have generally suffered from lack of political commitment. In addition, these countries have a limited scientific community and low labour force skills, and innovation activity is concentrated in low-tech sectors. As such, R&D investments are low, with a limited participation of private firms and lack of interactions with universities. Furthermore, innovative firms tend to operate isolated, without creating upstream and downstream linkages.

Consequently, many of the developing countries are holding on to their static comparative advantages and failing to build innovation and technological capabilities and target and pursue their dynamic comparative advantages. Well-designed and well-funded industrial policies, including the strategic use of conditionalities, can be the bridge between static and dynamic comparative advantages. A usual counterargument emphasises that developing economies, especially the least developed countries, still need to enhance their capital stock before focusing on innovation. However, innovation is a cumulative learning process that should be enhanced to avoid situations of "lock-in" and "path dependency" in commodities and low-productivity sectors, which traps these countries into a vicious cycle of underdevelopment (Arthur, 1989). Thus, it is crucial that developing countries can effectively innovate and build technological capabilities simultaneously with enhancing capital accumulation.

Interestingly, there were indications that technological efforts across economies were diverging even before the pandemic crisis. Between 2015 and 2020, for example, the change in R&D investments was positively correlated with GDP per capita (figure 4). Thus, developed economies tended to increase R&D investments more intensively than developing economies. Between 2015 and 2020, R&D investments in developed economies increased from 2.37 to 2.74 per cent of GDP. Among developing economies, R&D investments in East Asia

Figure 4

Change in R&D investments between 2020 and 2015, and GDP per capita



Source: UN DESA, based on data from the World Economic Forecasting Model (WEFM) and UNESCO.

Note: The natural logarithm of GDP per capita values are for 2020.

increased from 2.04 to 2.29 per cent, and they declined from 0.35 to 0.32 and from 0.72 to 0.63 in Africa and Latin America and the Caribbean, respectively. In low-income countries, R&D investments fell from 0.26 to 0.23 per cent in the same period.[5]

A WIDENING TECHNOLOGICAL DIVIDE?

Under the current economic conditions and industrial policy trends, most developing economies will encounter enormous difficulties to strengthen their productive and technological capacities in the coming years. The resurgence of industrial policy in the developed economies, along with the ongoing political fragmentation of the world economy and the onshoring and re-shoring of manufacturing away from many developing countries could imply less foreign direct investment (FDI) and fewer technology transfers and diffusion to the developing countries (Ahn and others, 2023; UNCTAD, 2020).

5 Regarding patents applications per million inhabitants (usually considered as an outcome of innovation efforts), most developing countries have not been able to catch up with the performance of developed countries in recent decades. Only China and a few other countries from East Asia were able to significantly expand their patent applications. Patent applications in African and Latin American countries remain largely limited.

In addition, trade growth remains subdued, and it is projected to remain so in the coming years, constraining productivity growth. In fact, limited export growth constrains the benefits from economies of scale, spillovers and the acquisition of knowledge associated with closer interaction with international markets (Vergara, 2017).

These trends will inevitably widen the technological divide between the developed and developing economies. Moreover, there are rising risks that the technological divide and the divergence of R&D investments could expand further even among the developing countries. Amid high risk of debt distress, low-income countries will remain severely constrained to implement industrial and innovation policies to strengthen their productive capacities and foster the green energy transition.

Moving ahead, it is critical for developing countries to redouble their efforts towards building institutional capacities and implementing effective innovation policies. For low-income countries and middle-income countries with vulnerable fiscal frameworks, debt relief measures are indispensable to help create fiscal policy space. Strengthening innovation systems and absorptive capacities will be crucial to creating new and sustainable sources of growth and jobs, diversifying exports and accelerating the energy transition.[6] This is critical for developing economies, many of which have seen a deterioration in their potential output in recent years. Furthermore, innovation capabilities will be critical to benefit from the disruptive technological changes emerging in advanced manufacturing, transport and logistics, energy transition, and digital services. Ambitious, strategic, and well-coordinated industrial and innovation policies can reduce the technological gaps across economies in the coming years and accelerate progress of developing countries towards the SDGs.

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Vergara, S. (2017). The slowdown in productivity growth: A view from international trade. Development Issues No. 11, April. New York: United Nations Department of Economic and Social Affairs.

6 The green transition offers new opportunities for accelerating growth and building technological capabilities in developing countries. Some countries are taking incipient steps in that direction. Chile, for example, is making important advances in implementing a national strategy to develop its green hydrogen industry, which would entail the development of productive capacities, productive linkages, and local knowledge. Also, Brazil launched an ambitious green transition package with hundreds of billions of dollars in investments through public and private partnerships. The plan involves initiatives across several areas, from carbon trading and bioeconomy to infrastructure adaptation, including federal funds for R&D investments in green technologies.