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A comparative review of the effectiveness of R&D tax credits and R&D grants for firm performance

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Innovation has been widely acknowledged as one of the main driving forces of sustainable economic growth and national competitiveness. On the other hand, not all firms innovate, and many of the firms that do are increasingly relying on public support for their innovation activities.

Governments provide support to private sector R&D and innovation through a range of policy schemes including direct R&D grants and indirect R&D tax incentives (R&D tax credits). While public R&D and innovation policies may induce beneficiary firms to increase their innovation activities, this does not necessarily mean that any such increase in input effort will automatically translate into commercial innovation outputs. Moreover, there are different mechanisms for administering R&D tax credits and grants, and for the policymaker, there are questions around which is the most effective and what boundary conditions influence their impact on firm-level performance beyond R&D investments. This review examines the available empirical answers to these questions through an examination of the research evidence. The overall findings of the majority of the studies reviewed suggest that tax credits are more effective than grants in promoting firm performance (Nana-Cheraa et al. 2023; Lenihan et al. 2023; Nilsen et al. 2020; Pang et al. 2020). Nonetheless, certain types of firms, including low-tech manufacturing, low knowledge-intensive service (low-KIS) and high-tech SMEs benefit significantly more from grant support (Nana-Cheraa et al. 2023; Kleine et al. 2022; Ghazinoory and Hashemi 2021; Radas et al. 2015).

Background

Economists acknowledge technological development as a main factor for sustainable growth in highly industrialised economies. The private sector is acknowledged as playing a critical role in ensuring continuous advancement in technological development through the creation of valuable knowledge. Firms search for, create and accumulate knowledge through R&D and innovative activities – stocks of knowledge that could potentially be translated into successful innovation outcomes (Roper and Hewitt-Dundas, 2015).

However, knowledge is characterised by non-rivalry and non-exclusivity, and as such privately generated knowledge can spill over to other agents. This social benefit to knowledge makes it difficult for an investing firm to fully appropriate the returns of its private investment (Arrow, 1962), even though may solely bear all the cost. Moreover, issues of the inherent high risk of innovation projects and uncertainty surrounding the commercialisation of innovations means profit seeking firms may discriminate against risky projects with potential high social returns. R&D grants and R&D tax credits are the main innovation supports used by policy makers to incentivise firms to undertake projects which the firms would not have otherwise undertaken in the absence of the public support. Both supports, among others, aim to reduce the cost and risk of innovation projects to the firm. They also provide liquidity allowing the firm to increase either or both the intensity and level of innovation activity.

R&D grants provide direct financial support to target specific R&D projects with high social returns and are awarded on a competitive selection basis. They are awarded ex-ante, providing the opportunity to undertake high-risk projects with potential high reward. Since grant funding is often given for a specific project, and not all projects in the firm's innovation portfolio, the funded project moves up the priority ranking within a firm, causing a distortion in the relative risk and return of the projects in the firm's portfolio. This may mean a project that was not initially ranked as the most profitable could potentially get executed first because it got grant support. That is, project selectivity relating to a grant committee's interest in, or bias towards a particular project, or even funding eligibility criteria, can potentially distort the firm's project ordering and alter the nature of firms' R&D investment (Appelt et al., 2016). Nonetheless, winning a grant out of a competition serves as a signal to other potential investors about the quality of the project and innovative capability of the firm (Spence, 1973). This reduces the problem of information asymmetry and moral hazard on the part of the firm allowing it to obtain complementary or future financing (Connelly et al. 2011; Bianchi et al. 2019).

R&D tax credits on the other hand are indirect financial support given after the R&D expense has occurred. They are corporation tax deductions that are available to all firms by considering either their total R&D spending (volume-based scheme) or their R&D spending in excess of specified threshold (incremental scheme). Unlike grants, tax credits are neutral in terms of the activity and content of the R&D project being supported, meaning that they can cover the firm's entire portfolio of projects once the R&D investment meets the eligibility criteria (OECD, 2014; Appelt et al. 2016). This means that the firm will most likely select and invest in projects in the order which offers the greatest private return. Also, the eligibility criteria of tax credits make their accessibility quite predictable which a provide a reliable base for long-term financial planning and R&D decisions (Appelt et al., 2016).

Research evidence

The relative effectiveness of grants and tax credits in improving firm performance is predominantly examined by so-called policy mix studies. Although quite limited in volume, this stream of research provides tremendous insight on the relative effectiveness of the two policy instruments in promoting performance outcomes beyond levels of R&D investment. Findings from recent studies which compare the effects of R&D grants and R&D tax credits are summarised in Table 1. Table 1 consists of studies which investigate policy effect on output performance outcomes, and studies which examine policy effects on both R&D input and output performance. Here, the output performance outcomes considered include innovation, employment, productivity, turnover, return on assets and exporting. Table 2 summaries the findings from the most recent studies which investigate the individual effect of tax credits and grants on firms' output performances. Here, since these studies do not directly compare grants and tax credits, only studies published from 2020-date are considered. The motivation for reviewing these studies is to examine if their policy effect trajectories are consistent with those in Table 1.

We find in Table 1 that tax credits are generally more effective than grants in promoting firms' performances beyond R&D investment. For instance, tax credits were found to create higher impacts than grants in both product and process innovation in UK firms as well as in Spanish manufacturing firms (Nana-Cheraa et al. 2023; Petrin and Radicic, 2021), and product innovation among Chinese firms (Pang et al., 2020). In fact, the innovation effect of tax credits is two times the effect of grants (Nana-Cheraa eta al. 2023; Pang et al. 2020). Similarly, a higher tax credit than grant effect was found for value added in Irish firms (Lenihan et al., 2023), and R&D starters in Norway (Nilsen et al., 2020). Lenihan et al (2023) particularly provide a comparative analysis of tax credits and grants and found that a €1 million tax-credit-induced R&D spending corresponds to 15.9% higher turnover and 13.6% higher GVA in domestic firms, compared to 14.6% higher turnover and 11.9% higher GVA for a €1 million grant-induced R&D spending. The effectiveness of tax credits over grants is particularly true for domestic firms (except exporting in which grants are more effective), while grants tend to be more effective for foreign-own firms.

The superiority of tax credits or grants is not straightforward when specific types of firms are considered: Tax credits are superior in promoting innovation in high-tech manufacturing, knowledge-intensive-service (KIS) and high productivity firms (Nana-Cheraa et al. 2023; Petrin and Radicic, 2021) and value added in R&D-starters (Nilsen et al., 2020). Grants on the other hand are more effective for innovation in low-tech manufacturing, low-KIS and SMEs, particularly high-tech SMEs (Nana-Cheraa et al. 2023; Ghazinoory and Hashemi, 2021). Indeed, a study in the USA suggests that high-tech SMEs that are frequent grant awardees outperform their comparative non-frequent ones by over 100 times in patent applications, and 2.5 more in spinoff firms, particularly if the firm is matured with medium-size employees (Feldman et al., 2022).

In terms of innovation effects of mixing grants and tax credits, some studies find synergistic interaction effects (e.g., Nana-Cheraa et al. 2023; Pang et al. 2020), while others find policy mix creates either insignificant effects or is as effective as individual policies (Petrin and Radicic, 2021; Nilsen et al. 2020; Greco et al. 2022). For instance, Pang et al. (2020) found that, in China, a mix of any two or all of R&D tax credit, R&D grant, and public procurement significantly improved new product sales, more than any of the instruments in isolation. By contrast, Petrin and Radicic's (2021) panel analysis of Spanish manufacturing firms found no significant additionality effect on innovation, when R&D tax credits were used in combination with R&D grants.

It is worthy of note that prior studies either tended to consider the R&D input or innovation output effect of policy mix in isolation (e.g., Guerzoni and Raiteri 2015; Marino et al. 2016; Freitas et al. 2017), providing little insight into relative levels of effect and whether any additional increase in R&D input that firms achieve are translated into enhanced innovation outputs. Some of the most recent studies which investigated both R&D input and innovation output effects of policy mix include the work of Nana-Cheraa et al. (2023), Caloffi et al. (2022), and Ghazinoory and Hashemi (2021). In terms of R&D input effect, Nana-Cheraa et al. (2023), for instance, found evidence of strong and positive R&D tax credit, R&D grant, and policy mix effect on firms' internal R&D. Notably, the authors found the input effects from tax credits are consistently around twice as large as those of grants, and also larger than policy-mix impacts, suggesting some attenuation or substitution effects between the R&D input effect of grants and tax credits. The authors also found a difference in the scale of R&D input and innovation output effects for tax credits and the related policy mix: R&D input effects are consistently larger – 2-3 times – the scale of output additionality effects. Similar results by Ghazinoory and Hashemi (2021) suggest that R&D grants are more effective than R&D tax credits in promoting both R&D investment and R&D employment, and while both supports create significant innovation input effects, significant innovation output effects were found only for grant support. This suggests that while tax credits, grants and a policy-mix are very likely to achieve additional private R&D investment – they are significantly less likely to result in innovation.

Table 1. Studies on the relative effect of R&D grants and R&D tax credits

Author(s)	Country and sample details	Policy instrument	Performance measure (s)	Key findings
Petrin & Radicic (2021)	Manufacturing firms; Panel data (2001-2016); 6,769 observations; Spain	R&D grants; R&D tax credits	Product innovation; Process innovation	(1) Tax credit is effective for product innovation in both small and large firms, and only marginally effective for process innovation in large firms. (2) No significant grant and policy mix effect for any of the innovation outcomes (neither in SMEs nor large firms).
Lenihan, Mulligan, Doran, Rammer, & Ipinnaiye, (2023)	Panel data; 24,404 firms (2007-2016); Ireland	R&D grant R&D tax credit	R&D expenditure Turnover; Exports; Gross Value Added (GVA)	(1) Both R&D and tax credit individually drive firm-level private R&D investment. (2) On average, €1 of R&D tax credit support leads to €0.68 additional R&D spending in foreign-owned firms and €1.13 in domestic firms, while €1 of R&D grant support generates €1.22 additional R&D spending in foreign-owned firms and €0.42 in domestic firms. That is, while tax credit is more effective than grant for domestic firms' R&D, the reverse is true for foreign-own firms. (3) Induced R&D spending due to R&D grants and R&D tax credits is positively and significantly linked to higher performance outcomes in both domestic and foreign-owned firms: A €1 million increase in grant-induced R&D spending relates to 14.6% higher turnover, 11.9% higher GVA, and 17.2% higher export in domestic firms, while it is 0.775% higher turnover, 0.618% higher GVA, and 0.703% higher exports in foreign-owned firms. (4) In terms of tax-credit-induced R&D spending, a €1 million increase relates to 15.9% higher turnover, 13.6% higher GVA, and 13.2% higher export in domestic firms, while it is 0.668% higher turnover, 0.599% higher GVA, and 0.607% higher exports in foreign-owned firms.
Pang, Dou & Li (2020)	Panel data (2013-2018); 15,552 observations across 2,592 firms; China	R&D grants; R&D tax credits; Public procurement	Sale revenue from new products	(1) Tax credit effect (i.e., 10%p) is twice the effect of grant only (i.e., 5%p). (2) Mixing tax credits with grant (4%p effect) is as effective as grant only. (3) The strongest effect comes from a mix of grant and public procurement (28%p). (4) A mix of all three instruments creates about 16% more new product sales among the treated related to the firm that did not receive any public support.
Nilsen, Raknerud, & Iancu (2020)	Panel data: 23,737 observations (2002–2013)	Grants from Innovation Norway (IN) and Research	Value added; Employment Labour productivity	(1) Insignificant result for RCN supports for all output outcomes. (2) Significant result for both IN grants and tax credits (but only for outcome variables related to value added and employment); the effects

	Norway	Council of Norway (RCN) Tax credits	Return of assets	per NOK million in support are consistently higher for tax credits than for IN grants, both for R&D-starters (firms without R&D activity prior to support) and R&D-experienced (firms with R&D activity prior to support). (3) There is a decreasing return to higher support.
Nana-Cheraa, Roper & Mole (2023)	Pooled cross-section of UK innovation survey (2014, 2016, 2018)	R&D grant R&D tax credits	Internal R&D Product innovation Process innovation	(1) Significant R&D effect for tax credits only, grants only, and policy mix. (2) Tax credit outperforms grant irrespective of the type of firm. (3) Mixing tax credit with grant attenuates the effect of tax credits, except for low-tech manufacturing and low productivity firms in which mixing is more effective. (4) Generally, the R&D effect of policy mix (27%p) is larger than that of grants (13.2%p), but smaller than that of tax credits (31.4%p). (5) Policy mix effect on R&D is stronger among medium-large firms, service firms, low-tech manufacturing and less-knowledge-intensive service firms. (6) Significant (product; process) innovation impact for tax credits (11%p; 10.6%p), grants (5.9%p; 6.7%p) and policy mix (12.8%p; 13.8%p); (7) Insignificant result for grants when different types of firms are considered (i.e., along size, industry and firm productivity), except for product innovation in low-knowledge-intensive service firms in which grant impact is significant; Nonetheless mixing tax credit and grant creates a superior effect than either policy alone irrespective of firm's context; (8) The process innovation impact of tax credits increases with firm productivity. * R&D investment effects of tax credits and policy mix are consistently larger – 2-3 times – the scale of their innovation impact.
Ghazinoory & Hashemi (2021)	435 High-tech firms 375 small and 60 large Cross-sectional (2017) Iran	R&D grants R&D tax credits	R&D investment R&D employment Number of new products Sales from new products	**High-tech SMEs:** (1) Tax credit effect is significant only for R&D investment. (2) Significant effect of grant on R&D employment (mean increase of 66% compared to non- supported firms), and number of new product development (mean increase of 81.1% compared to non- supported firms). (3) Grant is more effective than tax credits for R&D investments (increase of 22% more compared to tax-credit-only recipients). (4) No significant effect for policy mix. **Large high-tech firms**: (5) Grant effect is significant only for R&D investment (121% mean increase compared to non-supported firms); (6) Policy mix effect is significant only for new product development (increase of 1.14 times more than non-supported firms, 2.38 times more than tax-credit-only recipients, and 5.33 times more than grants-only recipients).
Radas, Anić, Tafro	175 SMEs in Croatia	R&D grant	R&D intensity;	(1) R&D grants used alone or mixed with tax credits strengthen the R&D orientation of

& Wagner (2015)	Cross-sectional (2010)	R&D tax credit	R&D employment; R&D collaboration research; Absorptive capacity (ACAP) (aggregates) Number of innovations; New product sales	SMEs as well as increase their absorptive capacity1 (2) Significant positive policy mix effect on both innovation output measures (complementarity effect). (3) Policy mix is as effective as grant-only in promoting innovations.

Findings from Table 2 suggest that grants enhance the innovation capability of firms, and in particular SMEs, by promoting their engagement with knowledge experts, and facilitating a continuing engagement in R&D activities and internal knowledge exploitation (Kleine et al. 2022; Ning et al. 2022). Grants can generate on average 38% points more innovation for supported compared to non-supported firms, create over 3% more increase in new-to-the-market sales and about 5% more increase in new-to-the-firm sales, and produce significant reduction in both energy use and air pollution (Greco et al. 2022; Stojčić et al. 2020). R&D tax credits on the other hand facilitate the emergence of technology spillovers which subsequently cause firms to imitate rather than producing differentiated products, and also produce over 4 patents more for supported firms compared to their non-supported counterparts (Byun et al. 2023; Dai and Chapman, 2022). Here, we must be cautious in comparing effect size since each of these studies was conducted using different estimation methods and dataset from different countries.

Table 2: Studies on individual effect R&D grants and R&D tax credits

Author(s)	Country and sample details	Policy instrument(s)	Performance measure (s)	Key findings
Stojčić, Srhoj & Coad (2020)	Cross-country analysis; cross-sectional (2012-2014); 41, 623 firms; 8 Central & Eastern European countries	Financial support from local, national and EU bodies (aggregate) Public procurement for innovation contract	Product innovation Process innovation % Turnover from new-to-market products (NTM) % Turnover from new-to-firm products (NTF) Turnover growth	(1) PPI increases probability of product innovation by 36.3%p for recipient firms; Aggregate PFS (by 37.1%p); Policy mix (by 40.1%p). (2) PPI increases probability of process innovation by 23.1%p more for recipient firms; Aggregate PFS effect (39.1%p)***;*** Policy mix effect (30.1%p). (3) PPI increases sales from NTM by 6.9%; Aggregate PFS effect (3.2%)***;*** Policy mix effect (-4.2%). (4) PPI increases sales from NTF by 6%; Aggregate PFS effect (4.5%)***;*** Policy mix effect (insignificant negative). (5) Insignificant growth effect for PPI; significant negative effect for both aggregate PFS (-2.5%) and policy mix (-2.9%).
Byun, Oh & Xia (2023)	Staggered adoption of R&D tax credits at state level 923,597 observations (1996-2006) USA	R&D tax credits	Product convergence	(1) R&D tax credits leads to an increase in product convergence among recipients and non-recipient firms (1.75% to 2% increase in product similarity from the mean). That is, products of non-recipient firms become significantly more similar to that of recipient firms. This is particularly strong when non-recipient-firms face greater pressure from market participants to uphold short-term performances.

				(2) The emergence of technology spillover due to R&D tax credits cause firms to imitate rather than producing differentiated products.
Greco, Germani, Grimaldi & Radicic (2022)	Cross-sectional (2015); longitudinal data (2009, 2015); 2,053 German firms	**GI:** Integrated general innovation policy instrument (including grants, subsidised loans, equity or loan guarantees) **EI:** Environmental policy instrument (consisting of legal requirements, environmental innovation support, or environmental taxes)	Process eco-innovations (measured by reduced energy use, reduced CO_2 footprint, reduced air pollution)	**Short-run effects:** (1) ***GI only:*** Only significant for reduction in energy use (12.7%p). (2) ***Any EI:*** Effect of 38.2%p, 28.7%p and 13.8%p respectively for reduction in energy use, CO_2 footprint, and air pollution; (3) ***Policy mix of GI and any EI policy verse no treatment:*** Effect of 35.8%p, 20.4%p and 15.7%p respectively for reduction in energy use, CO_2 footprint, and air pollution. (4) ***Policy mix of GI and any EI policy verse GI only:*** Effect of 18.8%p, 17.1%p, and 16%p respectively for reduction in energy use, CO_2 footprint, and air pollution. **Long-run effects** (5) ***GI only:*** Significant reduction in energy use (75.8%p) and air pollution (90.9%p). (6) ***Any EI:*** Effect of 220.7%p, 140.7%p and 160.2%p respectively for reduction in energy use, CO_2 footprint, and air pollution. (7) ***Legal requirement only:*** Effect of 193%p, 165.8%p and 164.3%p respectively for reduction in energy use, CO_2 footprint, and air pollution. (8) ***Policy mix of GI and any 2 EI policy verse no treatment:*** Effect of 273.7%p, 296.5%p, and 266.3%p respectively for reduction in energy, CO_2 footprint, and air pollution. (9) ***Policy mix of GI and any 2 EI policy verse GI only:*** Effect of 197.8%p, 212.8%p, and 175.4%p respectively for reduction in energy, CO_2 footprint, and air pollution. **For all the three innovation measures, policy mix impact is stronger relative to the impact of general policy alone (both in the short and long term). Long-run policy mix effect are 197.8pp, 121.8pp and 175.4pp respectively for reduction in energy, CO_2 footprint, and air pollution. No significant difference between the additionality impact of policy mix and that of environmental instrument alone (both in the short and long term) for all the innovation outcomes.
Caloffi, Freo, Ghinoi, Mariani & Rossi (2022)	Italian regional policy implemented in 2011-2014; 515 SMEs in manufacturing and	Advisory services Innovation vouchers	Internal R&D; R&D collaboration; Various Innovative behaviour & capabilities (e.g., ability to design R&D	(1) Policy mix significantly outperforms vouchers-only in most performance outcomes: 47%p higher in terms of R&D collaboration, 31.7%p higher in terms of innovation, 26.6%p higher in terms of firms' capability in identifying external partnerships, 94.5 thousand Euros more in terms of labour

	construction sector		projects and identify external partners, awareness of technological and human capital needs); Innovation in product, process or strategies; Revenue; Productivity (value added per employee)	productivity in two years after treatment. (2) No significant difference between policy mix and advisory services for all performance outcomes, except in the case of additionality in labour productivity (Which is 94.5 thousand Euros more for policy mix than voucher-only, and 94.1 thousand Euro more for policy mix than advisory service). (3) Firms with no prior R&D experience before treatment had policy mix impacting on their internal R&D by 19.7%p more than that of advisory services in isolation.
Ning, Guo & Chen (2022)	Panel Data; 21,084 firms (2009-2015) China	R&D grant Moderator: Industrial technological complexity	Patent application	(1) Grant drives firms' patenting through internal knowledge exploitation as opposed to external knowledge exploration. (2) High degree of industrial technology complexity enhances subsidized firms' innovation which resulted from internal knowledge exploitation while impeding innovation based on external knowledge exploration.
Dai & Chapman (2022)	Panel data: 6,572 observations (2007 – 2019 China	Preferential corporate income tax rate of 15% compared to the standard 25% tax rate for High and New Technology Enterprise (HNTE)	R&D intensity Number of patent applications	(1) Tax incentive, on average led to an increase in R&D intensity of supported firms by 9.8% more compared to non-supported firms. This effect is due to only 47.54% of the supported firms. The remaining 52.46% experience no change or a decline in R&D investments; (2) Tax credit led to a 4.25 more patent applications among supported compared to non-supported firms. Again, this additionality impact was achieved by 66.4% of the supported firms, with the remaining firms experiencing no change or a decline in number of patents; (3) Tax credit size has an inverted-U shaped relationship with impacts on R&D intensity, and a U-shaped relationship with impacts on patenting; (4) The impacts of tax credits on both R&D and patenting increase with the number of HNTE certifications.
Feldman, Johnson, Bellefleur, Dowden & Talukder (2022)	Total of 96,864 Small Business Innovation Research (SBIR) grants awarded from 2000 to 2014 14,869 distinct small, high-tech businesses across 2000 to 2014 USA	R&D grants. Study compares the performance of the 10 most frequent grant awardees (firms that received 460 up to 1,119 awards over the 2000-2014 period) with that of firms who received less than 12 awards over the same period.	Number of new products, Patens, paper publications and Spinoff firms	(1) In terms of aggregate values, frequent grants awardees outperform the comparison group of firms in every metric: i.e., over 100 times more in patenting; 216 more in paper publications, and 2.5 more in spinoff firms. (2) In terms of performance per $1million of SBIR funding, the top ten firms outperform all other quartiles on an efficiency basis in publications, procurement amount, and spinoffs. However, they performed worse on other metrics: In total patents per 1 million SBIR dollars, they perform worse than firms' in quartiles 3 and 4 of the distribution. In patents by PIs, they

				are worse than firms in quartile 1 and barely better than the other quartiles. In product development, they produce fewer products than firms in quartile 1.
Kleine, Heite & Huber (2022)	Primary survey data (2016; 2017) on 2015 UK innovation voucher applicants. 459 SMEs UK	Innovation Vouchers issued in 2015	Number of minimum viable projects (MVPs); New products and services; Product and service awards; New internal processes; Patent applications; Design right applications; Trademark applications.	(1) Innovation voucher led to 55%p more recipient SMEs engaging the service of knowledge expert (e.g., university, research institute or IP advisor) when pursuing their innovation-related projects. However, this collaboration effect is a one-time effect for the period of the innovation voucher award and does not translate to the second year after the innovation voucher award. (2) Voucher led to 30.2% more recipient SMEs engaging in product and service innovation in year one, but insignificant effect found in second year after voucher award. (3) Firms with ongoing product and service projects experienced 56.3% increment in number of new product and service in year 1, and 93.6% increment in the number of MVPs in year 2 of voucher award.

Implications and evidence gaps

Once an R&D support has been received by a firm, and a decision made on the firms' own level of related R&D or innovation investment, questions arise as to how efficiently or effectively the investment will be used. Or, put another way, how productively the combined public and private investment will be translated into output effects including innovation. From a policy and managerial point of view, evidence from majority of the studies reviewed suggest tax credits are more effective than grants in helping firms to productively translate R&D input into output performances such as innovation, value added and sales growth (Nilsen et al., 2020; Pang et al. 2020; Petrin and Radicic, 2021). However, there is substantial evidence suggesting that firm context matters in the extent to which policies impact both R&D input and performance outputs (Czarnitzki and Lopes-Bento, 2014; Dimos et al. 2022). Tax credits are, for instance, more effective for innovation in high-tech, KIS and high productivity firms (Nana-Cheraa et al. 2023; Petrin and Radicic, 2021), while it is grants which are more effective for low-tech, low-KIS and SMEs. Also, R&D input effects are strongest in low productivity firms, although these firms seem to struggle to generate significant innovation (Becker 2015; Vanino et al. 2019; Nana-Cheraa et al. 2023), which may be a reflection of the commercial and technical challenges involved in innovation (Rhaiem and Amara, 2021). By contrast, while higher productivity firms often see lower R&D input effects this does eventually translate into higher and significant innovation effects (Gahan et al. 2021; Nana-Cheraa et al. 2023). Also, levels of R&D input tend to be greater than that of innovation output, suggesting that policy evaluations based purely on R&D input effect may over-estimate policy effectiveness.

It remains unclear from the studies reviewed how country-specific characteristics influence policy effects. Accessing a cross-country dataset with comprehensive information on the amount of the various supports that firms receive, and information on firms' R&D capability and the different stages of their innovation development presents much potential for future research.

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