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Policy instruments and private R&D investment

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Public funding to support firm-level Research and Development (R&D) is mainly delivered through three types of policy instruments: R&D grants; R&D tax credits; and publicly-supported academic-industry collaborations. Vast amounts of scarce public resources are dedicated to these policy instruments in many countries. Of particular note, the United Kingdom (UK) has recently launched an ambitious *Innovation Strategy* which involves increasing public R&D funding to private firms (BEIS, 2021). This necessitates a deep understanding of what current state of the art (SOTA) evidence says about the impact of different policy instruments on firm-level R&D. A focus on firm-level R&D is imperative, as it is key driver of firm innovation and performance, which underpins economic growth and productivity.

Studies examining R&D policy instruments have developed rapidly over the past decade. Overall, the evidence suggests that R&D grants, R&D tax credits, and academic-industry collaborations, have significant impacts on firm-level R&D, across many country contexts. However, several nuances exist when interpreting such findings. Most importantly, the concept of policy instrument 'mix', where firms receive multiple R&D policy instruments, has become fundamental to understanding firm-level R&D impacts. Studies examining instrument mix have focused almost exclusively on firms receiving different instruments at the same time. A crucial blind-spot in current research is the sequencing of policy instruments over time.

Background

A pillar of the UK government's *Innovation Strategy* is increasing national R&D investment to 2.4% of Gross Domestic Product (GDP) by 2027 (BEIS, 2021). To achieve this aspiration, the UK government launched its largest ever R&D Spending Review in 2021, at £39.8 billion. This review significantly increased the amount of public funding targeted at stimulating firms' R&D expenditure. Both in the UK and beyond, Lenihan *et*

al. (2020) highlight that the three main policy instruments targeted at increasing firm-level R&D in most countries have different key design features, as follows:

1. R&D grants: Direct financial support for specific R&D projects (often specified by policymakers in funding calls), awarded on a competitive basis.
2. R&D tax credits: Corporation tax deductions, relating to a percentage of R&D investment.
3. Publicly-supported academic-industry collaborations: Financial support which incentivises or enables collaboration between academics and firms, and funds specific R&D projects, usually in targeted economic sectors or research fields.

Evidence suggests that these design features lead to different impacts on firm-level R&D (Giga *et al.,* 2021; Sterlacchini and Venturini, 2019; Caloffi *et al.,* 2018).

R&D grants tend to support far-from-market R&D spending, which often produces radical innovations, with the greatest potential returns (Gao *et al.,* 2021). This type of R&D investment is often too risky to undertake without direct, up-front financial support. R&D grants also enable policymakers to direct firms towards certain R&D projects. In contrast, R&D tax credits help firms to engage in routine R&D spending, in near-to-market R&D projects (Holt *et al.,* 2021). This is because R&D tax credits do not require a competitive application process, but rather can be claimed on any qualifying R&D expenditure. Finally, publicly-supported academic-industry collaborations play a capacity-building role within firms. Collaborations enable firms to work closely with leading academics, and bring external knowledge in-house (Mulligan *et al.,* 2022).

Recent studies have focused on R&D policy instrument mixes, which occur when firms receive multiple policy instruments. The vast majority of these studies have focused on receiving a mix of different instruments at the same point in time (e.g. Petrin & Radicic, 2022; OECD, 2020; Stojčić *et al.,* 2020). However, policy instrument mix theory strongly suggests that the mix of instruments firms receive over time (i.e. in a sequence) is crucial to determining impact (Flanagan *et al.,* 2011; Rogge & Reichardt, 2016). A large proportion of firms in most countries receive mixes (OECD, 2020). Ignoring this fact is potentially hazardous, for reasons such as biased R&D impact estimates, and misattributing the impact of a mix to a single instrument in the mix. Most, but not all, studies find complementarity between policy instruments in a mix. All studies, however, highlight the importance of considering policy instruments, and their impact on firm-level R&D, in terms of the mix.

Evidence

Lenihan and Mulligan's (2018) Enterprise Research Centre SOTA review highlighted that, up to that point, "few empirical studies operationalise policy mix as it applies to business innovation" (p. 2). In the relatively short time period since this statement, research on the impact of R&D policy instrument mix has grown rapidly. The studies included in the current SOTA review represent what the authors' consider to be best practice and/or state of the art. All studies are post 2018, to reflect Lenihan and Mulligan's SOTA review from that year, and capture the most recent developments in the field. In addition, while all studies are considered to be best practice and/or state of the art, it is important to note that they take place in different country contexts. As such, the interpretation of results should be caveated with the stage of industrial development each country has reached.

Contemporary studies on R&D grants, R&D tax credits, and academic-industry collaborations, can be divided into two categories:

1. Studies which examine single policy instruments in a comprehensive and robust way, but do not examine policy instrument mix (Table 1).
2. A burgeoning number of studies which focus exclusively on policy instrument mix (Table 2).

Some of the studies in Tables 1 and 2 do not directly examine firm-level R&D. However, even studies which focus on innovation or firm performance, implicitly capture R&D impacts. A phase of policy instrument-driven R&D must precede any statistically identified innovation/performance outcomes. In addition, some of the studies in Table 1 control for the presence of other policy instruments, when examining the impact of one specific policy instrument. This is important, because not accounting for whether firms receive other policy instruments can lead to the over, or indeed under-estimation of the impact of the specific policy instrument being evaluated. However, due to data limitations, most studies concerned with single policy instruments are not able to control for whether firms also receive any other type of public R&D funding.

The studies examining single policy instruments reveal an overall positive and significant impact on firm-level R&D. This literature has matured to a notable degree of sophistication. Current studies often determine the truly 'casual impact' of policy instruments on firm-level outcomes. This has been made possible by new statistical methods, as well as access to more novel and comprehensive datasets, than was the case in previous decades.

Comparing the sign and statistical significance of the impact of different policy instruments on firm-level R&D across different studies, provides a useful overall picture as to the general effectiveness of public R&D funding at stimulating firm-level R&D. As noted by Freeman (1989, p. xi) "any 'finding' ought to be replicated on several data sets and under 'plausible' model specifications before one accepts it as valid". However, comparing the *magnitude* of different impacts across studies is potentially problematic. Different studies take place in a variety of country contexts, use different datasets, encapsulate different time-periods, and apply different methodologies. In addition, policy instruments in different countries often have specific design features unique to that country.

Even with the most comprehensive datasets and sophisticated methodologies, many studies face limitations which undermine the comparison of magnitudes. For example, many studies can only determine, in a strict sense, whether there has been full crowding-out (i.e. whether the firm has completely substituted public R&D funding for its own private R&D spending), as opposed the level of actual additionality (i.e. the additional R&D spending over-and-above what the firm would have invested in the absence of the support-the so-called counterfactual scenario). This is due (amongst other issues) to the need to use binary indicators of whether the firm received a particular policy instrument, as opposed to actual monetary amounts of public funding received. While such studies are extremely valuable in their own right, directly comparing the magnitude of their results with other studies can be misleading.

However, with these crucial caveats in mind, the studies presented in Tables 1 and 2 can be used to give some general indication of the magnitude of impact of each policy instrument on firm-level R&D. Overall, the results suggest that R&D grants have the greatest impact on firms' R&D expenditure, followed by R&D tax credits, and then publicly-supported academic-industry collaborations. The first two finding are perhaps

unsurprising, as R&D grants and R&D tax credits involve finance (direct and indirect) going to the firm. However, the latter result for academic-industry collaborations should not be interpreted as this policy instrument being 'least' effective. Academic-industry collaborations often do not involve funding going directly to the firm, but rather link the firm with the academic knowledge provider. Therefore, the firm often does not get an immediate windfall of finance, but rather gains access to key knowledge resources.

In terms of the policy instrument mix, most studies suggest that a mix of R&D grants and R&D tax credits can be more effective at driving firm-level R&D, than either policy instrument on its own. However, research on the mix is at a far earlier stage than studies focusing on individual policy instruments. Therefore, current studies provide a less clear indication of the magnitude of impact of policy instrument mix, relative to each policy instrument in the mix.

Many studies also consider how the impact of public R&D funding varies with firm size. Such studies reveal that the impact of policy instruments on firm-level R&D is most pronounced in Small and Medium-sized Enterprises (SMEs; <50 employees). Some studies in Tables 1 and 2 consider policy instruments that are targeted at SMEs only. Other studies examine the relative impact of policy instruments which are available to all firms (SMEs versus large firms). SMEs are of particular interest to policymakers for two main reasons. Firstly, SMEs often challenge large, incumbent firms by engaging in more radical forms of innovation, such as introducing new-to-the-world products (OECD, 2021). Radical innovations have the greatest potential for knowledge spillovers, where other firms can incorporate and benefit from knowledge produced by one firm (Laplane and Mazzucato, 2020). As such, supporting SMEs' R&D can be a powerful engine of innovation. With this in mind, the second reason policymakers target SMEs with public R&D funding is that they face specific barriers to engaging in R&D (OECD, 2020). SMEs typically have lower financial and non-financial resources, relative to larger firms (Perez-Alaniz *et al*., 2022). In addition, they find it more difficult to gain access to funding for risky R&D activities (Berrutti and Bianchi, 2020). Therefore, policymakers often intervene in the market with specific SME-targeted R&D support, and the effectiveness of policy instruments at driving SME R&D is of particular policy relevance.

The studies that consider SMEs versus large firms in Tables 1 and 2 do not have specific data on the design features and implementation of different policy instruments that make them more or less relevant for SMEs. Rather, they use more generic measures of each policy instrument, and test whether impact differs across each firm size. As noted above, in general, each of the three policy instruments included in this review have a greater impact in SMEs, when compared to their larger firm counterparts. Most studies argue that the mechanism by which this occurs, is that the need for public R&D support is greatest in SMEs. Therefore, SMEs often make more effective use of public R&D funding, relative to larger firms. The studies in Tables 1 and 2 provide little guidance on the relative impacts of each policy instrument in SMEs, however, and this is an important avenue for future research.

In terms of policy instruments that specifically target SMEs, one study for Italy showed that R&D grants that necessitated SMEs collaborate with public research institutions or other firms, have a greater impact than R&D grants that support individual non-collaborative projects (Caloffi *et al.,* 2018). This result was particularly important for SMEs with limited prior R&D experience. In addition, a UK study showed that Innovation Vouchers, which provide small amounts of funding to link SMEs and academics, drive SME innovation in the short run (Kleine *et al.,* 2022). However, these effects do not persist in the years after the support has been received. These results highlight the difficulties SMEs face in persistently engaging in R&D over the long term, and the role different types of policy instruments can play in driving SME R&D.

Table 1: State of the Art studies on single R&D/innovation policy instruments

Study	Data/country	Outcome measure	Key empirical results
R&D grant studies			
Gao, Hu, Liu, & Zhang, 2021	Panel data; 1,198 firms (2010-2014); China	Exploratory innovation (proportion of novel patents in total patents)	Both local R&D grants and R&D grants from the central government have a significant and positive impact on firm-level innovation. The impact of R&D grants implemented at the local level is greater.
Mardones & Zapata, 2019	Panel data; 21,875 firms (2007-2014); Chile	R&D expenditure; probability of having a formal R&D department; innovation (six different measures)	R&D grants have a positive and significant impact on R&D, and increase the probability of having a formal R&D department. No impact on firm-level innovation. R&D grants are more effective when they incentivise collaboration with research institutions and/or other firms.
Giga, Graddy-Reed, Belz, Terrile, & Zapatero, 2021	Panel data; 1,794 firms (2002-2012); USA	Patenting	A two-phase R&D grant programme increases micro firms' (<10 employees) probability of patenting; limited evidence of impact for larger firms (10-249 employees).
R&D tax credit studies			
Dai & Chapman, 2022	Panel data; 6,572 firms (2007-2019); China	R&D expenditure; patenting	R&D tax credits stimulate firms' R&D and patenting. Larger tax credit rates induce greater patenting, but begin to crowd out R&D.
Holt, Skali, & Thomson, 2021	Panel data, 1,715 firms (2011-2012); Australia	R&D expenditure	$1 in tax revenue forgone leads to $1.90 in private R&D spending.
Sterlacchini Venturini, 2019	Cross-sectional, circa. 1,300 firms in each country (2010); France, Italy, Spain, UK	R&D expenditure	In all countries (bar Spain), R&D tax credits stimulate firm-level R&D. Result is driven by small firms (<50 employees). Effect is largest in UK and Italy, where £/€1 in tax forgone, induces firms to spend £/€1.55 on R&D.
Publicly-supported academic-industry collaborations			
Caloffi, Mariani, Rossi, & Russo, 2018	Primary data collected *ex-post*; 1,142 SMEs (2002-2008); Italy	Propensity to be R&D active; R&D investment; R&D collaboration	R&D grants for collaborations and R&D grants for individual R&D projects have an equivalent impact on SMEs' R&D. Effects vary in different types of SMEs. Collaborative R&D support is more effective in SMEs with limited pre-existing R&D experience.
Kleine, Heite, & Huber, 2022	Primary data collected *ex-post*; 760 SMEs (2015-2017); UK	Large set of innovation measures (product/process innovation, patent applications, etc)	Innovation Vouchers have a positive impact on SMEs' product and process innovation, and patents. However, many effects fade quickly after the incentivised collaboration.
Mulligan, Lenihan, Doran, & Roper, 2022	Panel data; 2,489 firms (2007-2017); Ireland	R&D expenditure; basic research; applied research	Collaboration with publicly-funded research centres increases firm-level R&D. Over the longer term, collaboration re-orients firms to more *research* (undertaken to produce new knowledge, but with a specific practical aim), as opposed to *development* (which draws on knowledge that already exists).

Table 1: State of the Art studies on single R&D/innovation policy instruments (contd.)

Study	Data/country	Outcome measure	Key empirical results
R&D grant studies			
Ning, Guo, & Chen, 2022	Panel data; 21,084 firms (2009-2015); China	Patent applications	R&D grants drive firms' patenting through the reuse of existing combinations of knowledge internal to the firm; as opposed to the creation of new combinations taken from outside the boundaries of the firm.
Petelski, Milesi, & Verre, 2020	Cross-sectional; 1,391 firms (2012); Argentina	R&D; employment in innovation	R&D grants drive firms' R&D spending. However, R&D grants have a limited impact on innovation employment.
Lenihan, Mulligan, Doran, Rammer, & Ipinnaiye, 2021	Panel data; 24,404 firms (2007-2016); Ireland	R&D; firm performance (turnover, exports, gross value added, employment)	Both R&D grants and R&D tax credits drive firm-level R&D in foreign-owned and domestic firms. Impact is more robust for R&D grants in foreign-owned firms. Policy-driven R&D is associated with increased firm performance, in both firm ownership types.
R&D tax credit studies			
Blandinieres, Steinbrenner, & Weiß, 2020	Meta analysis; 22 studies (1993-2018); cross-country	R&D	Firm-level R&D impacts depend on different R&D tax credits design features. Both volume-based and incremental schemes are effective, in different contexts. Highlights importance of having a stable, clear, and simple R&D tax credit scheme.
Courtioux, Reberioux, & Métivier, 2021	Cross-sectional; 6,976 firms (2013); France	R&D	R&D tax credits increase firms' R&D, and induce firms to engage in R&D for the first time. Impact is not universal; highly dependent on the specific R&D strategies firms employ.
Dumont, 2019	Panel data; 16,208 firms (2003-2015); Belgium	R&D	R&D tax credits designed to reduce the wages of specific R&D employees drive firm-level R&D. Limited impact of general volume-based R&D tax credits, and claims associated with patent income.
Publicly-supported academic-industry collaborations			
Lee, Hwang, & Kim, 2022	Panel data; 31,123 firms (2012-2018); South Korea	R&D; patent applications; sales; return on assets	R&D grants for collaboration drive all outcome measures (except return on assets). Collaborative support is more effective than R&D grants not involving collaboration (in particular at driving patent applications).
Guerrero & Link, 2021	Panel data; 683 firms (2009-2014); Mexico	Product innovation	Collaborative R&D support is effective at driving innovation; greatest impact is in large firms (>50 employees).
Lanahan, Joshi, & Johnson, 2021	Panel data; 8,324 firms (2001-2015); USA	Employment growth	Firms that receive R&D grants necessitating/facilitating collaboration, hire fewer employees than matched non-recipients. Collaboration mainly important for R&D, not general employment growth.

SOTA studies on policy instrument mix have focused almost exclusively on so-called 'static' policy instrument mix. That is, when firms receive two or more different policy instruments at the same time. All bar one study in Table 2 shows a positive and significant impact from static mix, although there is considerable variation across studies. The most striking results come from a UK study (Pless, 2021), which used sophisticated methods to determine truly casual effects. This study found that higher R&D tax credit rates substantially enhance the impact of R&D grants on small firms' R&D. However, for large

firms, the opposite is true. Therefore, this UK study echoes an overall finding from Tables 1 and 2, that policy instruments and their mixes are most effective in SMEs.

In Table 2, only two studies examine the temporal (over time) dimension of the policy instrument mix. A Chinese study (Pang *et al.,* 2021) highlights that R&D grants are most beneficial to firms early in their innovation process, while innovation procurement is important later. Moreover, R&D tax credits play a balancing role over the full period. Although not directly tested, the likely implication from this study is that firms use different policy instruments over time, as their needs change. Direct evidence from Spain (Labeaga *et al.,* 2021), reveals increased product innovation for firms who claim R&D tax credits repeatedly over time, with stronger effects for SMEs. This result highlights that the sequencing of policy instruments over time is crucial in determining impact. While this study only focused on one policy instrument type, it captured an instrument mix of 'the same' instrument over time.

Conceptualising instrument mixes as occurring over time, fundamentally changes how the impact of policy instruments on firm-level R&D should be understood. It is not always single policy instruments (or static mixes) driving R&D in discrete time periods, but often the interplay of multiple instruments over time. A natural extension from the Chinese and Spanish studies is to examine mixes of 'different' instruments over time, in different sequences (e.g. an R&D grant followed by an R&D tax credit).

Table 2: State of the Art studies on R&D/innovation policy instrument mix

Study	Data/country	Policy instrument mix	Outcome measure	Key empirical results
Pless, 2021	Panel data; 22,071 small firms (2008-2017); 2,699 large firms (2009-2014); UK	R&D grants; R&D tax credits	R&D; labour & capital productivity	Receiving R&D tax credits substantially increases the impact of R&D grants on small firms' R&D. However, for large firms, the opposite is true. Results hold for productivity.
Petrin & Radicic, 2021	Panel data; 6,769 firms (2001-2016); Spain	R&D grants; R&D tax credits	Product innovation; process innovation	No impact of policy instrument mix on product or process innovation, in either SMEs or large firms.
Douglas & Radicic, 2022	Cross-sectional; 5,044 SMEs; 609 large Firms (2012); Spain	Regional innovation funding; national innovation funding	Firms' cooperation with external partners	SMEs: Mix more effective than regional support, only in promoting cooperation with suppliers and universities. Mix more effective than national funding, only in cooperation with government agencies and consultants. Large firms: Mix only effective when large firms cooperate with other firms.
Labeaga, Martínez, Sanchis, & Sanchis, 2021	Panel data; 1,556 large firms; 2,508 SMEs (2001-2014); Spain	R&D tax credits (multiple tax credits over time)	Number of product innovations	Receiving repeated R&D tax credits over time has a significant and positive impact on product innovation; effect is particularly strong for SMEs
Pang, Dou, & Li, 2020	Panel data; 15,552 firms (2013-2018); China	R&D grants; R&D tax credits; government innovation procurement contracts	Sales revenue from new products	Receiving a mix of policy instruments has a larger impact than any individual policy instrument on firms' innovative sales. R&D grants have greatest impact early in innovation process; innovation procurement is important later. R&D tax credits play a balancing role over the full period.

Table 2: State of the Art studies on R&D/innovation policy instrument mix (contd.)

Study	Data/country	Policy instrument mix	Outcome measure	Key empirical results
OECD, 2020	Firm-level panel data (range of years and sample sizes); 28 OECD member countries	R&D grants, R&D tax credits	R&D	Greater impact from R&D grants, relative to R&D tax credits. R&D grants have larger impact on promoting research, whereas R&D tax credits support development. Evidence of largest impact from policy instrument mix.
Heijs, Guerrero, & Huergo, 2022	Panel data; 8,280 firms (2007-2016); Spain	R&D grants from regional, national, & European governance levels	R&D	Impact on R&D greater for firms that receive R&D grants from multiple levels of governance. Diminishing returns for firms that receive multiple large grants. Higher returns for the most innovative projects; lower returns for market-oriented projects.
Ghazinoory & Hashemi, 2021	Cross-sectional; 375 SMEs; 60 large firms (2017); Iran	R&D grants, R&D tax credits	R&D; R&D employees; new product innovation	SMEs: R&D tax credits drive R&D investment only; R&D grants drive all outcome measures; no policy instrument mix effects. Large firms: Only R&D grants drive R&D investment; significant policy instrument mix effects on new product innovation.
Greco, Germani, Grimaldi, & Radicic, 2021	Cross-sectional (2015); panel data (2009-2015); 2,053 firms; Germany	General innovation policy instrument (aggregated); Environmen-tal policy instrument	Eco-innovation	Policy instrument mix has a greater impact on eco-innovation, relative to the impact of general innovation policy instruments alone (both in the short and long term). Impact of policy instrument mix on firms' eco-innovation is equivalent to environ-mental policy instruments alone.
Teirlinck, Spithoven, & Bruneel, 2021	Cross-sectional; 283 firms (2010); Belgium	R&D tax credits, R&D grants	R&D employees	Financial R&D-related slack resources increase R&D employ-ment, when firms claim an R&D tax credit; which increases when firms also receive an R&D grant.
Neicu, 2019	Pooled cross-sectional; 2,650 firms (2008-2012); Belgium	R&D grants, R&D tax credits	R&D; basic research; applied research; development	R&D tax credits alone increase private R&D spending. R&D grants only increase R&D spending, when received in a mix with R&D tax credits. R&D tax credits stimulate all types of R&D. R&D grants only increase basic and applied research spending (i.e. the 'R' in R&D, focused on knowledge creation) when received alongside R&D tax credits.
Stojčić, Srhoj, & Coad, 2020	Cross-sectional; 41,623 firms (2012-2014); 8 Central & Eastern European countries	Financial support for innovation (aggregate); Public procurement for innovation	Product & process innovation; new product sales; turnover growth	Public procurement for innovation on its own, has a large impact on innovation and output. When combined with financial innovation support, public procurement for innovation has a larger impact.
Caloffi, Freo, Ghinoi, Mariani, & Rossi, 2022	Primary data collected *ex-post*; 1,142 SMEs (2011-2014); Italy	Innovation Vouchers; Technology advisory services	R&D; R&D cooperation; Product & process innovation; behaviour change; productivity; revenue	Advisory services are more effective than innovation vouchers in promoting R&D and innovation. The policy instrument mix is as effective as advisory services, and more effective than each individual instrument in promoting long-run productivity.

Overview and evidence gaps

Overall, international evidence suggests that R&D grants, R&D tax credits, and publicly-supported academic-industry collaborations, all play key roles in driving firm-level R&D. Moreover, recent studies reveal that a mix of these policy instruments can be the most effective way to stimulate firms' R&D. The major evidence gap in this literature concerns the sequence in which firms receive policy instruments over time. To date, studies have focused on firms receiving different policy instruments at a point in time (i.e. a static mix). The above focus is understandable, as studies transition from a conceptualisation focused solely on single policy instruments, to instrument mixes. However, it ignores the fact that firms frequently receive multiple instruments over time. Caution is warranted, as the observed impact of a single policy instrument (or static mix) on firms' R&D, may in fact be due to the interplay (mix) of multiple instruments over time. In this respect, Coburn *et al.* (2021) lament that studies on instrument mix are "at an early stage of development" (p. 3), calling on future research "to study the sequencing of interventions over the long term" (p. 20).

Evaluating sequencing, therefore, represents the next step in understanding the impact of policy instruments on firm-level R&D. To truly examine sequencing, future studies will need to rely on comprehensive data on the different policy instruments firms receive, over a long time-period. Assuming data availability, future research might usefully explore the relative impacts of receiving policy instruments in one sequence, relative to a different sequence (e.g. an R&D grant followed by an R&D tax credit, and *vice versa*), and indeed relative to single policy instruments (e.g. an R&D grant followed by an R&D tax credit, relative to an R&D grant only). This line of research enquiry would shed new light on the most impactful way of driving increased firm-level R&D over time. It would also facilitate achieving the greatest return on investment concerning public funding for R&D.

In terms of policy implications, this review suggests that policy instrument mix holds many potentially untapped benefits for achieving policy goals. In this sense, Caloffi *et al.'s* (2022, p. 2) notion of so-called "deliberate policy mix" is particularly interesting. Our review suggests that a policy instrument mix of R&D grants and R&D tax credits can have a greater impact on firm-level R&D, than each policy instrument individually. However, most previous studies have just considered policy instrument mixes that occurred 'naturally' (i.e. the firm just happened to receive an R&D grant and claim an R&D tax credit at the same point in time). Following Caloffi *et al.'s* (2022) contribution, policymakers might usefully consider how to design the most effective policy instrument mixes for specific groups of firms. The latter will depend on firms' needs and policymakers' prevailing objectives (e.g. inducing non-R&D active SMEs to become consistent innovators). Finally, building on the above discussion of the need to understand sequencing in the policy instrument mix, a natural extension of this policy implication is to design a policy instrument mix over time. Firms' needs change as they grow, develop, and build up different capacities. Therefore, targeting different policy instruments at firms over time, could be an important avenue for policymakers to explore, with the overriding objective being that of maximising the returns of public R&D funding provided to firms.

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