

# ARE INDUSTRIAL POLICY INSTRUMENTS EFFECTIVE?

A REVIEW OF THE EVIDENCE  
IN OECD COUNTRIES

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*Are industrial policy instruments effective?  
A review of the evidence in OECD countries*

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*While the case for industrial policy is gaining traction across OECD countries, little consensus exists on the effectiveness of such interventions. Building on a new analytical framework for industrial policy developed in a companion paper (Criscuolo et al., 2022<sup>[1]</sup>), this paper reviews the empirical literature on the effectiveness of industrial policy instruments, laying out the knowns and unknowns. Overall, it strongly supports the premise that well-designed economic incentives for firms and good framework conditions shaping the business environment are effective. At the same time, it emphasises the limited and inconclusive nature of the evidence regarding the increasingly frequent targeted and demand-side instruments. Finally, it underlines the complementarities between economic incentives and other interventions such as skill policies or framework conditions, notably competition and trade policies. Framework conditions are indeed key in enabling the most productive firms to grow and an important channel for structural change.*

**JEL codes:** L52, L53, O25, O38, Q58

**Keywords:** industrial policy, tax expenditures, subsidies, public loans, public guarantees, public venture capital

## *Executive summary*

While the case for governments to perform a strategic and coordinating role in the private business sector is gaining traction across OECD countries, little consensus exists on the effectiveness of such interventions. In addition, despite the fact that new waves of interventions increasingly rest on the combination of various types of policy instruments within strategies, a synoptic view on the evidence related to complementarities and trade-offs between instruments is still lacking.

This paper reviews the empirical literature on the effectiveness of industrial policy instruments, laying out the knowns and unknowns of industrial policy, building on a new analytical framework for industrial policy developed in a companion paper. This analytical framework is aimed to analyse the formulation of industrial policies, defined as interventions intended to improve structurally the performance of the domestic private business sector. Importantly, the framework relies on a new taxonomy of instruments following the neo-Schumpeterian growth literature with a distinction between demand-pull instruments and two types of supply-push instruments: those that improve firm performance (“within” firm instruments) and those that affect industry dynamics (“between” or framework instruments). The companion paper also underlines the multidimensional nature of performance, thereby acknowledging that objectives of industrial policy can go beyond productivity growth and innovation to include, inter alia, sustainability, resilience, or strategic autonomy.

Overall, the review of existing empirical evidence strongly supports the premise that well-designed economic incentives for firms and good framework conditions are effective. At the same time, it emphasises the limited and inconclusive nature of the evidence regarding the increasingly frequent targeted and demand-side instruments. Given some important blind spots identified in the literature, the paper also calls for more empirical work, in particular on the effects of industrial policy instruments on other objectives, such as resilience, inclusiveness, environmental and social performance of firms, as well as on the evaluation of industrial strategies. More precisely, this paper identifies **four key findings** that industrial policy making should take into account when formulating interventions.

- **First, well-designed R&D tax credits and subsidies are effective in stimulating R&D and innovation, while skill and knowledge transfer policies are key complementary instruments.** Among the different types of economic incentives, the most studied by far are R&D tax credits and subsidies. While it has long been recognised that they stimulate R&D expenditures, recent studies also show that they increase innovation. However, the literature remains silent on important questions. In particular, the impact of these incentives on other objectives of industrial policy, such as environmental and social performance, inclusiveness, resilience or strategic autonomy remains largely unexplored. In addition, best practices for designing and modulating R&D incentives continue to be an open question. The evidence on the effectiveness of non-R&D incentives and risk-sharing instruments (such as public venture capital, loans and guarantee schemes) is growing, but remains scattered. Finally, instruments improving “access to inputs”, such as skill and knowledge transfer policies, are complementary to, i.e. enhance the effectiveness of, investment incentives and contribute to increasing the absorptive capacities of the least productive firms, thereby fostering technology adoption.
- **Second, there is limited evidence on the effectiveness of targeted grants and subsidies,** even as they become increasingly topical. The scarce evidence,

concentrated on the role of grants for R&D and investment, tends to show that effectiveness is higher for young and small firms rather than on large firms and multinationals. In addition, it seems that these instruments contribute to reducing asymmetry of information between investors and innovative ventures, thereby alleviating financial constraints. This suggests that, instead of grants, financial instruments, such as public loans, guarantees or public venture capital, could be interesting tools for targeted interventions. The piecemeal evidence also suggests that targeted policies should avoid technological biases and that the whole industrial ecosystem, often more than a single sector, should be taken into account when designing industrial policy. Going forward, evaluations of targeted interventions should consider the potential spillovers on non-targeted firms and the interactions between policy instruments within targeted strategies.

- Third, **framework conditions shaping the business environment, notably competition and trade policies, are key in enabling the most productive firms to grow and an important channel for structural change.** Reallocation between firms is one of the main drivers of productivity growth and structural change. In particular, a large body of evidence shows that competition policy promotes efficiency-enhancing resource reallocation and, indirectly, incentivises firms to innovate and adopt new technologies. Although industrial policy often aims to insulate domestic companies from existing and potential competitors, this evidence casts serious doubts on the effectiveness of such “national champions” initiatives. Likewise, the literature unambiguously rejects the use of trade protection as an effective industrial policy tool, even if trade openness raises relevant policy questions in terms of possible effects on increases in inequalities, the potential non cooperative behaviour of some countries and the resilience of global value chains.
- Fourth, **demand-side instruments can effectively complement supply-side instruments to foster innovation.** The literature shows that carbon pricing and environmental regulation are effective instruments to foster the green transition of firms, with only limited negative impacts on competitiveness, even though command-and-control regulations can limit business dynamics in the long-run. Open questions remain as demand-side instruments play an increasingly important role in transformative mission-oriented industrial strategies, including the optimal combination of supply- and demand-side instruments. Evidence on the effectiveness of public procurement policies is also lacking, even if public procurement could be effective in stimulating innovation when demand emerges from the public sector (e.g. aerospace, defence, infrastructure).

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## 1. Introduction

The case for governments to more actively direct structural change in the business sector is gaining traction across OECD countries in the wake of major shocks and long-term trends, such as the 2008 Global Financial Crisis, the current COVID-19 pandemic, tensions in international trade, the productivity slowdown, the digital transformation and climate change. Questions on the role and modalities of industrial policy in advanced economies have returned in both academic and policy circles.

The COVID-19 crisis is reinforcing the perceived urgency of global societal challenges and is highlighting the role of industrial policy, notably through large-scale recovery plans that are now being implemented around the world (Hepburn et al., 2020<sup>[2]</sup>). Industrial policy is gaining further traction as countries seek to ensure a green, digital and inclusive recovery after the Covid-19 pandemic, with a goal of building back better. Following these urgent needs, governments have announced new industrial strategies in recent years such as the European Green Deal (2019), the Next Generation EU fund (2020), the Korean New Deal (2020), the American Rescue Plan Act (2021) and the EU New Industrial Strategy (2020, updated in 2021). The COVID-19 crisis has also prompted the emergence (or the revival) of new industrial policy objectives, such as economic resilience and strategic autonomy.

A tempered and rational debate on industrial policies requires both a clear framework and a stocktaking of the existing evidence. Against this backdrop, a companion paper (Criscuolo et al., 2022<sup>[1]</sup>) offers new perspectives on a present-time industrial policy paradigm for OECD countries. It proposes a coherent framework for analysing the formulation of industrial policy, defined as interventions intended to improve structurally the performance of the domestic business sector, including a new taxonomy of industrial policy instruments (Box 1 and Figure 2). The taxonomy follows the neo-Schumpeterian growth literature in distinguishing between demand-side instruments and two types of supply-side instruments: those that improve firm performance (“within” instruments) and those that affect industry dynamics (“between” or framework instruments). The companion paper further underlines the multidimensional nature of performance, thereby acknowledging that objectives of industrial policy can go beyond productivity growth and innovation to include, inter alia, sustainability, resilience, or strategic autonomy.

Relying on this taxonomy, this paper synthesises the key papers providing empirical evidence on the effectiveness of industrial policy instruments in OECD countries.

Available literature reviews often focus on innovation policies and objectives (OECD, 2015<sup>[3]</sup>; Bloom, Van Reenen and Williams, 2019<sup>[4]</sup>; Edler et al., 2016<sup>[5]</sup>) or do not account for the recent evidence and the renewed interest in targeted and mission-oriented industrial policies (Warwick, 2013<sup>[6]</sup>; Warwick and Nolan, 2014<sup>[7]</sup>). This review tries to fill this gap.

The paper identifies **four key findings** that industrial policy making needs to take into account when formulating interventions. First, well-designed R&D tax credits and subsidies are effective in stimulating R&D and innovation, while skill and knowledge transfer policies are key complementary instruments. Second, there is limited evidence on the effectiveness of targeted supply-side interventions, even as they become increasingly topical. Third, framework conditions shaping the business environment, notably competition and trade policies, are key in enabling the most productive firms to grow and an important channel for structural change. Fourth, demand-side instruments can effectively complement supply-side instruments to foster innovation.

This literature review also underlines important blind spots regarding the effects of industrial policies:

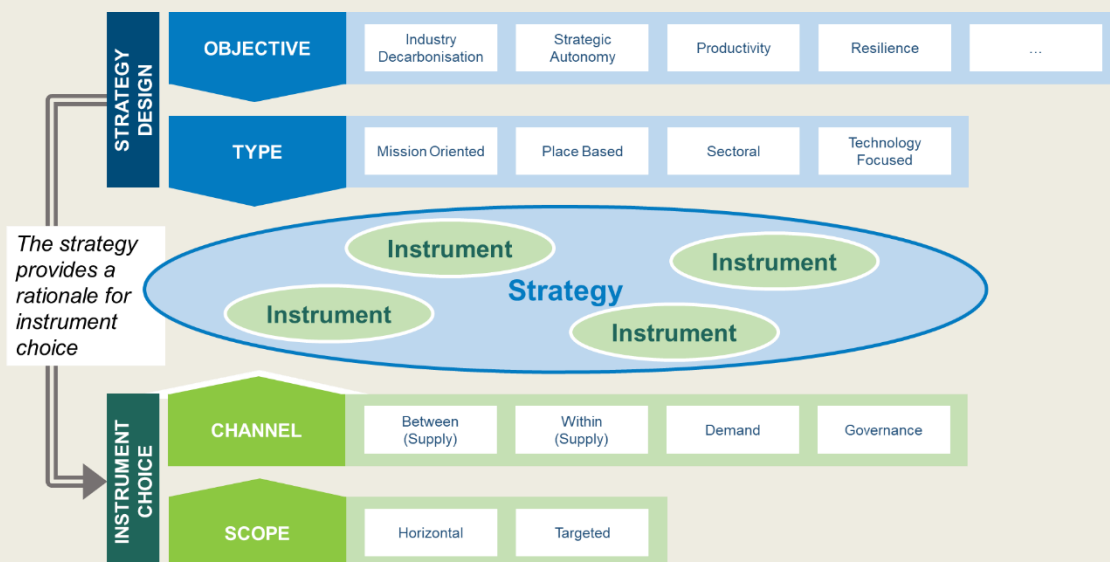
- Even if this paper takes into account the growing number of objectives assigned to industrial policies, the bulk of the evidence focuses on the impact of industrial policy instruments on innovation, productivity and growth. There is an urgent need for more empirical work on the effects of industrial policy instruments on other objectives, such as resilience, inclusiveness, and the environmental and social performance of firms.
- Whereas empirical work mainly analyses individual instruments, governments are increasingly resorting to industrial policy strategies (Box 1), which bring together several policy instruments that are considered as complementary. Despite extensive evidence on the complementarity between the various categories of instruments, such strategies have rarely been evaluated.

Section 2. focuses on the effectiveness of ‘within’ instruments. Given the particular emphasis on targeted policies in the industrial policy debate, Section 3. consists in a deep dive in the evaluation of targeted policy instruments. Section 4. then describes the available evidence on the role of framework conditions, with a special focus on competition and trade policies. Finally, Section 5. summarises the available evidence on demand-side policies, echoing their increasing importance in mission-oriented industrial strategies.

**Box 1. An industrial policy framework for OECD countries**

The formulation of industrial policy rests on the combination of instrument choice and strategy design (Figure 1). On one hand, a strategy is designed in order to achieve a predefined objective. On the other, instruments with specific targets and channels are chosen and bundled.

**Figure 1. The formulation of industrial policy**



Source: Criscuolo et al. (2022<sub>[1]</sub>)

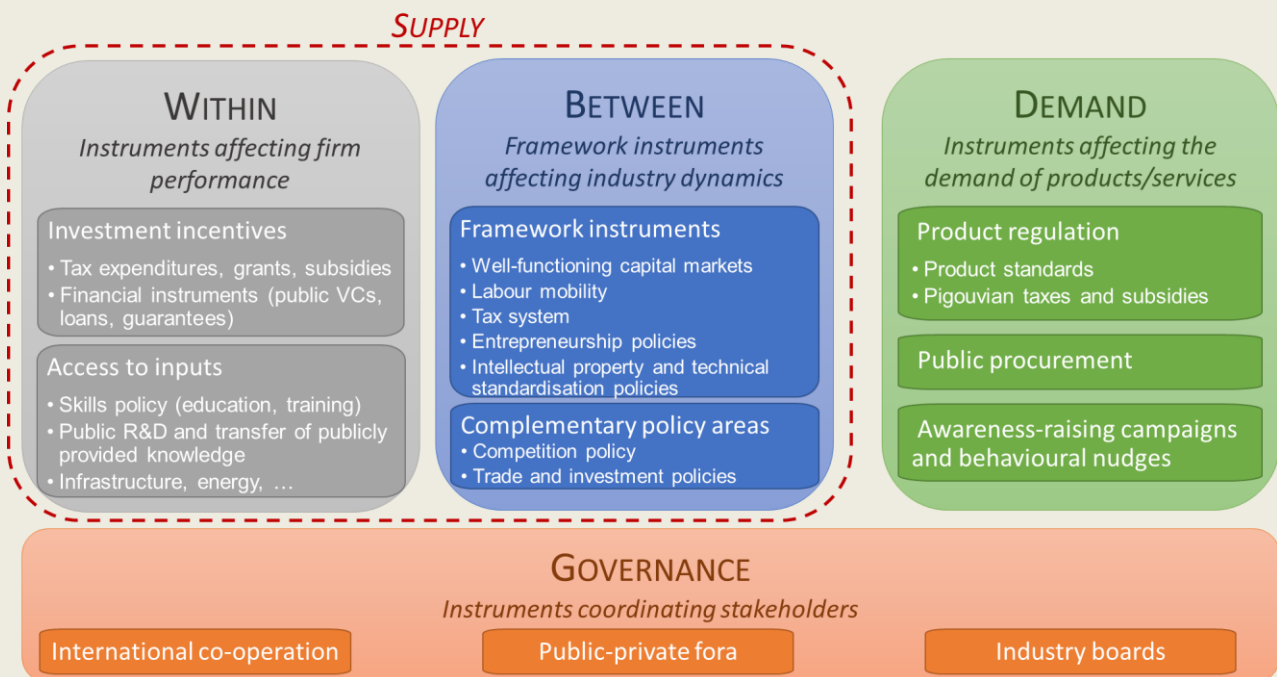
The framework introduces a new taxonomy of industrial policy instruments (Figure 2), which allows (i) uncovering the underlying rationales and channels through which different



instruments operate and (ii) underlining possible complementarities between different types of instruments. The new taxonomy is designed to serve as a conceptual backbone of industrial policy analysis, and is used throughout this paper to organise the literature review.

This taxonomy builds upon two essential distinctions. First, it builds on the mainstream split between supply-side instruments and demand-side instruments (Edler et al., 2016<sup>[8]</sup>). Supply-side instruments directly affect production decisions, while demand-side instruments directly affect consumption decisions, and apply to domestic consumption, irrespective of the location of production. Second, among supply-side instruments, the taxonomy further distinguishes those that affect efficiency within firms from those that affect the allocation of production factors between firms, following the productivity literature (Olley and Pakes, 1996<sup>[9]</sup>; Syverson, 2011<sup>[10]</sup>; Bartelsman and Doms, 2000<sup>[11]</sup>). This taxonomy allows capturing any interaction between different instruments in any industrial strategy.

Figure 2. Taxonomy of policy instruments



Note: Examples based on main channel through which policy instruments work.  
 Source: Criscuolo et al. (2022<sup>[1]</sup>).

## 2. The effectiveness of instruments affecting firm performance (‘within’ instruments)

### Key messages

Market failures such as knowledge spillovers, credit constraints or the public good nature of basic research justify the recourse to “within” instruments. These interventions aim at providing incentives for business investment through sharing either the costs or the risks with the public sector (e.g. tax expenditures, grants, subsidies, financial instruments) or affecting firm performance through the provision of efficiency-improving inputs (e.g. skills, public R&D, infrastructure).

From the evidence reviewed in this section, two decisive conclusions emerge for policy makers:

- Well-designed R&D tax credits and subsidies are effective in stimulating R&D and innovation;
- “Access to inputs” instruments, such as skill and knowledge transfer policies, enhance the effectiveness of investment incentives and contribute to increasing the absorptive capacities of the least productive firms, thereby fostering technology adoption.

Many unknowns and open questions remain, suggesting that significant efficiency gains can be potentially obtained from the optimisation of horizontal instruments, in particular regarding best practices for designing and modulating R&D incentives. The evidence on the effectiveness of non-R&D incentives and risk-sharing instruments (such as public venture capital, loans and guarantee schemes) is growing, but remains scattered. Even for R&D tax credits and direct subsidies, further studies are needed to provide a set of best practices.

This section provides a review of the literature on the effectiveness of ‘within’ policy instruments. The first subsection focuses on business investment incentives (tax expenditures, subsidies and financial instruments), while the second discusses ‘access to input’ instruments. While these two subsections report the evidence on the impact of instruments on innovation, productivity and growth, the last subsection briefly synthesises the scarce evidence on the effectiveness of these instruments on other policy objectives.

### 2.1. Incentives for business investment

Incentives for business investment can cover several assets, which are affected differently by externalities and market failures, thereby explaining the use of different policy instruments. First, some assets may be subject to positive spillovers or externalities. This is for instance the case for innovation and R&D investments, which are usually thought to bring knowledge spillovers to other firms, and for investments aiming at the reduction of carbon emissions. When assets are subject to positive spillovers and externalities, economic theory justifies the subsidisation of these investments, through tax expenditures, grants and subsidies. Second, credit constraints can affect any asset, but could be more acute for assets that cannot be pledged and more risky investments. Credit constraints can be lessened

through financial instruments, such as public loans, guarantees and venture capital, whose objective is to share risk between the private and public sectors<sup>1</sup>.

### *2.1.1. Tax expenditures, grants and subsidies*

Because the subsidisation of business investment can affect negatively competition (see Section 4. ), tax expenditures, grants and subsidies are often used to correct well-identified horizontal externalities, such as knowledge spillovers, or are part of targeted policies focusing on regions or industries affected by specific market failures (see Section 3. ). This is exemplified by the European framework for state aid, which prohibits government support except in a limited number of cases covered by exemptions, which are justified by market failures. For this reason, while there is a large body of evidence on innovation incentives, evidence on the effectiveness of non-R&D incentives are scarce, and mainly concerns targeted instruments, which are described in the next section.

A notable exception is bonus depreciation (sometimes called super- or hyper-amortisation), which has been used in a large number of countries over the last twenty years (e.g. France, Germany, Italy, the Netherlands, the United States). Bonus depreciation generally allows firms to amortise (some of) their investments more rapidly than usual, thereby reducing their corporate income tax base. Bonus depreciation is equivalent to a tax allowance that would reduce the after tax cost of capital, providing additional incentives to invest for eligible firms. In theory, as bonus depreciation lowers the cost of capital, it allows firms to undertake new investment projects whose rate of return is below the cost of capital absent the bonus depreciation.

Bonus depreciation seems to be effective in stimulating investment<sup>2</sup>. However, in line with theory, bonus depreciation seems to have a significant negative impact on the quality of investments, in particular for large and low-productivity firms (Eichfelder, Jacob and Schneider, 2020<sup>[12]</sup>). Calvino et al. (2022<sup>[13]</sup>) show that the Italian hyper-depreciation policy, despite having positive effects on the adoption of digital technologies, output, employment and productivity on aggregate, has limited effectiveness on micro and small firms, due to a lack of skilled workers and managers.

R&D tax credits have been extensively studied in the literature (Bloom, Van Reenen and Williams, 2019<sup>[4]</sup>; Becker, 2014<sup>[14]</sup>; Appelt et al., 2016<sup>[15]</sup>; What Works Centre for Local Economic Growth, 2015<sup>[16]</sup>; OECD, 2020<sup>[17]</sup>). There is now a large body of evidence in favour of their effectiveness in increasing business R&D expenditure, with most of the recent studies finding that each unit of tax credit translates into at least one additional unit of R&D – see Box 2. However, this input additionality is insufficient to assess the effectiveness of R&D tax credit in promoting growth.

On the one hand, the additional R&D expenditures prompted by tax credits may not directly translate into additional research or innovation.

- First, if researchers are in short supply, R&D tax credits can have inflationary effects on their wages, at least in the short run. The effect of R&D tax credits on R&D labour costs seems limited (see Box 1), but several studies distinguish short and long run effects of R&D tax credits and obtain higher long run responses (Appelt et al., 2016<sup>[15]</sup>).
- Second, some firms may relabel other types of expenditures into R&D expenditures (Bloom, Van Reenen and Williams, 2019<sup>[4]</sup>). To circumvent inflationary and relabelling effects, many analyses also measure the impact of R&D tax credits on the number of researchers or directly on innovation. Some recent studies uncover a causal link between R&D tax credits and innovation in firms (measured through

patents, or innovation surveys) (Dechezleprêtre et al., 2016<sup>[18]</sup>; What Works Centre for Local Economic Growth, 2015<sup>[16]</sup>). They confirm the positive effect on the number of researchers and innovation. Estimating the impact of R&D tax credit on innovation is statistically challenging since measures of innovation are imperfect and the time lag between the R&D expenditures and the innovation can weaken the ability to uncover significant relationships (Appelt et al., 2016<sup>[15]</sup>).

- Third, R&D tax credits may shift R&D activity across border, rather than genuinely increasing R&D at the global level. Knoll et al. (2021<sup>[19]</sup>) indeed find that this relocation effect largely contributes to the positive impact of R&D tax credits on R&D expenditures for multinational enterprises.

On the other hand, R&D tax credits are justified by knowledge spillovers. A complete cost-benefit analysis thus needs to take into account the impact of R&D tax credits on the other firms. Few studies have investigated the existence and magnitude of these spillovers, but they tend to substantiate their existence (Dechezleprêtre et al., 2016<sup>[18]</sup>; Bloom, Schankerman and Reenen, 2013<sup>[20]</sup>).

## Box 2. The Microberd distributed microdata project: Impact of public support for business R&D

Many governments use the tax system as an incentive mechanism to encourage business R&D investment (“tax incentives”). Preferential tax provisions relate to either R&D inputs (expenditures) or outputs (incomes from licensing or asset disposal attributable to R&D or patents). R&D tax incentives, especially expenditure-based, have become a major policy tool to support business innovation in OECD countries and partner economies. In 2017, R&D tax incentives accounted for about half of total government support for business R&D in the OECD area, up from about one third in 2000 (OECD, 2020<sup>[17]</sup>).

The pervasiveness of R&D tax incentives raises the question of their effectiveness in stimulating R&D, the heterogeneity of their effect across different types of firms and their interaction with other policies. Against this background, the microBeRD distributed microdata project investigates the structure, distribution and concentration of business R&D and R&D funding, and models the incidence and impact of public support for business R&D. In particular, the first phase of the project (2016-19) focused on R&D input additionality, i.e. the effectiveness of R&D support policies in encouraging additional business R&D investment compared to a counterfactual scenario without support.

The microBeRD project estimates incrementality ratios for tax and direct support measures, defined as the amount of R&D induced by one monetary unit of public funding (sometimes referred to as “the bang for the buck”). Five key findings emerge from the first phase of the project (OECD, 2020<sup>[17]</sup>):

- **Effect:** the gross incrementality ratio is around 1.3 across countries, i.e. one extra unit of R&D tax support translates into 1.3 extra units of R&D; the effect on experimental development is about twice as large as the effect on basic and applied research.
- **Mechanisms:** tax incentives increase both R&D expenditures and the level of human resources that firms report to dedicate to R&D; incentives do not appear to affect R&D unit labour costs, suggesting that the effects of tax incentives are not absorbed into higher wages. Incentives encourage additional business R&D

both because existing R&D performers increase their R&D expenditure (intensive margin) and because additional firms start performing R&D (extensive margin).

- **Heterogeneity:** the input additionality of R&D tax incentives is larger for small and medium-sized firms than for large firms, which reflects the fact that smaller firms perform less R&D than larger firms on average; similarly, little input additionality is found for firms in highly R&D-intensive industries (Pharmaceuticals, Computer manufacturing, Scientific R&D), reflecting the fact that their business models are based on R&D irrespective of policy interventions.
- **Complementarity:** exploratory analyses indicate slightly larger input additionality for direct R&D government funding measures compared to tax incentives; direct measures appear more conducive towards promoting research whereas tax support is principally associated with heightened levels of experimental development; this suggests that direct support and tax incentives are complementary.
- **Country level:** substantial heterogeneity in input additionality exists across countries; this is in part related to differences in the distribution of R&D expenditures and in the uptake of direct support measures and tax incentives across different types of firms.

In addition to R&D tax credits, governments often rely on direct R&D support, in the form of R&D subsidies, to support private R&D investments. In general, direct R&D subsidies are found to have an additionality effect on R&D spending and positive effects on innovation, although existing literature reviews usually acknowledge that the results are more heterogeneous than for R&D tax credits (Becker, 2014<sup>[14]</sup>; Le and Jaffe, 2016<sup>[21]</sup>; What Works Centre for Local Economic Growth, 2015<sup>[22]</sup>). Moreover, these schemes are likely to be more expensive to administer than tax credits. However, Box 2 shows that direct subsidies may be more effective to support research, whereas tax credits are more effective for development. Section 3. discusses in more detail the impact of targeted R&D subsidies.

The case for targeting R&D tax credits and direct R&D subsidies at small firms is unclear. Even if the input additionality of R&D tax incentives is larger for small and medium-sized firms than for large firms (Box 2), the higher response of small firms to R&D incentives (Becker, 2014<sup>[14]</sup>; What Works Centre for Local Economic Growth, 2015<sup>[16]</sup>; European Commission, 2018<sup>[23]</sup>; OECD, 2020<sup>[17]</sup>; Lokshin and Mohnen, 2011<sup>[24]</sup>; Appelt et al., 2016<sup>[15]</sup>) may be due to financing constraints that would be better addressed by risk-sharing instruments (Dechezleprêtre et al., 2016<sup>[18]</sup>). Moreover, knowledge spillovers from small firms seem lower (European Commission, 2014<sup>[25]</sup>; Bloom, Schankerman and Reenen, 2013<sup>[20]</sup>). In addition, small firms are more likely to relabel existing activities into R&D (What Works Centre for Local Economic Growth, 2015<sup>[16]</sup>).

The detailed provisions of R&D tax credits, but also of other policy measures more broadly, may affect their effectiveness, and explain the heterogeneity of results. The additionality effects of R&D tax credits have been analysed and verified widely, but little effort has been devoted to linking their effectiveness and efficiency to different design features of the policy (incremental vs volume base, refundability, possibility of carry-forward, optimal rate, etc.), although the European Commission (2014<sup>[25]</sup>) and OECD (2015<sup>[31]</sup>) provide some best practices<sup>3</sup>. The microBeRD project seeks to close this gap by linking the effectiveness

of R&D tax credits to their design features (Appelt, Galindo-Rueda and González Cabral, 2019<sub>[26]</sub>).

More recently, some governments have also resorted to patent (or innovation) boxes to incentivise R&D, i.e., special corporate tax regime that tax patent (or more generally intellectual property – IP) revenues less than other revenues. These have been found to be inefficient (OECD, 2015<sub>[3]</sub>; Bloom, Van Reenen and Williams, 2019<sub>[4]</sub>; European Commission, 2014<sub>[25]</sub>), because they reward successful innovators that are already protected by the IP system, they might bias firms' incentives towards patentable (rather than non-patentable) innovations, and they may have detrimental effects on tax competition<sup>4</sup>.

### 2.1.2. Financial instruments

Governments have provided financing via government-backed venture capital funds to support innovation and in particular innovative start-ups and to compensate for a lack of private risk capital, especially in the seed and early stage phases. The evidence on government venture capital (GVC) funds is mixed (Colombo, Cumming and Vismara, 2014<sub>[27]</sub>; Warwick and Nolan, 2014<sub>[7]</sub>), whether it is assessed against their impact on the development of the private venture capital (VC) industry, or on the invested firms' outcomes. Interestingly, however, a recent consensus seems to emerge on the higher performance of firms simultaneously backed by private and public VCs, the so-called mixed funds (Bertoni and Tykvová, 2015<sub>[28]</sub>; Grilli and Murtinu, 2014<sub>[29]</sub>; Cumming, Grilli and Murtinu, 2017<sub>[30]</sub>)<sup>5</sup>. Still, this literature suffers from a number of limitations. First, it fails to relate the heterogeneity of results to the design of the policy instrument<sup>6</sup> (e.g. early vs later stage interventions; role of mentorship services). Second, there is no evidence on the effectiveness of other indirect interventions in risk capital markets, such as funds of funds or tax breaks for VC and business angels investments,<sup>7</sup> which are increasingly popular (Wilson and Silva, 2013<sub>[31]</sub>). Third, side effects of these investments on other outcomes, such as the direction of innovation or spillovers have not been studied.

The evidence on other types of horizontal financial interventions supporting innovative investment by start-ups and SMEs is scant.<sup>8</sup> Regarding public loans, two papers (Hottenrott and Richstein, 2020<sub>[32]</sub>; Bertoni, Martí and Reverte, 2019<sub>[33]</sub>) show that they have positive effects on employment, sales or tangible investments but do not find evidence of spillovers or any effect on R&D expenditures. However, Hottenrott and Richstein (2020<sub>[32]</sub>) and Huergo and Moreno (2017<sub>[34]</sub>) show that loans are complementary to subsidies. In particular, Hottenrott and Richstein (2020<sub>[32]</sub>) establish that loans facilitate the investment in tangible assets, thereby allowing firms to transform innovations into marketable products. OECD (2021<sub>[35]</sub>) measures explicit and implicit support through below-market finance for 306 firms in 13 industrial sectors, showing that below-market borrowings are correlated with larger investments in fixed tangible assets, potentially contributing to excess capacities in several sectors.

For public credit guarantees, the few available evaluations (Uesugi, Sakai and Yamashiro, 2010<sub>[36]</sub>; Lelarge, Sraer and Thesmar, 2010<sub>[37]</sub>; de Blasio et al., 2018<sub>[38]</sub>; Lagazio, Persico and Querci, 2021<sub>[39]</sub>; Zecchini and Ventura, 2007<sub>[40]</sub>; Martín-García and Morán Santor, 2019<sub>[41]</sub>; Altavilla et al., 2021<sub>[42]</sub>; Bachas, Kim and Yannelis, 2021<sub>[43]</sub>) agree on a positive impact on credit availability. They obtain diverging results on the price of credit, the subsequent growth of the beneficiaries and their financial health, and remain silent on innovation or productivity. Key parameters of public guarantees include its depth (cost of the guarantee and coverage of the loan) and its breadth (eligibility criteria, notably creditworthiness). The latter is particularly important, as public guarantees are likely to have the most significant effects on firms that cannot access credit without them. However,

Lagazio, Persico and Querci (2021<sup>[39]</sup>) show that relaxing the creditworthiness criteria for the Italian public guarantee scheme led to a deterioration of admitted firms' financial health in the medium run, thereby contradicting the initial purpose of the policy. Finally, some studies tried to identify the firms that show greater responses to this support. In the Madrid region, Spain, Martín-García and Morán Santor (2019<sup>[41]</sup>) show that microenterprises (less than 10 employees) benefitting from the Madrid regional mutual guarantee scheme experienced a larger impact on turnover and investment, compared to larger firms. Ciani, Gallo and Rotondi (2020<sup>[44]</sup>) find the greatest effects on credit availability for firms with an intermediate risk level.

Given the widespread use of public loans and public guarantees during the Covid-19 crisis, evidence on their effectiveness and their optimal design is likely to grow quickly. Both researchers (Altavilla et al., 2021<sup>[42]</sup>) and governments (Coeuré, 2021<sup>[45]</sup>) are eager to learn from this experience to improve the efficiency of public spending during crises, understand the medium- and long-run implications of widespread government support and potentially improve the targeting of emergency measures.

## 2.2. Access to skills and knowledge

Access to skills is a crucial enabler of innovation and productivity growth (OECD, 2015<sup>[3]</sup>; Becker, 2014<sup>[14]</sup>; Bloom, Van Reenen and Williams, 2019<sup>[4]</sup>). All types of skills are shown to contribute to innovation and productivity: science, technology, engineering and mathematics (STEM), management and entrepreneurship skills enabling innovation (Bloom, Van Reenen and Williams, 2019<sup>[4]</sup>; Giorcelli, 2019<sup>[46]</sup>; OECD, 2019<sup>[47]</sup>), vocational training for production (OECD, 2014<sup>[48]</sup>), and learning skills which allow workers to update their competences throughout their career (OECD, 2019<sup>[49]</sup>). Beyond upskilling, human capital policy based on immigration or the reduction of barriers to entry into inventor careers are likely to stimulate innovation (Van Reenen, 2021<sup>[50]</sup>; Kerr, 2018<sup>[51]</sup>).

Beyond innovation and productivity growth, access to skills allows technology diffusion, in particular digital technologies, and contributes to limiting productivity dispersion across firms (Calvino and Criscuolo, 2022<sup>[52]</sup>). For instance, lifelong learning through adult training, policies aimed at improving management practices or active labour market programmes have the potential to accelerate the catch-up of laggard firms, especially in digital- and skill-intensive industries (Berlingieri et al., 2020<sup>[53]</sup>; Criscuolo et al., 2021<sup>[54]</sup>; Giorcelli, 2019<sup>[46]</sup>; Calvino et al., 2022<sup>[13]</sup>).

Access to frontier knowledge is also key for innovation and productivity growth. Spillovers of public research have been largely documented (OECD, 2015<sup>[3]</sup>; Becker, 2014<sup>[14]</sup>), both in terms of innovation quantity and direction (Iori, Martinelli and Mina, 2021<sup>[55]</sup>), and recent literature now focuses on how to transfer efficiently this knowledge in order to transform it into new products or processes. It highlights several formal channels (contractual and cooperative research, commercialisation of academic research, researchers' mobility and spin-offs), but also stresses the importance of informal channels (e.g., conferences, networking) (OECD, 2015<sup>[3]</sup>; Lavergne, 2017<sup>[56]</sup>; Criscuolo and Fadic, forthcoming<sup>[57]</sup>; Dechezleprêtre and Fadic, forthcoming<sup>[58]</sup>), whose respective importance may differ across sectors, Technology Readiness Level (TRL) and firms' absorptive capacity.<sup>9</sup> This literature stresses the importance of public support and aligning the incentives of researchers, universities, research centres and firms. A large body of literature has examined the impact on research commercialisation of legislation regulating the assignment of IP between researchers or inventors, universities or public research institutions, and the government. For instance, several analyses evaluate the Bayh-Dole Act in the United States<sup>10</sup>, but found mixed results (OECD, 2015<sup>[3]</sup>; Bloom, Van Reenen and

Williams, 2019<sup>[4]</sup>; Lavergne, 2017<sup>[56]</sup>). More generally, given the growing importance of knowledge transfer, further quantitative and qualitative evaluations are needed to identify the relevant mechanisms and to assess the effectiveness of the corresponding policy instruments.

### 2.3. ‘Within’ policy instruments and the multiple objectives of industrial policy

Criscuolo et al. (2022<sup>[1]</sup>) acknowledge that industrial policy now targets a multiplicity of objectives (e.g., innovation, productivity and growth, competitiveness, inclusiveness, green, sustainable development goals, resilience, strategic autonomy). Yet, most of the evidence summarised in this section evaluates the effect of industrial policy instruments on innovation, productivity and growth.

Despite the scarce evidence on the distributional impact of industrial policies, investment incentives are usually considered as increasing the wage of skilled workers, and possibly inequalities, as they encourage investment in assets that are complementary to skilled labour or substitute to unskilled labour. However, skill policies have the potential to reverse or limit this positive impact on inequalities through two channels. First, they can increase the supply of skilled workers (Bloom, Van Reenen and Williams, 2019<sup>[4]</sup>). Second, they can foster technology diffusion and, since productivity is an important determinant of firm wage premia (Criscuolo et al., 2021<sup>[59]</sup>), reduce wage inequalities. Moreover, recent evidence shows that gains from innovation may spill over within firms from skilled workers to some of their unskilled co-workers, thereby lessening the effect of pro-innovation policies on inequalities (Aghion et al., 2019<sup>[60]</sup>).

Evaluations on the impact of industrial policies on resilience are not yet available. However, indirect evidence suggests that existing industrial policies can contribute to improving economic resilience, as resilience is shown to be related to other industrial policy objectives, such as sustainability (Ding et al., 2020<sup>[61]</sup>; Chintrakarn, Jiraporn and Treepongkaruna, 2021<sup>[62]</sup>), innovation (Krammer, 2021<sup>[63]</sup>) or digital capabilities (Doerr et al., 2021<sup>[64]</sup>).



### 3. The effectiveness of targeted policy instruments

#### Key messages

The evidence on the effectiveness of targeted policy instruments is scattered and focused on the role of grants for R&D and investment. It tends to show that their effectiveness is higher for young and small firms and that their effect is due to a reduction in the asymmetry of information. It suggests that, instead of grants, other types of instruments, such as financial instruments, or even start-ups certification programmes, could be interesting tools for targeted interventions. Ascertaining this would require further thorough evaluations of these policy instruments.

Evaluation of grants and de-risking instruments is hindered by the endogenous selection of beneficiaries. Thinking about the evaluation at the inception of the programme can help overcome this difficulty. For instance, keeping track of the scoring of projects, both for selected and rejected ones, allows devising quasi-experimental evaluations based on regressions discontinuity design (RDD). Developing legal and administrative frameworks to link administrative data on supported firms with other firm-level data on supported and non-supported firms could provide the data necessary to implement different types of evaluation.

Further research linking effectiveness to the design of policy instruments and to the broader industrial strategy (other policy instruments and framework conditions in place, see section 4. ) is needed. Otherwise, the external validity of evaluations, no matter their robustness, is subject to caution as the effectiveness of any programmes will depend on its design and the implementation of other policies.

As pitfalls of targeted industrial policies have been well documented by economists (information asymmetries, capture or rent-seeking and general equilibrium effects, see Criscuolo et al. (2022<sup>[1]</sup>)), it is particularly important to document the effectiveness of targeted industrial policies. This section synthesises the scarce evidence on targeted industrial policies, first focusing on firm-level studies, and then on industry-level studies. The last subsection discusses the limits of available policy evaluations and suggests some options to overcome these limits.

#### 3.1. Scarce evidence on causal effects of targeted policies

Analyses at the industry or country level are poorly designed to identify a causal relationship between the policy instrument and the outcome, such as productivity, employment or growth. Indeed, governments often target industrial policy to regions or industries that are plagued by market failures or affected by negative shocks. Because of this endogenous selection of beneficiaries, naive industry or country level regressions would yield biased estimates of their effectiveness.

While it is difficult to go beyond naïve estimations at the industry or country level, firm-level data can be used to obtain a causal identification of the effects of targeted policy instruments. Even if endogenous selection is still present at the firm level, with governments either picking losers or winners, firm level evaluations can take advantage of thresholds or specific features of the policy causing exogenous changes in eligibility across

firms to identify causal effects (see Box 3 for a glossary introducing the main methods to identify causal effects of policy instruments). In some instances, these evaluations also allow uncovering the channels through which policy instruments affect firms' behaviour<sup>11</sup>.

Despite renewed interest and a growing number of related publications, firm-level evidence on the effectiveness of targeted industrial policy instruments remains scarce. Surveys of the literature are also quite rare, a notable exception being Lane (2020<sub>[65]</sub>). Several factors hinder evaluation and could be responsible for this lack of evidence. First, the culture of evaluation is still in its infancy for industrial policies, resulting in high costs and barriers for potential evaluators. Even at the aggregate level, countries rarely provide a detailed picture of their industrial policies, and easily accessible information on the design of the policies and related expenditures is rarely available. Second, the information gathered is often insufficient. Having information on firms that applied but were not selected could help in building a sound counterfactual, but this information is seldom collected. Third, accessing data can also prove difficult. Conducting a thorough evaluation not only requires administrative data on the policy itself, its beneficiaries and rejected firms, but also linking this information with other administrative, commercial and statistical sources (e.g. balance sheet data, patent data, innovation or Information and Communication Technologies (ICT) surveys).

A large share of available evaluations concerns place-based investment subsidies, using the geographical dimension in their identification strategy. Four targeted policies have been subject to careful firm-level evaluations:

- Investment subsidies from Italy's Law 488/92 (L488). Because grants are allocated through regional competitions and treatment thus depends on regional exogenous factors, it allows comparing similar funded and non-funded firms in different regions. The studies usually find significant effects on output growth, employment or capital, but not on Total Factor Productivity (TFP) nor labour productivity (Bernini and Pellegrini, 2011<sub>[66]</sub>; Cerqua and Pellegrini, 2014<sub>[67]</sub>). Pellegrini and Muccigrosso (2016<sub>[68]</sub>) find that subsidies lowered the default rate of start-ups.
- Regional Selective Assistance in the United Kingdom. Using exogenous changes in regions' eligibility, Criscuolo et al. (2019<sub>[69]</sub>) find significant effects on employment, but limited to small firms, and no effect on productivity.
- *Expansiesteun* (Expansion support) in Flanders, Belgium. Ramboer and Reynaerts (2020<sub>[70]</sub>) do not use firm-level data but municipality-level data. They however use an exogenous change in eligibility to estimate causal effects of this policy. The authors conclude that their results (positive impact on the number of employees and establishments, but mainly jobs safeguarded in declining industries and no effect on firm birth) cast doubt on the effectiveness of the scheme.
- Industrial policy targeting the heavy and chemical industries in Korea during the 1970s. Kim, Lee and Shin (2021<sub>[71]</sub>) use a difference-in-differences setting, comparing treated and non-treated industries and regions. They show that affected regions have higher output and labour productivity. However, even if TFP of treated plants increases, industrial policy has a negative effect on allocative efficiency, so that the TFP of treated industry-region pairs is not affected compared to non-treated ones. The authors argue that industrial policy did not necessarily target the most productive plants. Choi and Levchenko (2021<sub>[72]</sub>) confirm the positive impact on treated firms and show that these subsidies, which ended in 1979, still have a significant effect on treated firms 30 years after. They argue that these dynamic effects can be explained by learning-by-doing and the relaxation of

financial constraints, and that their magnitude suggests a positive welfare effect of industrial policy.

For targeted R&D grants, it is inherently difficult to disentangle properly the effect of selection by governmental agencies from the effect of the treatment per se. The usual approach is to control for a large set of observable variables to compare similar treated and non-treated firms (matching methods, see Box 3), but the risk of a selection on unobservables by the agency remains. However, in some cases, some implementation details of the policy allow for a more robust identification strategy.

- For instance, Bronzini and Iachini (2014<sup>[73]</sup>) estimate the effect of R&D subsidies in place-based policy in Emilia-Romagna, taking advantage of a threshold in the score assessment that determines eligibility to the programme. They only find additionality for small firms. Bronzini and Piselli (2016<sup>[74]</sup>) find that this policy has an effect on patent applications for small firms, but not for larger ones. This is confirmed by Lanahan and Feldman (2018<sup>[75]</sup>), who, studying the US SBIR (Small Business Innovation Research) State Match programme – a place-based policy linked to SBIR, find that the effect is higher on firms with less previous SBIR experience, which are smaller and younger.
- Howell (2017<sup>[76]</sup>) studies the part of US SBIR administered by the Department of Energy. This scheme organises project competitions in very granular subsectors (such as ‘Solar Powered Water Desalination’). Comparing firms around the award cut-off, she finds that Phase 1 grants (around USD 150 K) have a large and significant impact on a variety of firm outcomes (e.g. patents, VC funding, survival, revenue, successful exit), whereas the subsequent Phase 2 grants (around USD 1 M) have no measurable effect. She tests several possible channels for the impact of Phase 1 grants and concludes that her results are more consistent with a ‘prototyping channel’, allowing the reduction of uncertainty for future investments, and crowding in investors for the next development stage. It suggests that these grants are helpful in tackling the asymmetric information between entrepreneurs and investors. In the same vein, Howell (2019<sup>[77]</sup>) shows that start-ups winning competitions in the United States attract more VC funds.
- Lechevalier, Ikeda and Nishimura (2010<sup>[78]</sup>) study government-sponsored private R&D consortia focused on robot technology in Japan and their effect on the patenting activity of firms. Interestingly, they find that research productivity of participating firms increased, but only for the second phase of the policy, when Japanese authorities carried out a comprehensive industry-wide project, whereas the first phase focused on specific applications.
- Another strand of literature focuses on the impact of defence R&D on private R&D expenditures. Moretti, Steinwender and Van Reenen (2019<sup>[79]</sup>) show, using both cross-country industry-level and French firm-level data, that government-funded defence R&D crowds in privately funded R&D and increases productivity. Pallante, Russo and Roventini (2020<sup>[80]</sup>), using data at the US state level, confirm this crowding-in effect on private R&D expenditures and employment. Gross and Sampat (2020<sup>[81]</sup>) show that World War II research effort has had large effects on the direction and location of U.S. invention and high-tech industrial employment, setting in motion agglomeration forces which shaped the technology clusters of the post-war era. Although defence R&D programmes are usually considered as mission-oriented strategies, the applicability of these results to societal challenges (e.g. climate change) may be limited (Pallante, Russo and Roventini, 2020<sup>[80]</sup>).

Girma, Görg and Stepanok (2020<sub>[82]</sub>) study the impact of production subsidies in People's Republic of China (hereafter "China") targeting specific industries. They find positive effects on export market participation, but negative effects on non-subsidised firms. They conclude that the overall efficiency of targeted production subsidies in improving Chinese export performance is likely to be low.

Many of these evaluations focus on the impact of policies on treated firms, but a complete cost-benefit analysis would also require identifying the effect on non-treated firms. Rotemberg (2019<sub>[83]</sub>) studies the impact of subsidies to small firms in India. He uncovers positive effects for treated firms, but negative effects for their competitors. Using a structural model, he shows that programme gains are divided by three once these spillovers are taken into account. In the same vein, Greenstone and Moretti (2003<sub>[84]</sub>) measure the local spillovers of subsidies to attract a new plant by looking at the impact on property values at the county level in the United States.

### 3.2. Sector and country-level evidence

Studies at the industry-level usefully complement firm-level evidence. First, firm-level studies cannot easily take into account policy packages and strategies (Warwick and Nolan, 2014<sub>[7]</sub>). Second, designing a complete cost-benefit analysis from micro-evidence is not easy because spillovers and social benefits are easier to assess at the local, country or sector level, although new models are developed to compute general equilibrium effects with firm-level data (Greenstone, Hornbeck and Moretti, 2010<sub>[85]</sub>; Sraer and Thesmar, 2018<sub>[86]</sub>; Rotemberg, 2019<sub>[83]</sub>). The number of industry-level quantitative studies remains however limited.

Papers aiming at testing the infant industry argument<sup>12</sup> are not evaluations per se, but provide an indirect test of the likely effects of a temporary sectoral support. The conclusions from these studies are ambiguous (Manelici and Pantea, 2021<sub>[87]</sub>; Irwin and Klenow, 1994<sub>[88]</sub>; Pons-Benaiges, 2017<sub>[89]</sub>). Against the learning-by-doing hypothesis, Irwin and Klenow (1994<sub>[88]</sub>) show that, using data on the semi-conductor industry in the 1980s for Japan and the US, learning-by-doing spillovers are limited, international in scope,<sup>13</sup> and do not carry over to new generations of products. They conclude that their results provide little support for targeted national subsidies based on the learning-by-doing argument. Pons-Benaiges (2017<sub>[89]</sub>) finds evidence of external learning-by-doing in post-WWII Japan, with the spillovers differing significantly across sectors.<sup>14</sup> However, as Japanese industrial policy seems negatively correlated with the degree of learning-by-doing across industries, this result also highlights the practical difficulties of implementing industrial policies targeting these spillovers.

Blonigen (2015<sub>[90]</sub>) studies the impact of industrial policy strategies in the steel sector of 22 countries over 1975-2000 and finds harmful effects on the export competitiveness of downstream sectors for most instruments. This paper confirms the crucial role of upstream sectors, by underlining that ill-designed industrial policy can harm downstream industries.

Kalouptsidi (2017<sub>[91]</sub>) evaluates the impact of Chinese subsidies to shipbuilding and finds that, although they increased Chinese production, they only had a small effect on ship prices and freight costs. Moreover, she finds that subsidies lead to an inefficient international sharing of production by increasing the market share of high cost Chinese shipyards at the expense of low cost Japanese ones.

Gourdon and Guilhoto (2019<sub>[92]</sub>) quantify the economic gains of the abolition or relaxation of local content based policies in Brazil and the United States. Static simulations based on OECD Trade-in-Value-Added data suggest large economic benefits for both countries in the long-term despite initial losses in the target industry.

However, because they highly depend on the national and cyclical contexts, the external validity of these evaluations may be weak, even for similar industries in other countries and especially for historical case studies. Even for more recent episodes, the importance of governance and policy objectives calls for prudence when extrapolating the results derived from these studies.

### 3.3. Learning from horizontal policies to design targeted instruments?

Beyond the causal impact of individual targeted policy instruments on treated and non-treated firms, a complete assessment of targeted industrial policies would require compelling evidence on the interaction between instruments within a strategy<sup>15</sup>. Evidence from the literature on horizontal instruments, showing benefits from (i) the combination between cost reduction and risk-sharing instruments and (ii) the combination between incentives and access to inputs policy, is however helpful and should guide the design of targeted strategies.

The comparison between the effectiveness of horizontal and targeted instruments is also relatively limited. However, the literature shows that, when focused on specific sectors, both grants and R&D tax credits (What Works Centre for Local Economic Growth, 2015<sup>[16]</sup>; What Works Centre for Local Economic Growth, 2015<sup>[22]</sup>) are less effective. Some results (Lechevalier, Ikeda and Nishimura, 2010<sup>[78]</sup>) suggest that targeted policies should not be too narrow, but instead take into account the whole industrial ecosystem. In the same vein, technological bias can limit the effectiveness of targeted policy instruments. For instance, incentives for tangible investments may adversely affect intangible capital formation and reliance on flexible inputs, such as use of external services. DeStefano et al. (forthcoming<sup>[93]</sup>) show that policies that subsidise IT capital and hardware tend to reduce investment in big data and cloud computing.

Experimental methods akin to randomised controlled trials (RCTs, see Box 3 for a definition) have been proposed to evaluate industrial policy measures, but their application remains scarce. An example is the approach combining the randomised assignment of firms to treatment and control groups (see Box 3) with a longitudinal data collection strategy incorporating quantitative and qualitative data, which was used to evaluate Creative Credits, a UK-based business-to-business innovation voucher programme designed to foster new innovative partnerships between SMEs and creative service providers (Bakhshi et al., 2015<sup>[94]</sup>).

Big data and machine learning techniques have the potential to improve the design of targeted industrial policies (Criscuolo et al., 2022<sup>[1]</sup>). In particular, the application of digital technologies could lower the cost of policy impact evaluation (Johnstone et al., 2019<sup>[95]</sup>). First, the increasing availability of granular data can facilitate the use of standard policy evaluation methodologies such as regression discontinuity, difference-in-differences and propensity-score matching methods (see Box 3). Second, big data can provide evaluators with unprecedentedly rich sets of relevant covariates for the identification of relevant control groups. Third, data generated by embedded digital technologies and other alternative data sources (e.g. credit card transactions, electronic invoices) can help assess the effects of changes in policy-induced settings.

The vast amount of data on horizontal instruments should be used to understand the characteristics of firms for which the policy is the most efficient. This evidence can be used in a second step to design targeted policies. The targeting or the modulation of these instruments could yield significant efficiency gains.

At this stage, however, the literature remains inconclusive on which firms to target. For instance, regarding the heterogeneous effects of R&D grants, some studies found a higher

effectiveness on the less productive (Vanino, Roper and Becker, 2019<sup>[96]</sup>), or low-tech firms (Becker, 2014<sup>[14]</sup>), whereas Hünermund and Czarnitzki (2019<sup>[97]</sup>) on the contrary find effects only for the better-rated projects.

A related question is whether support should be targeted at foreign MNEs, in particular to attract Foreign Direct Investment (FDI). First, foreign MNEs can benefit the local economy through knowledge spillovers. Veugelers and Cassiman (2004<sup>[98]</sup>) do not find that they are not more likely than other firms to transfer knowledge to the local economy, thereby casting doubt on the benefits for innovation of targeting support at subsidiaries of foreign MNEs. Second, as indicated above, there could be negative effects on non-treated firms, for instance through the labour and product markets. Third, there is some evidence that MNEs can be considered as ‘footloose’. As they are more likely to exit the market following a negative domestic shock (Van Beveren, 2007<sup>[99]</sup>; Alvarez and Görg, 2009<sup>[100]</sup>; Ferragina, Pittiglio and Reganati, 2014<sup>[101]</sup>), the efficiency of targeting subsidies at MNEs could be limited, in particular as these policies could tend to increase the volatility and lower the resilience of the domestic economy.

Similarly, some countries are targeting support at (potential) exporters. These policies are intended to bring direct benefits by increasing the demand addressed to domestic firms, but also indirect benefits as exporting is often associated with increased productivity<sup>16</sup>. In this context, many countries have export promotion agencies, whose role is to support firms in overcoming the difficulties of exporting, for instance by providing information on foreign markets (‘access-to-input instrument’), and export promotion programmes, which include financial instruments such as export guarantees or subsidies (‘investment incentives’ instruments). Shroj, Vitezic and Wagner (2020<sup>[102]</sup>) survey the literature on export support and underline that export promotion agencies and grants and subsidies for commercialisation and export production activities are often found to have positive effects. However, it remains an open question whether targeting (potential) exporting firms or sectors dominates horizontal support.

### Box 3. Short glossary – Important terms for policy evaluation

This box briefly describes the main policy evaluation methods. For more detailed descriptions of these methods, see also HM Treasury (2007<sub>[103]</sub>), Angrist and Pischke (2008<sub>[104]</sub>) or Wooldridge (2010<sub>[105]</sub>).

#### Randomised controlled trials (RCTs) and natural experiments

RCTs are the ideal evaluation methodology to infer programme effectiveness. It is the only method that can completely eliminate the influence of other known and unknown factors, which can otherwise produce misleading evaluation results. The trial compares a control group and a treatment group. Random selection of these two groups reduces systematic differences in any characteristics between them, leading to high level of confidence that any differences can be attributed to the intervention. In the context of this paper, treatment groups include firms that directly benefit from industrial policy instruments, whereas control groups include similar firms that do not benefit from the policy.

When RCTs are not possible (or not desired), evaluators have to rely on natural experiments. Evaluators exploit specific provisions in the policy to construct a control group whose characteristics (both observable and unobservable) match those of the treatment group. Various methodologies are used to infer causal effects of policies in a natural experiment setting: instrumental variable, difference in differences, regression discontinuity design.

#### Instrumental variable method

The instrumental variable method relies on exogenous shifts to the probability of being treated to identify the causal impact of the policy. The instrument is the variable driving these shifts and has to fulfil two criteria: (1) the instrument at least partly explains assignment to treatment, but (2) does not affect outcome, except through a higher probability of being treated.

Evaluators use the natural experiment setting created by the exogenous shift to compare the outcome for units that have the same characteristics but are differently affected by the instrumental variable.

For an example, see the evaluation of Regional Selective Assistance in the United Kingdom by Criscuolo et al. (2019<sub>[69]</sub>).

#### Difference-in-differences (DID)

DID compares the average outcomes of the treatment group and the control group for at least one relevant point before and one after policy implementation. In essence, DID “differences out” the pre-policy differences between both groups and the common time trend. For an example, see the evaluation of Korean industrial policies targeting the heavy and chemical industries by Kim, Lee and Shin (2021<sub>[71]</sub>).

#### Regression discontinuity design (RDD)

RDD is a before and after design that involves splitting participants from the eligible population into treatment and control groups based on whether they are above or below a known threshold of an observed continuous assignment variable. The discontinuity or observed jump between the outcomes of units just below and just above the threshold is

taken to be the treatment effect of the programme. For an example, see the evaluation of R&D subsidies in Emilia-Romagna by Bronzini and Iachini (2014<sup>[73]</sup>).

### **Matching methods**

When it is not possible to find a natural experiment setting, evaluators can use statistical methods to construct a control group. Each selected participant is matched to a non-participant (or a weighted average of non-participants). Non-participant comparators should be identical to their matched counterparts in all observable factors, with the exception that participants participate and controls do not. The impact of the programme is the difference in outcomes between the two groups.

Importantly, whereas natural experiments aim at controlling for both observable and unobservable differences between the treatment and control groups, matching methods can only control for unobservable differences, thereby assuming that both groups do not differ on unobservable characteristics that are correlated with the treatment.

Propensity score matching is a popular technique to construct the control group. The first stage consists in estimating a model predicting assignment to the treatment group based on firms' characteristics. The predicted probability of being treated is the propensity score. The control group is constructed by matching participants and non-participants with similar propensity scores.

Evaluators increasingly combine matching methods with DiD, by comparing both groups before and after the treatment. This helps in 'differencing out' systematic differences between both groups that would remain constant over time. For an example, see the evaluation of the French cluster policy by Mar and Massard (2021<sup>[106]</sup>).

Source: Adapted from OECD (2010<sup>[107]</sup>).



## 4. The role of framework conditions (‘between instruments’)

### Key messages

Framework instruments affect the reallocation of production factors between firms, which is one of the main drivers of efficiency enhancement, hence productivity growth, and more generally an important factor driving structural change.

The evidence indicates that framework instruments affecting industry dynamics enable business dynamics, allow the most productive firms to grow and to translate firm-level successes into macroeconomic impact. In particular, there is a large body of evidence showing that competition policy is an efficient instrument to reallocate resources toward more productive firms and, indirectly, incentivise firms to innovate. This casts serious doubt on the paradigm of “national champions”, whose growth would be favoured by an insulation from potential and existing competitors.

By contrast, the emergence of the digital economy and winner-takes-most dynamics has led to the reallocation of resources toward the more productive firms at the cost of potential entrenchment of large incumbents and reduced market entry, with potentially detrimental effects on innovation. This has engendered a new debate on the possible need to update antitrust policies, which according to some authors might have become too lax in the last decade, especially in some countries.

More work is needed to better measure market power in the digital economy and further analyse the consequences of rising concentration, mark-ups and mergers and acquisitions on several outcomes such as productivity, wages, business dynamics and innovation. This would inform antitrust enforcement, advocacy and merger control by Competition Authorities, and ensure coherence with industrial policy objectives.

This section provides a synthesis on the effectiveness of framework (or ‘between’) instruments. After reviewing the available evidence on labour, capital and product market instruments on the one hand and more thematic framework instruments on the other hand (entrepreneurship, IP and standardisation policies), it focuses on the role of competition and trade policies for industrial policy objectives.

### 4.1. Labour, capital and product markets

Labour market instruments that restrict the mobility of workers may hamper labour reallocation, technology diffusion, innovation and spillovers. Non-compete clauses significantly impede entrepreneurship and employment growth in US metropolitan areas (Samila and Sorenson, 2011<sup>[108]</sup>) and the mobility of inventors with firm-specific skills or specialised in narrow fields (Marx, Strumsky and Fleming, 2009<sup>[109]</sup>).

Occupational licensing restricts job mobility, but competitive restrictions in professional services are pervasive – see, e.g., OECD (1999<sup>[110]</sup>; 2009<sup>[111]</sup>; 2004<sup>[112]</sup>; 2007<sup>[113]</sup>). Evidence from the United States points to wage gains from job-to-job moves being lower in states with more licensing, likely a result of reduced competition (Hermansen, 2019<sup>[114]</sup>). Although evidence on the implication of non-compete clauses and occupational mobility

are scarcer for other countries, these measures exist across OECD countries. The OECD has recently developed some indicators related to occupational licensing and shown that easing the requirements can increase productivity growth in the corresponding sectors (Bambalaite, Nicoletti and von Rueden, 2020<sub>[115]</sub>).

Employment protection legislation (EPL) has been found to affect experimentation, risk taking and innovation, but also seems to affect radical and incremental innovation differently and heterogeneously across countries (Griffith and Macartney, 2014<sub>[116]</sub>; Bartelsman, Gautier and De Wind, 2016<sub>[117]</sub>; Aghion, Bergeaud and Van Reenen, 2021<sub>[118]</sub>). Stringent legislations are detrimental to creative destruction and the reallocation of production factors, e.g. EPL are associated with lower net job creation by start-ups across OECD countries in industries with high reallocation needs (Calvino, Criscuolo and Menon, 2016<sub>[119]</sub>). On the other hand, an appropriate regulation of temporary employment favours within-firm efficiency through the accumulation of firm-specific human capital (Bassanini, Nunziata and Venn, 2009<sub>[120]</sub>).

Well-functioning capital markets can relax financial constraints linked to intangible assets investments by altering the overall composition of finance, encouraging competition, or strengthening the legal environment in which businesses operate (Demmou, Stefanescu and Arquie, 2019<sub>[121]</sub>). Relatedly, inefficient bankruptcy legislation weakens market selection and enable low-productivity firms to survive. Across OECD countries, it can prevent capital and labour reallocation, and create barriers to entry and constrain the post-entry growth of young firms (Adalet McGowan, Andrews and Millot, 2018<sub>[122]</sub>; OECD, 2019<sub>[123]</sub>; Calvino, Criscuolo and Verlhac, 2020<sub>[124]</sub>).

While tax expenditures constitute a privileged channel for investments incentives (see Section 2. ), tax systems also have major effects on the user cost of capital (Jorgenson, 1963<sub>[125]</sub>) and therefore on the allocation of capital across firms, both internationally and domestically.

- Internationally, tax systems are a major determinant of competitiveness and attractiveness (Millot et al., 2020<sub>[126]</sub>). Corporate income tax rates in particular have attracted a lot of attention and have been subject to a race to the bottom, which produced negative spillovers, in particular through base erosion and profit shifting (BEPS<sup>17</sup>), amplified by digitalisation and globalisation. This undermines the fairness of tax systems and limits the ability of countries to raise tax revenues. Recently, around 140 jurisdictions reached an agreement on a minimum tax rate of 15% for MNEs (second pillar of the OECD BEPS framework)<sup>18</sup>. Beyond rates, simplicity, transparency and efficiency of the tax system also participate to the attractiveness of a country for foreign direct investments (FDI) (see Edmiston, Mudd and Valev (2003<sub>[127]</sub>) and the next subsection on red tape).
- Domestically, tax systems, which comprise corporate income tax but potentially other taxes such as property tax, taxes on inputs, carbon taxation, etc., affect the relative costs of different types of capital (Auerbach, Devereux and Simpson, 2010<sub>[128]</sub>). They can have differential impacts by asset type (e.g. real estate vs other tangible assets) or financing mode (equity vs debt<sup>19</sup>). Tax systems also have an impact on innovation and business dynamics (Akcigit and Stantcheva, 2020<sub>[129]</sub>), the allocation of production factors across firms and the input mix by affecting the relative costs of capital and labour, capital and energy, etc.

Stringent product market regulations have been found to be associated with slower factor reallocation, e.g. barriers to entrepreneurship are negatively correlated with net job creation by both start-ups and incumbents across OECD countries (Calvino, Criscuolo and Menon, 2016<sub>[119]</sub>). Pro-competitive product market regulations might also promote technology

diffusion from frontier firms to laggards, as countries where product market reforms were the least extensive experienced a more pronounced productivity divergence between the best-performing firms and the rest (Andrews, Criscuolo and Gal, 2016<sub>[130]</sub>).

Framework instruments, by contributing to the reallocation of labour and capital towards the most productive firms, may exacerbate inequalities. In some instances, and given the opportunity cost of public funds to finance other policies, policy makers may be tempted to use these instruments to smooth the reallocation of labour and capital and spread the adjustment costs over time.

Finally, framework conditions can also contribute to economic resilience. Indeed, it can be achieved through two channels: increasing firm-level resilience and improving the ability to swiftly mobilise and (re)allocate resources across firms. The latter is likely to be affected by framework instruments promoting business dynamics, but empirical evidence is lacking at this stage.

## 4.2. Entrepreneurship, intellectual property and standardisation policies

Entry support policies can be split into “direct” policies, such as information provision or coaching for would-be entrepreneurs or early stage firms, and “indirect policies” aimed at reducing administrative burdens, which disproportionately affect potential entrepreneurs and young businesses<sup>20</sup>. While direct entry support measures are shown to have mixed results (Rigby and Ramlogan, 2016<sub>[131]</sub>), reducing red tape has been found to be effective (Calvino, Criscuolo and Menon, 2016<sub>[119]</sub>; Parker and Kirkpatrick, 2012<sub>[132]</sub>). Red tape disproportionately weighs on young firms, thereby discouraging entry and hindering their growth and ability to compete with incumbents (OECD, 2015<sub>[3]</sub>). For instance, Aghion, Bergeaud and Van Reenen (2021<sub>[118]</sub>) show, analysing the effect of thresholds in labour regulation in France, that the perspective of reaching these thresholds and incurring the associated costs deters innovation, and in particular radical innovation.

The design of IP rights systems has received much attention in recent literature.<sup>21</sup> By providing a temporary monopoly on technologies, IP rights increase incentives to innovate, at the expense of a temporary reduction in competition. Some also consider that IP protection provided by e.g. patents, copyrights, design and trademarks, participate in the codification and dissemination of knowledge. Many studies have pointed to some shortcomings of the IP system:<sup>22</sup> patent transactions are subject to market failures, notably due to asymmetric information; the patent system may encourage patent thickets, patent races, royalty stacking, patent ambush and patent trolls. The literature showed that these adverse effects and opportunistic behaviours indeed deter innovation, in particular for small firms. The debate in this policy area is wide and includes discussions on the type of technologies that are patentable, application costs, transparency of the system, and litigation costs and procedures.

Standardisation concerns an increasing share of the economy, in particular IT products (Rabier, 2017<sub>[133]</sub>; Blind, Jungmittag and Mangelsdorf, 2012<sub>[134]</sub>) and green technologies such as hydrogen (Anderson et al., 2021<sub>[135]</sub>). By coordinating stakeholders on technical norms, standardisation favours compatibility between devices or systems and is expected to generate positive externalities. But it can also have social costs, by reducing variety and competition or by leading to the adoption of suboptimal technologies. The number of patents declared ‘standard-essential’ has been multiplied by 5 over the last 15 years.<sup>23</sup> This trend increases the strategic interest in holding patents and magnifies the above-mentioned adverse effects and market failures. Even if it does not reach operational conclusions, the literature stresses the need to improve transparency regarding the standardisation process

and the inclusion of patents in standards as well as the pricing of licences for standard-essential patents (Rabier, 2017<sub>[133]</sub>; Blind, Jungmittag and Mangelsdorf, 2012<sub>[134]</sub>).

Governments need to strike a balance between stability and adaptability of industrial policy. On the one hand, new technological developments can prompt for a modernisation of the legislation, or for specific provisions (e.g. sandboxes) to allow firms to realise their productivity gains (e.g. fintech, ride-hailing services). On the other hand, policy changes and policy uncertainty come at a cost for businesses, in particular through lower employment and investment (Baker, Bloom and Davis, 2016<sub>[136]</sub>). Policy uncertainty is likely to be particularly relevant for long term investments, for instance investments in new green production facilities (see Cammeraat, Dechezleprêtre and Lalanne (forthcoming<sub>[137]</sub>) on hydrogen). Amidst the Covid-19 pandemic, Brexit and trade tensions, policy uncertainty has increased recently (Altig et al., 2020<sub>[138]</sub>).

In addition, interconnectedness of economies and fragmentation of global value chains has confirmed the increasing importance of coherence between regulatory frameworks (OECD, 2017<sub>[139]</sub>).<sup>24</sup> This has become particularly apparent during the ongoing COVID-19 crisis, which highlighted international regulatory co-operation as key for embedding resilience in regulatory frameworks. Regulatory co-operation can help manage cross-border risks, promote work sharing and pooling of resources across government for effective regulatory responses, and reduce costs of production and trade of essential goods (OECD, 2020<sub>[140]</sub>). In particular, information exchange on regulatory matters facilitates the adoption of emergency regulations, common rules on conformity assessment procedures help the provision of essential goods, and regulatory alignment is key in maintaining the interoperability of essential services, e.g. transportation and telecommunication.

### 4.3. The complementarity between innovation and competition policies

#### 4.3.1. Competition and industrial policies are closely linked

As made clear in the taxonomy (Figure 2), competition policy is an important component of industrial strategies, favouring an efficient allocation of production factors between firms, and thereby contributing to aggregate productivity and structural change – see OECD (2014<sub>[141]</sub>) for an overview of how competition policy affects macroeconomic outcomes.

At the same time, industrial policy also has an impact on competition.

- First, industrial policy, by promoting technology adoption, innovation and entrepreneurship, can foster competition by supporting business dynamism.
- Second, targeted industrial policies, by giving an explicit advantage to some firms over others, might compromise competitive neutrality principles, while horizontal industrial policies are less likely to have a detrimental effect on competition – see OECD (2009<sub>[142]</sub>).

Even if they might be at risk of hurting competition, targeted industrial policies that are designed to fix market failures or to address externalities do not necessarily affect competition negatively. By increasing the returns for a given project, they may even enable more firms to enter into that market (Aghion et al., 2015<sub>[143]</sub>).

In general, targeted interventions should be competitively neutral; in case competitive neutrality is not feasible to achieve the desired objective, interventions should be narrow, temporary and monitored closely (OECD, 2020<sub>[144]</sub>).

Inclusiveness and technology-neutrality are key to ensure that in practice industrial policies do not unduly discriminate between firms, even for policy instruments that are non-

discriminatory at first sight, such as ‘access to inputs’ and ‘governance’ instruments. This issue is even more meaningful for instruments that are by essence discriminatory, such as incentives that are provided on a competitive basis (grants, loan or equity financing). In these cases, high standards of transparency, accessibility and governance have to be observed to ensure that all firms can compete on an equal footing (Box 4).

#### Box 4. Balancing competition and targeted policies: alliances and Important Projects of Common European Interest (IPCEI)

In some instances, targeted industrial policies may hurt competition. Against that backdrop, EU competition policy – which regulates market interventions in EU countries – is a key element in the discussions on new green and digital industrial policies for Europe.

Re-visiting EU competition rules is a necessary pre-condition for developing an EU green industrial policy. Reform should not aim at permitting countries to intervene in the market as they prefer (“negative co-ordination”) but rather at authorising them to jointly act in certain technologies, internalising externalities and exploiting synergies (“positive co-ordination”).

The Important Projects of Common European Interest (IPCEI), introduced in 2014 in the context of the modernisation of state-aid rules, are a key scheme regarding such positive co-ordination. Within the IPCEI framework, state aid is permitted if selected projects meet the following conditions: i) contribute to strategic EU objectives; ii) involve several EU countries; iii) include private financing by the beneficiaries, iv) generate positive spill-over effects across the EU; and v) show high research and innovation ambitions. At the time of writing, IPCEI projects include the European Batteries Alliance and the European Clean Hydrogen Alliance, plus several others in the pipeline.

Source: adapted from Tagliapietra and Veugelers (2020<sub>[145]</sub>).

#### 4.3.2. *The inverted-U shape relationship between innovation and competition*

In theory, competition has non-monotonic effects on within-firm innovation. At low levels of competition, there is an “escape competition” effect, whereby an increase in competition, due to entry of new firms, puts pressure on firms to innovate, to escape imitation by entrants and to secure a technological advantage over their competitors. At high levels of competition, increasing competition may reduce innovation: there is a “fishing-out” effect when many firms are trying similar ideas. Each firm becomes less likely to innovate successfully as everyone is “fishing out of the same pond” (Acemoglu and Cao, 2015<sub>[146]</sub>). In addition, in sectors where firms have heterogeneous productivity levels, increased competition reduces the post-innovation rents of laggards and thus their incentives to catch up with leaders (the so-called “Schumpeterian effect”).

Aghion et al. (2005<sub>[147]</sub>) formalised these arguments into a theoretical model where the relationship between innovation and competition has an inverted-U shape. It is therefore an empirical matter to determine whether competition is beneficial to innovation or not, and the answer can be context-dependent. Empirical studies tend to find a positive relationship but the question is not settled. While acknowledging the diversity of the results, Bloom, Van Reenen and Williams (2019<sub>[4]</sub>) conclude that competition increases innovation. Still, Aghion et al. (2005<sub>[147]</sub>) find evidence in support of their theoretical

inverted-U shape relationship in UK data, while Hashmi (2013<sub>[148]</sub>) finds a mildly negative relationship for publicly traded US firms.

Complementary analysis by Levine et al. (2020<sub>[149]</sub>) shows that more stringent competition laws foster innovation (as measured by patents) and innovation quality (citations, share of explorative patents, etc.).

Both theory and evidence suggest the existence of important complementarities between industrial and competition policies: for example, Acemoglu et al. (2018<sub>[150]</sub>) point to the fact that R&D support might not be effective in the absence of efficient exit policies. Interestingly, Aghion, Howitt and Prantl (2015<sub>[151]</sub>) show that there is a complementarity between competition and intellectual property rights (patents) in fostering innovation. Indeed, with stronger patent rights, the incentives to escape competition are higher.

In a nutshell, the available literature points towards a potential complementarity between competition (and competition policy) and other horizontal industrial policies: Competition promotes the most efficient firms and provides incentives for innovation, while industrial policy increases the ability to innovate and protects the rights of innovators, thus guaranteeing the returns to innovation and investment.

Besides innovation, competition is also a major driver of technology adoption and of organisational and managerial improvements, since competitive pressures boost returns to adoption (Andrews, Criscuolo and Gal, 2016<sub>[130]</sub>).

#### *4.3.3. Merger policy: market concentration vs the emergence of national champions*

In the discussion on competition and industrial policy, merger control has attracted a lot of attention. The proponents of “national champions” argue that merger control should become laxer. The potential increase of market power for few large players, as suggested by evidence of increased industry concentration, increased entrenchment as well as increased mark-ups, has pushed some to rather call for more stringent merger control (Philippson, 2019<sub>[152]</sub>; Koltay, Lorincz and Valletti, 2020<sub>[153]</sub>).

In sectors with increasing returns to scale or network externalities, governments may want to foster the development of ‘national champions’ (OECD, 2009<sub>[142]</sub>), large firms able to compete on the global market with world leaders, including by the merger of several smaller firms (e.g. Engie, CRRC or, more recently, the attempted merger between Alstom and Siemens). Critics usually argue that the strictness of merger control does not allow realising enough economies of scale, and results in a comparative disadvantage for domestic firms compared to large foreign competitors with less-stringent competition regulation and enforcement (Franco-German Manifesto, 2019<sub>[154]</sub>).

This argument is reinforced in a world where an increasing share of sectors, especially digital, may be subject to a winner-takes-most dynamics, the largest firms taking advantage of network effects and intangibles (Autor et al., 2017<sub>[155]</sub>). Beyond the boundaries of sectors, Aghion et al. (2019<sub>[156]</sub>) also argue that these large firms have decreasing costs of spanning multiple markets.

Nevertheless, economists rather argue that a laxer merger control policy has detrimental effects on the within and between-firm components of productivity growth. It calls for sticking to best practices when it comes to merger control, which does not preclude allowing mergers if large economies of scale were to be expected based on sound evidence. First, even though lower competition may bear fruits in the short run by allowing firms to benefit from economies of scale and scope and network effects, it can have negative effects in the end, by reducing competition and, therefore, incentives for innovation, as discussed

above. Second, if intended to keep struggling incumbents in business, mergers can slow the reallocation process. Third, the available evidence shows that mergers do not systematically create efficiency gains, and may sometimes reduce competition.<sup>25</sup>

Moreover, faced with a large body of evidence that concentration (Bajgar et al., 2019<sup>[157]</sup>) and mark-ups are increasing (Calligaris, Criscuolo and Marcolin, 2018<sup>[158]</sup>) while business entry is receding (Calvino, Criscuolo and Verlhac, 2020<sup>[124]</sup>), it remains necessary to ensure the contestability of markets, e.g. in the retail sector during and after the COVID-19 crisis (OECD, 2020<sup>[159]</sup>).

Support to ‘national champions’ is in most cases in conflict with competition (and trade) policy (OECD, 2019<sup>[160]</sup>; OECD, 2019<sup>[161]</sup>), even when the selection of the firm to be supported obeys the highest standards of transparency. In fact, such a policy generally reduces the contestability of the market, the creative destruction process and, as a consequence, innovation and competition in the long run.

#### *4.3.4. Merger policy and killer acquisitions in the digital economy*

So-called “killer acquisitions” are also an important issue for merger policy. On one hand, the absorption of young innovative firms by large digital firms threatened by their emergence (Furman et al., 2019<sup>[162]</sup>; Argentesi et al., 2020<sup>[163]</sup>; Cunningham, Ederer and Ma, 2021<sup>[164]</sup>) is increasingly considered as reducing competition, innovation, and the contestability of markets (Koski, Kässi and Braesemann, 2020<sup>[165]</sup>).

On the other hand, however, some papers argue that systematic acquisitions of small challengers may incentivise innovative entrepreneurship (Motta and Peitz, 2021<sup>[166]</sup>), even if such an ‘entry-for-buyout’ behaviour may become harmful when small firms are less efficient in innovating (Mermelstein et al., 2020<sup>[167]</sup>) or when this threat dis-incentivises customers to switch to a new platform (Kamepalli, Rajan and Zingales, 2020<sup>[168]</sup>).

Policy analyses tend to conclude in favour of a heightened control of acquisitions of start-ups by large digital platforms (Crémer, De Montjoie and Schweitzer, 2019<sup>[169]</sup>; Shapiro, 2019<sup>[170]</sup>; Furman et al., 2019<sup>[162]</sup>; Kamepalli, Rajan and Zingales, 2020<sup>[168]</sup>; Argentesi et al., 2020<sup>[163]</sup>; Motta and Peitz, 2021<sup>[166]</sup>), with a need to act in two respects:

- Reviewing problematic mergers. Most of the acquisitions of start-ups by large digital platforms escape scrutiny by competition authorities, since they are below the applicable thresholds. Two approaches have been put forward to broaden the scope of merger controls: (i) reviewing the thresholds (Motta and Peitz, 2021<sup>[166]</sup>) or (ii) granting a special status to large digital platforms, with a systematic assessment of their mergers (Furman et al., 2019<sup>[162]</sup>).
- Amending merger control procedures and procedural frameworks. Propositions include shifting the burden of proof to the acquiring firm for horizontal mergers (Motta and Peitz, 2021<sup>[166]</sup>) or creating a ‘balance of harms’ in the impact assessment of mergers which takes potential competition and innovation into account (Furman et al., 2019<sup>[162]</sup>; Crémer, De Montjoie and Schweitzer, 2019<sup>[169]</sup>).

It is worth noting that complementary policies such as data portability and open standards can promote competition more broadly in digital markets (Stigler Committee on Digital Platforms, 2019<sup>[171]</sup>), even if the impact could remain limited (OECD, 2020<sup>[172]</sup>).

## 4.4. The nexus of trade and industrial policies

### 4.4.1. Trade and productivity

In theory, trade (and foreign direct investment - FDI) policies have three distinct effects on productivity.

1. As framework instruments, they favour an efficient allocation of production factors between firms, thereby contributing to aggregate productivity (Melitz, 2003<sub>[173]</sub>).
2. In addition, as for competition policies, trade policy has an ambiguous impact on the within-firms incentives to invest and innovate. On the one hand, by increasing the effective market size for domestic firms, openness increases the profits, the value of the firms, and the incentives to invest and innovate. On the other hand, by intensifying competition with foreign firms, openness may in theory decrease mark-ups, investment and innovation.
3. Finally, trade and FDI enhance knowledge flows and positively affect productivity (Gorodnichenko, Svejnar and Terrell, 2020<sub>[174]</sub>).

The empirical literature extensively addresses the link between openness on the one hand and investment, innovation and productivity on the other. The literature based on firm-level data generally concludes that trade and FDI foster innovation at the firm level and reallocation towards more productive firms (Shu and Steinwender, 2019<sub>[175]</sub>). While the impact is overwhelmingly positive for trade in intermediate inputs and new export opportunities, the effect of import competition, usually evaluated using the increase in Chinese exports since 2000, is mixed. Chinese competition increased patenting activity, IT investment and productivity in Europe (Bloom, Draca and Van Reenen, 2015<sub>[176]</sub>; Aghion et al., 2018<sub>[177]</sub>)<sup>26</sup> and patenting activity in Japan, although the quality of the additional patents seems to be low (Yamashita and Yamauchi, 2019<sub>[178]</sub>). However, the estimated impact is negative on patenting activity and R&D expenditures in the United States (Autor et al., 2020<sub>[179]</sub>). The authors justify the peculiar result for the United States by a higher level of competition compared to Europe, positioning the United States in the downward sloping section of the inverted U-shape relationship between innovation and competition. Analysis based on the OECD Services Trade Restrictiveness Index (STRI) suggests that services trade reforms can strengthen domestic productivity (OECD, 2017<sub>[180]</sub>).

Moreover, the literature shows that dynamic gains from trade, occurring through the increased pace of creative destruction and international knowledge spillovers, are an order of magnitude larger than static gains from trade, be it for trade between developed economies (Hsieh, Klenow and Nath, 2019<sub>[181]</sub>) or between developed and emerging economies (Hsu, Riezman and Wang, 2019<sub>[182]</sub>).

Finally, while granting (temporary) trade protection is often cited as a solution to boost some sectors, it is often counterproductive, in particular for upstream sectors. The corresponding products are used by domestic downstream sectors, which are negatively affected by increases in input prices (Handley, Kamal and Monarch, 2020<sub>[183]</sub>).

### 4.4.2. Trade policy and industrial policy

Even if the literature unambiguously rejects the use of trade policy as an industrial policy tool (Lashkaripour and Lugovskyy, 2019<sub>[184]</sub>; Bloom, Van Reenen and Williams, 2019<sub>[4]</sub>), three questions are still to be addressed:

- The impact of openness on productivity and innovation may be heterogeneous, affecting negatively a significant share of firms (Aghion et al., 2018<sub>[177]</sub>; Shu and



Steinwender, 2019<sup>[175]</sup>). Coupled with a stalling diffusion of innovation among firms and a lack of investment in complementary assets (e.g. skills), openness may contribute to the polarisation of the productivity (and wage) distribution<sup>27</sup>. If this finding were confirmed, it would call for complementary measures to address this divergence.

- The political economy of international trade (and investment) rules is absent from this literature. In principle, a rule-based international trade system would ensure fair practices. However, when some non-cooperative countries do not comply with these rules and engage in unfair practices, some argue that trade policy, notably FDI and trade defence instruments, should be used (European Political Strategy Centre, 2019<sup>[185]</sup>; Enderlein et al., 2019<sup>[186]</sup>; Franco-German Manifesto, 2019<sup>[154]</sup>; ITIF, 2020<sup>[187]</sup>; Werner, 2018<sup>[188]</sup>). Using FDI and trade defence instruments would reduce the incentives for these countries to support their firms through unfair practices, and could in the long-run promote global openness. But this could also lead to retaliation and escalation.
- There is a lively debate over the impacts of COVID-19 on the structure of global production and global supply chains (OECD, 2020<sup>[189]</sup>). For some, COVID-19 has exposed the fragility of supply chains (e.g. medical supply, semiconductors), which should be reshored, or at least shortened, to reduce risks from global exposure. Yet there is a danger of making quick assumptions about what is necessary to ensure resilience – see e.g. OECD (2020<sup>[190]</sup>) – and strategic autonomy. Firstly, internationally diversified production is often a source of resilience and adjustment for firms in an adverse environment. Secondly, reducing risk and ensuring strategic autonomy by producing essential goods domestically has to be traded off against the efficiency loss due to increased production costs and heightened vulnerability to domestic shocks. Thirdly, stockpiling and diversifying the sourcing of inputs, even if they may raise production costs, are credible alternatives to reshoring, at least for some products<sup>28</sup>.

Finally, issues related to subsidies that distort the international competitive playing field are becoming an important part of the industrial policy debate (OECD, 2019<sup>[161]</sup>; OECD, 2019<sup>[160]</sup>; OECD, 2021<sup>[35]</sup>; Gourdon and Guilloto, 2019<sup>[92]</sup>), at the intersection between investment policy and competition policy. For instance, acquisitions of domestic firms by heavily subsidised foreign firms lead to the return of investment screening as a policy tool – see UNCTAD (2019<sup>[191]</sup>) or the new EU foreign investment screening mechanism.<sup>29</sup>

## 5. The effectiveness of demand-side policy instruments

### Key messages

The evidence reviewed in this section brings four main policy messages regarding demand-pull interventions:

- Pigouvian taxes and subsidies can effectively complement supply-side policy instruments in fostering innovation;
- Product regulations seldom provide a short-run regulatory comparative advantage to domestic firms but can entail long-run negative effects on business dynamics;
- The effectiveness of innovative public procurement has not been demonstrated by the literature. Public procurement might be more effective to stimulate innovation in cases where demand emanates from the public sector (e.g. aerospace, defence, infrastructure), as the risk of excessive tailoring to public needs is less acute.
- The most pressing policy issue regarding demand-side instruments concerns their optimal combination with supply-push instruments, which ultimately depends on the design of both types of instruments. Among the main remaining unknowns is the overall and comprehensive cost-benefit analysis of innovation-oriented public procurement, notably taking into account industry heterogeneity.

Demand-side instruments are heavily used in mission-oriented strategies, as they contribute to addressing externalities at the core of missions, such as climate change. Demand-side instruments affect the demand for products, through either their price, availability or public demand. The underlying rationale is the creation of demand (where imperfect markets fail to do so) in order to incentivise scaling-up and improving efficiency through, e.g., learning by doing. Indeed, using demand-side instruments as part of the industrial policy toolkit is motivated using different arguments:

- Product regulations and Pigouvian taxes and subsidies, by reducing market uncertainty for some technologies, can efficiently foster innovation.
- Some argue that product regulations, and Pigouvian taxes, might provide a regulatory comparative advantage to domestic firms on their domestic markets, especially when the latter are large (e.g. General Data Protection Regulation – GDPR, green standards).
- When final demand emanates from the public sector (especially in some industries such as aerospace, defence and infrastructure), the use of public procurement may foster innovation.

This section focuses on these three issues, starting with the impact of demand-side instruments on innovation, mostly studied for environmental policies.

### 5.1. Demand-side instruments and innovation: environmental policies

The 'weak' version of the Porter hypothesis (Ambec et al., 2013<sup>[192]</sup>) states that environmental policies, if well designed, can enhance innovation.

Surveys (Haščič et al., 2010<sup>[193]</sup>; Ambec et al., 2013<sup>[192]</sup>; Blind, 2016<sup>[194]</sup>) show that environmental policies<sup>30</sup> are effective in fostering innovation, as measured by patents, in environmental technologies. However, at the country-level, they remain a secondary determinant of green innovation, less important than for instance general inventive capacity (Johnstone, Haščič and Popp, 2009<sup>[195]</sup>). Aghion et al. (2016<sup>[196]</sup>) specifically estimate the effect of a demand-side instrument (namely fuel taxes through their impact on fuel prices) on innovation. They confirm that fuel prices have a positive impact on the number of green patents, and show that the pattern of green innovation displays path-dependency<sup>31</sup> at the firm-, as well as at the country-level.

The literature tends to show that market instruments (feed-in tariffs, cap-and-trade schemes, carbon levies, ...) have larger effects on innovation than more rigid instruments such as command-and-control regulations (Popp, Newell and Jaffe, 2010<sup>[197]</sup>). Whereas market instruments allow heterogeneous reactions across firms while allocating efficiently emission reductions according to abatement costs, command-and-control regulations impose the same objective on all companies, with some having to make little effort and others much more.

Demand-side instruments, and in particular regulatory standards, which can increase red tape, may increase entry costs and have a detrimental effect on smaller firms. Fang, Gao and Lai (2020<sup>[198]</sup>) show that command-and-control regulations in China have a positive effect on the innovation of large firms, but have an inhibitory effect for small firms.

Environmental policies may foster green innovation either by increasing the innovation effort, or by changing the innovation composition without affecting the total effort. Calel and Dechezleprêtre (2016<sup>[199]</sup>) find support for the former hypothesis by looking at the European Union Emissions Trading System.

Demand-side instruments should also play a role in the diffusion of technologies, by allowing them to become cost-effective or even mandatory. Indeed, the induced innovation effect is supposed to channel through an increased demand for green technologies. The positive effect of demand-side instruments on technology diffusion tends to be confirmed by the literature (Popp, Newell and Jaffe, 2010<sup>[197]</sup>), but the effect of national innovations on the subsequent diffusion of the new technology seems to remain limited (Popp, Hascic and Medhi, 2011<sup>[200]</sup>; Bednarz and Broekel, 2020<sup>[201]</sup>).

Among these demand-side instruments aiming to foster the diffusion of cleaner products based, electric vehicles (EV) subsidies is very common. However, evidence on the impact of EV subsidies remains scarce. Even if the existing studies show that EV subsidies significantly increase the uptake of EVs (Tal and Nicholas, 2016<sup>[202]</sup>; Muehlegger and Rapson, 2018<sup>[203]</sup>), a welfare analysis would rest on a quantification of avoided externalities (greenhouse gas emissions, reduction of pollutants and noise, reduced dependency to oil, ...) over the lifecycle of the vehicle, and the magnitude of these externalities are likely to vary by geography (Rapson and Muehlegger, 2021<sup>[204]</sup>). The efficiency of EV subsidies should then be compared to that of alternative policy instruments (e.g. investing in the charging infrastructure). Moreover, existing studies do not provide any impact on the development of EV technologies and the EV industry.

No consensus was reached yet on the optimal mix of instruments to be used in green industrial strategies, although some studies are trying to address this issue from a theoretical perspective (Fischer, Preonas and Newell, 2017<sup>[205]</sup>). The impact of demand-side

instruments will ultimately depend on their design and their complementarity with other policy instruments<sup>32</sup>. OECD (2015<sub>[3]</sub>) emphasised five characteristics that are key in the impact of regulation on innovation: its stringency, predictability, flexibility, incidence and depth.

## 5.2. Environmental policies and competitiveness

A positive effect of environmental policies on competitiveness (‘strong’ version of the Porter hypothesis<sup>33</sup>) is not consistent with the hypothesis of profit-maximising firms. Otherwise, firms would have voluntarily complied with environmental targets. Nevertheless, with several market failures, and possible departures from the profit-maximising assumption, this question remains of empirical relevance.

The ‘strong’ version of the Porter hypothesis is not verified in empirical analysis (Ambec et al., 2013<sub>[192]</sub>; Dechezleprêtre and Sato, 2017<sub>[206]</sub>; Dechezleprêtre et al., 2019<sub>[207]</sub>). Even if environmental policies fosters innovation and productivity, the net impact on competitiveness remains negative or close to zero in the majority of studies<sup>34</sup>, calling for international coordination regarding environmental goals (Anderson et al., 2021<sub>[135]</sub>).

Moreover, demand-side policies seem to foster domestic as well as foreign innovation (Peters et al., 2012<sub>[208]</sub>; Fabrizio, Poczter and Zelner, 2017<sub>[209]</sub>). International spillovers can magnify the impact of these policies on innovation and their environmental effects, but may also reduce the effectiveness of demand-side policies in incentivising domestic innovation or technology adoption. The two above-mentioned studies, respectively on solar photovoltaic modules and energy storage technologies, cite the example of solar panels, for which demand-side subsidies from developed countries are generally considered as having contributed to financing the learning curve of Chinese manufacturers. These examples seem to contradict the ‘regulatory comparative advantage’ hypothesis.

## 5.3. Public procurement and innovation

The literature usually defines innovation-oriented public procurement as the ‘purchase of technologies and innovative products and services’ by the public sector with the primary objective of meeting public sector needs and the secondary objective of fostering innovation (Aschhoff and Sofka, 2009<sub>[210]</sub>). Public procurement can also be used to pursue other industrial policy objectives (e.g. green public procurement, procurement favouring the economic inclusion of some disadvantaged parts of the population, procurement for strategic autonomy through the domestic development of key technologies<sup>35</sup>), some of them being related to innovation.

The use of innovation-oriented public procurement is widespread in OECD countries (Appelt and Galindo-Rueda, 2016<sub>[211]</sub>; OECD, 2017<sub>[212]</sub>). As public procurement represents a large share of final demand<sup>36</sup>, this channel is likely to represent a powerful way to induce innovation. Nearly half of OECD countries reported improved effectiveness or efficiency of the procurement process, or increased user satisfaction following the use of procurement for innovation.<sup>37</sup> Moreover, as domestic producers are often overrepresented in public procurement,<sup>38</sup> this option may be appealing for policy-makers.

There are however a number of difficulties in the implementation of innovation-oriented public procurement. First, it is inherently hard to design call for tenders for products or services that do not exist yet. The literature calls for functional procurement, specifying needs rather than technologies (Edquist and Zabala-Iturriagoitia, 2020<sub>[213]</sub>). Second, the implementation difficulties listed for targeted industrial policies in Criscuolo et al. (2022<sub>[1]</sub>) may be particularly acute for innovative public procurement. Specifically, OECD (2015<sub>[3]</sub>)

stresses the need for technical expertise in the public sector, the potential fragmentation of demand across government layers and the importance of paying particular attention to the inclusiveness of calls for tender, especially for SMEs. The operationalisation of public procurement for innovation is therefore key to overcome these difficulties and can rely for instance on a monitoring system, the use of targets and incentives for buyers, capacity building in the administration and resources to support buyers (OECD, 2021<sup>[214]</sup>).

The current literature provides a mixed picture of the effectiveness of innovative procurement on innovation and productivity of awarded firms (Warwick and Nolan, 2014<sup>[7]</sup>). It mainly rests on matching techniques (Guerzoni and Raiteri, 2015<sup>[215]</sup>; Stojčić, Srhoj and Coad, 2020<sup>[216]</sup>; Castelnovo, Clo and Florio, 2021<sup>[217]</sup>; Caravella and Crespi, 2020<sup>[218]</sup>; Appelt and Galindo-Rueda, 2016<sup>[211]</sup>), which only imperfectly identify the effects of the treatment per se and the selection by government officials, as they rely on very strong assumptions (see Box 3). Two exceptions are worth noticing. First, taking advantage of an exogenous variation in public demand across US states, Slavtchev and Wiederhold (2016<sup>[219]</sup>) show that shifting USD 10 of procurement from low-tech to high-tech sectors results in a USD 2 increase of business R&D expenditures. Second, using the introduction of ‘Public Procurement with Contracted Innovation’ in Germany, Czarnitzki, Hünermund and Moshgbar (2020<sup>[220]</sup>) estimate that this new provision increased the share of sales from products and services that are new to the firm, whereas the effect is insignificant on the share of sales from products and services that are new to the market.

A complete cost-benefit analysis of innovation-oriented public procurement would require more evidence, in particular on two types of costs, which may offset the benefits. First, introducing an innovation criterion in public procurement can reduce the cost-effectiveness of the procurement process, whose main objective remains to provide the best product at the best price. Second, innovation-oriented public procurement can affect the direction of innovation by firms, and carry the risk of an excessive-tailoring to public sector needs (Aschhoff and Sofka, 2009<sup>[210]</sup>), in the sense that resulting innovations can be of little value to other users.

There is also a need to investigate industry heterogeneity. For instance, the share of public demand for a given product affects the effectiveness of public procurement for innovation, as well as the risk of excessive tailoring. The trade-off between efficient procurement and innovation is also likely to vary tremendously across products or services.<sup>39</sup>

## *Endnotes*

<sup>1</sup> When financial instruments are not provided at market conditions, they can also represent an indirect subsidisation of investment. Beyond risk sharing, they also reduce the total cost of investment by lowering financial charges.

<sup>2</sup> See for instance House and Shapiro (2008<sub>[238]</sub>), Eichfelder, Jacob and Schneider (2020<sub>[12]</sub>) and the references therein.

<sup>3</sup> See also Agrawal, Rosell and Simcoe (2020<sub>[224]</sub>) on the impact of making an R&D tax credit refundable.

<sup>4</sup> See discussions of the nexus approach, under the Base Erosion and Profit Shifting project.

<sup>5</sup> However, Breschi, Johnstone and Menon (2021<sub>[239]</sub>) find that start-ups receiving mixed public-private funding in the first round receive a lower amount of funding in subsequent rounds.

<sup>6</sup> For a qualitative discussion of these features, see Lerner (2010<sub>[222]</sub>).

<sup>7</sup> Two papers, with conflicting conclusions, are however investigating the impact of business angel tax credits (Howell and Mezzanotti, 2019<sub>[236]</sub>; Gonzalez-Urbe and Paravisini, 2019<sub>[235]</sub>).

<sup>8</sup> For information on policies supporting the financing of SMEs and entrepreneurship, see the most recent OECD's Financing SMEs and Entrepreneurs Scoreboard publication (OECD, 2020<sub>[223]</sub>).

<sup>9</sup> Absorptive capacity is the ability to identify, assimilate, transform, and use external knowledge, research and practice.

<sup>10</sup> The Bayh-Dole Act “allowed universities to own the patents arising from federal research funding, and provided incentives for their commercialisation” (OECD, 2015<sub>[3]</sub>).

<sup>11</sup> See Azoulay et al. (2019<sub>[221]</sub>) for some ideas on the way to evaluate of ARPA-type interventions.

<sup>12</sup> According to the infant industry argument, sectoral productivity increases with experience, based on the idea that firms discover and improve processes over time. See Criscuolo et al. (2022<sub>[1]</sub>)

<sup>13</sup> See e.g. Korea's semi-conductor industry (OECD, 2019<sub>[160]</sub>).

<sup>14</sup> In support of the learning-by-doing hypothesis, two studies, focusing on historical episodes and providing a natural experiment of temporary protection, show the existence of dynamic external spillovers. Juhász (2018<sub>[245]</sub>) analyses the cotton spinning industry in France, that enjoyed de facto a lesser competition with Britain during the Napoleonic Blockade. Hanlon (2019<sub>[244]</sub>) focuses on the transition from wood to metal shipbuilding in Canada and the US before WWI, comparing regions that differ by their exposition to the competition with British shipbuilders. These two papers find long run positive impact of the temporary protection, and evidence in favour of the learning-by-doing argument with dynamic external economies of scale. In addition, Hanlon (2019<sub>[244]</sub>) provides suggestive evidence that these externalities were local and channelled through the building of a pool of skilled craft workers.

<sup>15</sup> For instance, evaluating the French cluster strategy (Pôles de compétitivité), Mar and Massard (2021<sub>[106]</sub>) show that animation actions and common services are complementary to R&D subsidies.

<sup>16</sup> Productive firms self-select into exporting, but there is also evidence that firms “learn by exporting” (Atkin, Khandelwal and Osman, 2017<sub>[243]</sub>). See also the literature on export-oriented industrial policy in East-Asian countries in the 1970s.

<sup>17</sup> <https://www.oecd.org/tax/beps/>

<sup>18</sup> <https://www.oecd.org/tax/beps/oecd-releases-pillar-two-model-rules-for-domestic-implementation-of-15-percent-global-minimum-tax.htm>

<sup>19</sup> See for instance the literature on the role and impact of allowances for corporate equity (ACE).

<sup>20</sup> See also the Box on Entrepreneurship and SME policies in the companion paper, detailing the role of these policies in industrial strategies. Financial support for entrepreneurs, young and small firms (e.g. subsidies, loans, and government venture capital) is considered as an investment incentive and discussed in sections 2. and 3. .

<sup>21</sup> This paragraph focuses on patents but other types of IP rights, such as copyrights, trademarks and design, are also important for productivity growth – see OECD (2015<sub>[229]</sub>).

<sup>22</sup> For reviews, see Rabier (2017<sub>[133]</sub>) and Bloom, Van Reenen and Williams (2019<sub>[4]</sub>).

<sup>23</sup> Source: Baron and Pohlmann (2018<sub>[232]</sub>). Patents are considered as standard-essential when they cover a technology for which there is no alternative compatible with the standard.

<sup>24</sup> See the 2012 OECD Recommendation of the Council on Regulatory Policy and Governance, <http://www.oecd.org/gov/regulatory-policy/2012-recommendation.htm>.

<sup>25</sup> See Pike (2018<sub>[230]</sub>) and Shapiro (2019<sub>[170]</sub>).

<sup>26</sup> Note that Campbell and Mau (2021<sub>[233]</sub>) replicate the analysis of Bloom, Draca and Van Reenen (2015<sub>[176]</sub>) and find an insignificant impact of Chinese competition on patenting activity.

<sup>27</sup> On the contrary, Chen and Steinwender (2019<sub>[231]</sub>) find that in Spain the firms whose productivity increases are the less productive family-managed firms. Their increase in productivity is driven by the rationalisation of their processes rather than innovation.

<sup>28</sup> See also the concept of ‘open strategic autonomy’, recently developed by the European Commission: [https://trade.ec.europa.eu/doclib/docs/2021/february/tradoc\\_159434.pdf](https://trade.ec.europa.eu/doclib/docs/2021/february/tradoc_159434.pdf).

<sup>29</sup> [https://ec.europa.eu/commission/presscorner/detail/en/ip\\_20\\_1867](https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1867)

<sup>30</sup> Environmental policy tools mainly include demand-side instruments. According to the taxonomy of policy instruments, carbon pricing is in theory a typical example of Pigouvian taxes, and as such a demand-side instrument. However, in practice, carbon pricing concerns only domestic emissions and treats differently domestic and foreign production, thereby potentially affecting competitiveness. Recent discussions on Carbon Border Adjustment Mechanisms aim to address the adverse competitiveness effects (as well as the associated carbon leakages) and would bring carbon pricing closer to a pure demand-side instrument. Environmental policies also rely to a large extent on product regulations, such as emission standards for vehicles or recycled content minimums, but also on regulations of production (e.g. command-and-control policies, emission caps), the latter being considered as supply-side instruments since they apply regardless of where consumption takes place.

<sup>31</sup> There is path-dependency if the likelihood of green innovation is higher for firms that have already performed some green innovation in the past, compared to other innovators.

<sup>32</sup> See also Nesta, Vona and Nicolli (2014<sub>[225]</sub>), who find weak evidence supporting the complementarity between renewable energy policies and the level of competition in energy markets. Albrizio et al. (2014<sub>[226]</sub>) also underlines the complementarity between framework instruments (notably entry and competition policies) and environmental regulation to maximise the impact on productivity growth. Yamazaki (2022<sub>[240]</sub>) shows that the impact of environmental taxes depend on how their revenue is recycled (e.g. by lowering the corporate income tax rate).

<sup>33</sup> Under this hypothesis, the compliance costs are more than offset by the benefits of induced innovation.

<sup>34</sup> Interestingly, Ferracane, Kren and Marel (2020<sub>[227]</sub>) reach the same conclusion for data policies. They estimate the impact of a data policy restrictiveness index on the productivity of data-intensive sectors in a cross-country panel setting and find a sizeable negative effect. Koski and Valmari

(2020<sup>[237]</sup>) estimate the impact of GDPR and show that profit margins of data-intensive firms were reduced in Europe compared to the United States. This effect is mostly driven by the impact on SMEs.

<sup>35</sup> The development of Covid-19 vaccines enter into this category (e.g. Operation Warp Speed in the United States).

<sup>36</sup> 12% on average in the OECD countries (OECD, 2017<sup>[212]</sup>).

<sup>37</sup> 49% of 35 countries that responded to the OECD Survey on Strategic Innovation Procurement (OECD, 2017<sup>[212]</sup>).

<sup>38</sup> Although it is against the principles of the World Trade Organization's Government Procurement Agreement to target domestic producers, information asymmetries and domestic bias may result in a disproportionate share of public procurement for domestic suppliers (Rickard and Kono, 2013<sup>[241]</sup>; Shingal, 2011<sup>[242]</sup>).

<sup>39</sup> Examining the case of airplane manufacturers in the United States during WWII, Jaworski and Smyth (2017<sup>[228]</sup>) find a significant effect of government contracts on post-war market shares. Draca (2013<sup>[234]</sup>) shows that US Department of Defense procurement has had a positive impact on patenting and R&D investment.



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