Innovation Growth Lab by nesta

IGL Working Paper Series

Subsidized R&D Collaboration: The Causal Effect of Innovation Vouchers on Innovation Performance

Marco Kleine, Jonas Heite and Laura Rosendahl Huber

December 2020

IGL Working Paper No. 20/04

IGL Working Paper No. 20/04 December 2020

Subsidized R&D Collaboration: The Causal Effect of Innovation Vouchers on Innovation Performance

Marco Kleine
Max Planck Institute for Innovation and Competition
marco.kleine@ip.mpg.de

Jonas Heite
Max Planck Institute for Innovation and Competition
jonas.Heite@ip.mpg.de

Laura Rosendahl Huber
Max Planck Institute for Innovation and Competition
Erasmus University Rotterdam
rosendahlhuber@rsm.nl

ABSTRACT

We study the causal effect of subsidized R&D collaboration on innovation performance of small and medium-sized enterprises (SMEs). In particular, we make use of a randomized controlled trial to analyze the effect of a nationwide innovation voucher scheme in the United Kingdom that grants SMEs across all industries financial support of up to 5,000 GBP for engaging the services of experts, e.g., from universities, research institutes or IP advisors, when pursuing an innovation-related project. Our results show that the innovation voucher program successfully promotes the execution of these innovation projects with positive short- and medium-term effects on product and service development, internal processes and intellectual property protection. Based on our results, we also provide some practical guidance to further improve the effectiveness of voucher programs.

Keywords: randomized controlled trial, industrial policy, SMEs, open innovation, collaboration subsidy, innovation performance

We are grateful for helpful comments and suggestions by Marc van der Steeg, Alessandro Maffioli and Joris Meijaard on an earlier version, and by discussions at the IGL Research Winter Meetings 2017 and 2019 in Washington D.C. and Amsterdam and the VHB-TIE conference 2019 in Darmstadt. We would also like to thank researchers at IGL, Teo Firpo, Albert Bravo-Biosca and James Phipps, for their support and advice. The data collection was funded by Innovate UK, part of UK Research and Innovation (www.innovateuk.ukri.org) and the access to Innovation Voucher program data is gratefully acknowledged.

1 Introduction

The acquisition of external knowledge, for example through networking and collaboration, has been shown to be an important driver for innovation (Criscuolo et al., 2018; Haus-Reve et al., 2019; Hottenrott & Lopes-Bento, 2014). While firms traditionally mostly relied on internal research and development (R&D), in recent years the new paradigm for innovation management has shifted increasingly towards the use of external sources in R&D and innovation processes (Chesbrough et al., 2006; Laursen & Salter, 2004). The key assumption underlying these practices and the related academic literature is that due to widely dispersed knowledge and increased technological complexity of products, enterprises no longer have all the required resources in-house to conduct innovation activities successfully.

Indeed, research has shown that R&D collaborations are an effective tool to enhance R&D outcomes and firm performance (Belderbos, Carree, & Lokshin, 2004; Cassiman & Veugelers, 2002). This indicates that if firms are successful in expanding or broadening their knowledge base, this could lead to positive innovation outcomes (Keupp & Gassmann, 2013; Leiponen & Helfat, 2010). Traditionally, most of the research in this area has focused on large manufacturing firms and the university-industry link in terms of technology transfer (George et al., 2002; Laursen & Salter, 2004; Maietta, 2015; Mina et al., 2014). However, several recent papers show that this type of collaboration is also highly relevant for small and medium-sized enterprises (SMEs) (Hossain & Kauranen, 2016; van de Vrande et al., 2009). These studies find that in today's increasingly complex and knowledge-intensive environment, SMEs need to leverage their networks to acquire missing knowledge and find complementary resources to innovate and grow their businesses (Parida et al., 2012; Spithoven et al., 2013).

At the same time, SMEs face serious constraints, which hinder them from engaging with the external knowledge base. To name a few, due to the size of the firm, external partnerships might be harder to develop for SMEs because of information asymmetries, transaction costs, and the lack of absorptive capacity within the firm (van de Vrande et al., 2009). Given the highlighted advantages of external collaboration, relaxing some of these constraints and helping SMEs overcome the burden of establishing connections with external partners bears the potential of innovation boosts on the side of these companies.

Stimulating SME's innovation by means of supporting external knowledge acquisition also seems desirably from a societal perspective. There is ample evidence that innovation and R&D by new ventures are important for economic growth and employment creation (e.g., Haltiwanger et al., 2013; Howell, 2017). Research also shows that SMEs are particularly

effective in developing radical innovations which, in turn, have been associated with value creation and productivity growth (Audretsch et al., 2006; Criscuolo et al., 2012; Hottenrott & Lopes-Bento, 2015; Scherer & others, 1986). Hence, given the importance of SMEs for innovation activities and the constraints they face in establishing new collaborations, it is important to understand what policy tool could help stimulate the use of external partners by SMEs in order to improve their innovation performance.[1]

To date, relatively little is known about the effectiveness of policy interventions that foster innovation activities and performance through increased collaborations between SMEs and external knowledge providers. This paper aims to fill that gap by testing the effectiveness of a small innovation subsidy (innovation voucher), which is targeted at increasing external knowledge collaborations, in order to foster innovation activities and outcomes of SMEs. This policy tool has become popular in recent years and provides a small subsidy of typically 5,000 to 10,000 EUR (Bakhshi et al., 2015; Sala et al., 2016; Schade & Grigore, 2009).[2] SMEs can apply for the voucher to acquire knowledge that is not available within their organization to develop or accelerate a particular innovation activity or project. Previous studies have already shown a positive impact of this type of subsidy on attitudes towards external knowledge providers (Chapman & Hewitt-Dundas, 2018) and the number of projects conducted with an external partner (Cornet et al., 2006).

In this paper, we go beyond the analysis of collaboration activities and provide causal evidence on the effectiveness of these innovation vouchers on short- and medium-term innovation outcomes. In particular, we examine a large-scale randomized controlled trial (RCT) on a cross-industrial innovation voucher program in 2015 that addressed all SMEs in the United Kingdom (UK). Firms that were awarded the innovation voucher received (up to) 5,000 GBP to conduct an innovation-related project with any type of expert or partner they wanted to collaborate with, as long as they had not worked with them before. Applicants were randomly assigned to the treatment and the control group, where the firms in the treatment group were offered the voucher whereas the firms in the control group were not. Firms were further tested for eligibility for the voucher (cf. section 3.2 for eligibility criteria). The

[1] There is also a large strand of literature studying the effects of R&D subsidies on innovation activities by SMEs, yet this literature mostly deals with large(r) subsidies aiming at relaxing firms' financial constraints. The results from these studies typically show a positive impact of these subsidies on innovation outcomes such as patents and new product development (Czarnitzki & Delanote, 2015; Czarnitzki & Hottenrott, 2011; Howell, 2017; e.g., Lerner, 2000).

[2] Innovation voucher programs are widely spread throughout Europe, Australia, Canada, and the US with schemes on the national and regional level (Schade and Grigore 2009). The respective scope varies from consultancy services, intellectual property protection, technical development, to design advice and ranges from amounts of 500 EUR to 25,000 EUR (Schade and Grigore 2009). More recently, innovation voucher programs have also been introduced by universities, such as the University of Surrey, the University of Essex, or the University of Chester.

population of all eligible firms consisted of 1,463 firms (1,107 in the treatment and 356 in the control group). In order to assess short- and medium-term effects of the innovation voucher program, we collected data by means of two surveys. The first survey was conducted one year after the award of the voucher, the second survey two years after the award of the voucher. Our final sample covers 760 observations (from 570 unique firms) that had applied for the voucher in 2015 and replied to one or both of our surveys. To evaluate the effectiveness of the innovation voucher, we collected various outcome measures related to innovation outcomes and activities.

In our theoretical framework, we elaborate on arguments from the literature on open innovation and university-industry collaborations (Laursen & Salter, 2004; Tether & Tajar, 2008) and corresponding recent work focusing on SMEs (e.g., Hossain & Kauranen, 2016) to emphasize the importance of open innovation and external collaboration for SMEs. We then point to the constraints that preclude SMEs from successful collaborations and finally argue that by relaxing some of these constraints, the innovation voucher should have positive effects on collaboration activities and innovation outcomes.

In terms of firms' collaboration activities, we can report a significantly positive short-term effect on the probability of having any external support for innovation activities. However, we do not find evidence for lasting effects on collaboration beyond the very period of the innovation voucher project execution. Importantly, our results show that being awarded a voucher has a positive effect on project-related innovation outcomes. First, we find positive effects on product and service development for those firms aiming to conduct respective projects with the innovation voucher, both in the short- and medium-term. Second, the innovation voucher has a large positive impact on the number of patent applications for those firms planning to use the innovation voucher for IP-related projects. Third, the innovation voucher leads to a significant improvement of firms' internal processes. Furthermore, and perhaps not surprising given the size of the subsidy and the time horizon studied in this paper, we do not find any impact of the voucher on overall business outcomes of SMEs. Finally, our results suggest that innovation voucher redemption rates and hence successful project implementations could be increased by allowing for longer project execution periods and by further simplifying the administrative process. We offer some practical guidance that may help improve the effectiveness of innovation voucher programs further towards the end of the paper.

With this paper, we make important contributions to the innovation policy literature by providing causal evidence on the impact of the innovation vouchers on the innovativeness of SMEs. Endogeneity in the choice to search for and use external knowledge for innovation

activities typically prevents the estimation of causal impacts of open innovation on innovation outcomes. The random assignment of a subsidy that intends to increase external collaborations provides us with the perfect instrument to estimate these effects in a causal way. We extent existing findings on innovation vouchers that are limited to a narrow scope in terms of industry, type of collaboration partner and region (Bakhshi et al., 2015; Cornet et al., 2006) and show large positive treatment effects for a nationwide, all-industry program with a broad scope of potential partners. Furthermore, we increase the understanding of the impact of innovation vouchers on firms' innovation performance by showing more fine-grained heterogeneous effects depending on the firm-specific goals pursued with the innovation voucher project. Lastly, our study makes important contributions to the policy debate on how to support innovation activities of SMEs. In this respect, our results also provide guidance on how to increase the effectiveness of innovation voucher programs.

The remainder of the paper is structured as follows. In section 2, we provide an overview of the theoretical framework. Section 3 covers the context of the innovation voucher program and the design of the RCT. The data and methods description (section 4) is followed by the presentation of the results (section 5). In section 6, we discuss and conclude.

2 Theoretical Framework

There is a large stream of literature that shows the importance of external knowledge and R&D collaboration for innovation activities, not only for large firms but also for SMEs (e.g., Criscuolo et al., 2018; Haus-Reve et al., 2019; Spithoven et al., 2013; van de Vrande et al., 2009). In the beginning, most of this research focused on large manufacturing firms and the university-industry link (Laursen & Salter, 2004, 2014). More recently, this research on open innovation and external knowledge collaborations has expanded to include multiple industries and different types of collaboration (Haus-Reve et al., 2019; Mina et al., 2014; Tether & Tajar, 2008). The rationale behind fostering external collaboration and open innovation is that successful innovation depends on accessing and integrating new knowledge to accelerate internal innovation processes (Chesbrough et al., 2006).

Research shows that open innovation can take many different forms and can be related to both knowledge inflows and outflows (Hossain & Kauranen, 2016; van de Vrande et al., 2009). Inbound open innovation is described as firms monitoring the external environment to insource technology and knowledge in addition to in-house R&D (e.g., customer involvement, external networking and external participation), whereas outbound open innovation is related

to firms looking for external organizations that are better suited to commercialize technology (e.g., venturing or outside licensing of IP) (Chesbrough et al., 2006; van de Vrande et al., 2009). In this paper, we focus on one particular type of knowledge inflow that has been found to be particularly relevant for SMEs: external networking. External networking is defined as all activities to acquire and maintain connections with external sources of social capital, including formal collaborative projects as well as more general and informal networking (van de Vrande et al., 2009 p.425). The overall purpose of external networks is that it allows firms to quickly fulfill knowledge needs without having to develop them internally or acquire them through vertical integration.

External networking is particularly important for SMEs, because research has shown that SMEs need a broader external network that includes yet goes beyond science and technology collaboration (Spithoven et al., 2013). In contrast to larger firms, SMEs may lack the capabilities to transform input from universities and research institutions into (innovation) success (Laursen & Salter, 2004; Spithoven et al., 2013). Moreover, the type of collaboration that is most conducive for innovation performance strongly depends on the project or goal of the SME (Hossain & Kauranen, 2016). For example, Parida et al. (2012) look at vertical collaboration (i.e., technology sourcing) and horizontal collaboration (i.e., technology scouting) and find that the former is more related to radical innovations and latter more to incremental innovation. This also is in line with findings by Belderbos et al. (2004) who show that different types of collaborations lead to different innovation outcomes.

There is quite some evidence that shows that technology acquisition, R&D collaboration and the adoption of open innovation practices are positively related to SME's innovation performance, in terms of product or service innovation, patenting activity, and process innovation (Hossain & Kauranen, 2016; Parida et al., 2012). For example, research has shown that collaboration with partners has a more positive influence on launching new products and services for SMEs as compared to large firms (Spithoven et al., 2013). Moreover, for SMEs external collaborations have been found to be particularly important at the commercialization stages in order to allow them to capture the value of their invention (van de Vrande et al., 2009).

At the same time, there are a number of challenges SMEs face when implementing more open forms of innovation. For example, due to the size of the firm, external partnerships might be harder to develop for SMEs because of information asymmetries and transaction costs (van de Vrande et al., 2009). Moreover, SMEs might be more concerned with appropriability (compared to large firms) and therefore less likely to seek external knowledge and build partnerships (Laursen & Salter, 2014). Finally, since trust is important for successful

collaboration (Chapman & Hewitt-Dundas, 2018), resistance within the firm to use external sources could hinder successful access and use of relevant knowledge. Even if SMEs can overcome these organizational barriers, resource constraints could still prevent them from establishing successful external collaborations and open innovation.

For example, one of these constraints is that SMEs have less resources available to search for the right partner (Hossain & Kauranen, 2016) and research has shown that searching too broadly could even have a negative influence on innovation performance (Laursen & Salter, 2006). Moreover, once the correct partner has been found, it is important to have sufficient absorptive capacity within the firm to use the external knowledge effectively which may be more challenging for SMEs compared to large firms (van de Vrande et al., 2009). Another important requirement of successful collaboration and innovation performance is correct and sufficient intellectual property (IP) protection. Even though SMEs also need to protect their IP in order to capture value, and the risk of appropriability might even be larger for them, they seem to be more selective than large firms about what IP they protect (Spithoven et al., 2013). That is, limited resources, both in terms of money as well as knowledge on the topic, might prevent them from obtaining the appropriate protection for their IP.

Based on these challenges and the potential benefits of open innovation for SMEs, there seems to be room for a policy tool to nudge external collaborations and help SMEs overcome some of the barriers described. Some recent studies have looked at innovation vouchers as one such policy intervention and studied how innovation vouchers influence behavioral outcomes in terms of attitudes towards external knowledge providers and the number of projects conducted with external partners (Cornet et al. 2006, Chapman and Hewitt-Dundas 2018). The results from these studies indicate that innovation voucher recipients indeed have more positive attitudes towards external knowledge providers (Chapman and Hewitt-Dundas 2018) and are more likely to collaborate with external partners in their innovation activities one year after having received the voucher (Cornet et al. 2006). These studies show that being awarded an innovation voucher leads to an increase in external collaborations for innovation activities among SMEs (at least in the short term). Accordingly, we argue that SMEs that are offered monetary incentives in the form of an innovation voucher will make more use of external support for their innovation activity than those who were not offered the voucher.

The crucial follow-up question is to test if such a policy tool also leads to improved innovation outcomes. Some evidence on the effectiveness of a small subsidy on project-level innovation outcomes is provided by the study by Bakhshi et al. (2015). The authors examine a regional program that provides firms in the treatment group with a small (4,000 GBP) subsidy

intended to stimulate partnerships between SMEs and creative service providers around Manchester City (United Kingdom). In terms of innovation output, Bakhshi and colleagues find that firms in the treatment group are more likely to have product, service, or process innovations, or new to market innovations one year after they have been awarded the voucher. Our study extends this evidence by investigating whether innovation vouchers can stimulate innovation performance on a broader scale. That is, we study a nationwide (instead of regional) program that addresses SMEs across all industries and allows for collaboration with a large diversity of partners and a wide range of different projects. Based on the above literature we expect that SMEs that are awarded an innovation voucher will have higher short-term innovation performance compared to the control group without the subsidy.

Clearly, the subsidy is small and – considering the monetary value alone – may not suffice to boost firms overall R&D activities beyond the very project planned by means of the innovation voucher. The innovation voucher may help SMEs to push forward or speed up the development of particular (already planned) innovation activities or projects and these effects should show up soon after the innovation voucher award. However, the effect of the innovation voucher on medium-term performance most likely rests on the question whether the effect extends beyond the direct effect due to the subsidized collaboration, i.e., whether there are spillovers in terms of collaboration or new R&D stimuli beyond the very innovation voucher project. To test if being awarded a voucher only leads to a short-term boost in innovation performance, we compare the innovation outcomes of the treatment group and the control group between the different survey rounds, i.e., one year and two years after the award of the innovation voucher. If the voucher only speeds up a certain project that would have been conducted irrespective of the voucher, then we may even observe negative treatment effects in the second year after the voucher has been awarded. Because by that time the control group would have had time to catch-up and conduct their innovation project without the support of the subsidy. However, if external collaboration is stimulated beyond the very project or if the project success has positive effects on follow-on innovation activities, we should also see positive medium-term effects on innovation performance.

Finally, although it is not the core of our study, we also test if the voucher has a general impact on business outcomes of SMEs, such as turnover, profit, and number of employees.

3 Context and RCT Design

3.1 Context and Program

The innovation subsidy that is analyzed in this study is called "Innovation Vouchers Programme". It was established by InnovateUK[3] in 2012 with an annual budget of 4 million GBP. The program provides up to 5,000 GBP to enable innovative small and medium-sized businesses to engage the services of experts they have not worked with before to gain new knowledge that could help their business to innovate and grow. In the 10 rounds that were conducted before our study, over 6,600 firms applied for a voucher with the result of over 3,100 subsidies being awarded. Of those, nearly 2,000 vouchers were redeemed.

The program has three main objectives: First, it aims to stimulate SMEs to work with external knowledge providers by incentivizing a first contact. Second, collaboration with external experts is presumed to result in enhanced knowledge and capabilities of SMEs which in turn should lead to more innovation outcomes. Finally, the goal of the voucher is to stimulate ongoing collaborations with the new knowledge base beyond the expiry of the voucher.[4] To this end, the governmental initiative grants SMEs from all sectors financial support of up to 5,000 GBP for engaging the services of experts from the public or private sector for pursuing a particular innovation-related project within the firm. Given the relatively small amount of support, the scheme is mainly targeted at small-scale projects, for example leading to IP applications and product, service, or process development, rather than breakthrough innovations.

3.2 Design of the RCT

To analyze the effectiveness of the program we use the randomized allocation of the voucher for three application rounds in 2015. The vouchers in these rounds were awarded in April, July, and October of 2015, respectively. We focus on the year 2015 because the application rounds before and after this time period were targeted at specific themes such as energy, water, or cyber-security.

[3] InnovateUK (also referred to as the Technology Strategy Board) is the UK government's national innovation agency and part of the UK Research and Innovation organization. Its aim is to improve productivity and economic growth by supporting firms to develop and realize the potential of ideas and innovative projects.
[4] Figure A.1 in the Appendix depicts the innovation voucher's logic chain (developed by InnovateUK).

There are four main stages for participation in the innovation voucher program: (1) application, (2) lottery and eligibility checks, (3) voucher claim, and (4) final payment. In the initial application stage, firms indicated the specific innovation project that they wanted to pursue with external help. The applicants further proposed a certain external partner that they anticipated working with and assessed the potential impact of the innovation project on their business. In addition, firms answered a questionnaire which included baseline firm characteristics, past innovation-related activities as well as plans on future activities.

In the second step, a lottery was run. The randomization was conducted within the financial restrictions of the overall budget of the innovation voucher program. As such, the lottery could produce as many offers as were needed to ultimately meet the budget. The selected firms were then reviewed by three independent reviewers who checked for certain eligibility criteria. The eligibility criteria for the program required an applicant to be located in the UK and to be a start-up, micro (<10 employees), small (10-49 employees), or medium-sized (50-249 employees) business. Furthermore, the applicant should require help from a specialist to execute a specific innovation project or meet a certain business challenge. Firms were only eligible for the innovation voucher if they had not worked with the chosen external partner before the program. Finally, applicants were not considered if they had previously received an innovation voucher from InnovateUK. In order to obtain a control group that is comparable to the firms in the treatment group, businesses that did not succeed during the lottery were also subjected to the eligibility check. Reviewers did not know whether a firm had passed the lottery or not. After the review process, a due diligence check with an optional personal credit check was conducted for the firms in the treatment group.[5] An innovation voucher was offered if the applicant passed the lottery and all outlined checks.

The third step included the process of claiming the innovation voucher. Applicants had 10 days to accept their offer and up to 6 months to complete the proposed project. After the work was completed, the applicant uploaded a claim form. Finally, the claim was reviewed by a program official with the result of issuing the payment of an amount of up to 5,000 GPB in case of approval.

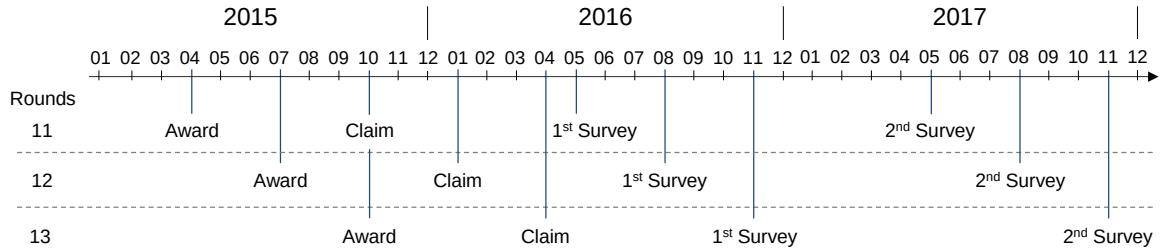
[5] For legal reasons, firms in the control group could not be subjected to a due diligence check. In our estimations we will therefore compare the treatment and the control group based on the lottery and the eligibility check.

4 Data and Methodology

4.1 Data and Sample

In order to evaluate the voucher's effectiveness, we collected data from several sources. First, InnovateUK provided us with information on the firms that applied for the innovation voucher program, covering all details from the application form. They also informed us on the allocation of firms into the treatment and the control group in the respective rounds, including information on whether firms passed the eligibility checks. Second, we designed a questionnaire measuring the firms' innovation activity and outcomes as well as collaborations and business outcomes (cf. Appendix X.1). All applicants of the innovation voucher scheme in 2015 were contacted twice. For each application round, the first survey was conducted one year after the voucher's award and the second survey was conducted two years after (cf. Figure 1). Thus, we capture short- to medium-term effects of the voucher.

Figure 1: Timeline of the RCT



Firms were first contacted via an online survey (Computer-assisted web interviewing, CAWI) with follow-up phone calls (Computer-assisted telephone interviewing, CATI) in each of the two survey rounds. Firms were contacted by an independent research organization. They were told that they are being surveyed in order to learn more about the innovation activities and needs of UK firms. Hence, in order to prevent any biased responses or behavior, the survey participants were not informed about the objective of evaluating the innovation voucher scheme.

For the analyses, we focus on the group of companies which passed the program eligibility check.[6] Table 1 shows the resulting sample composition. Overall, 2,149 firms applied for the program of which 1,463 firms were eligible to the voucher. These eligible firms were divided

[6] Firms that did not pass the eligibility checks were not included in our analyses because these were not the firms that were intended to be treated by the innovation voucher scheme.

into the treatment (1,107 firms) and the control (356 firms) group depending on whether they passed the lottery.

In addition, Table 1 presents data on the number of respondents for the two survey rounds. A total number of 459 firms participated in the first survey that was conducted one year after the subsidy was awarded. This equals a response rate of 31%, which is similar in the treatment (33%, 364 firms) and the control group (27%, 95 firms). The second survey round is characterized by a lower response rate of 21% (301 firms). Again, the treatment (22%, 240 firms) and control (17%, 61 firms) group show similar response rates. Overall, the total number of observations amounts to 760 for both surveys. As 190 firms responded to both survey rounds the number of unique firms sums up to 570 businesses (447 treatment, 123 control group).

Table 1: Sample composition

	Total	Treatment	Control
Total	**1,463**	**1,107**	**356**
Survey 1 (year 1 after award)	459	364	95
(%)	*31%*	*33%*	*27%*
Survey 2 (year 2 after award)	301	240	61
(%)	*21%*	*22%*	*17%*
Total observations: Survey 1 and Survey 2	760	604	156
Unique firms: Survey 1 or Survey 2	570	447	123
(%)	*39%*	*40%*	*35%*

Table 2 shows some background characteristics of the firms in our sample. Panel A depicts the industry structure of our survey respondents. 29.5% of the businesses can be classified as manufacturing entities and 70.5% indicated their principal activities as services. Panel B shows the firm size distribution at the time of application. The majority of our survey respondents reported to have 1-10 employees (84%). 6% of the observations refer to firms not having any employees, whereas 2% indicated that they had more than 50 employees.

Table 2: Summary statistics of survey sample

Panel A					
Industry classification	Survey 1	Survey 2	Total	%	Unique firms
Manufacturing					
Manufacturing	99	72	171	22.5%	130
Construction	12	8	20	2.6%	14
Waste and recycling	8	7	15	2.0%	9
Agriculture, forestry, and fishing	7	5	12	1.6%	9
Others	3	3	6	0.8%	4
Total manufacturing	129	95	224	29.5%	166
Services					
Professional, scientific, and technical services	132	85	217	28.6%	156
Information and communication services	89	54	143	18.8%	112
Retail and wholesale services	42	27	69	9.1%	53
Human health services	16	9	25	3.3%	16
Administrative services	14	8	22	2.9%	18
Others	37	23	60	7.9%	49
Total services	330	206	536	70.5%	404

Panel B					
Firm size	Survey 1	Survey 2	Total	%	Unique firms
No employees	27	18	45	5.9%	34
1-10 employees	386	249	635	83.6%	475
11-50 employees	34	29	63	8.3%	48
> 50 employees	12	5	17	2.2%	13
Total	459	301	760	100%	570

Note: One firm changed the industry classification from "professional, scientific and technical services" in survey 1 to "information and communication services" in survey 2. In the column "unique firms" this firms is assigned to the latter category since this is the more recent firm activity.

4.2 Randomization Check and Response Bias

Randomization check. An important assumption underlying the validity of our estimation of the treatment effect is the random assignment to the treatment and the control group. In this section, we therefore test whether firms have been randomly assigned to the treatment and the control group based on baseline firm characteristics from the application form. We apply randomization checks on three different levels: the comparison of the entire population, the

comparison after the eligibility decision (i.e., after firms were excluded that did not pass the eligibility checks), and the comparison of firms that responded to the survey and passed the eligibility checks (see Table A.1 in the Appendix). Even though there seem to be some small differences in terms of observed baseline characteristics between the firms in the treatment and in the control group, the Chi^2-test for joint orthogonality (McKenzie, 2015) is not significant for any of the sample specifications. Overall, we conclude that the random allocation to the treatment and the control group has been successful and valid.

Response bias. Another potential threat to the validity of our findings could be due to the non-random responses of firms to our surveys. We test for this potential response bias between respondents, i.e., firms that participated in at least one of our two survey rounds, and non-respondents (see Table A.2 in the Appendix). When looking at the individual coefficients we see that there are some differences between respondents and non-respondents. However, these differences do not seem to be systematic. Moreover, the Chi^2-test for joint orthogonality is insignificant when comparing all survey respondents with the overall population or when comparing respondents to the first or second survey round with the non-respondents of the overall population. The Chi^2-test for joint orthogonality is also insignificant when comparing the survey respondents from the treatment group with the whole population of treated firms and when comparing the survey respondents from the control group with the whole population of firms in the control group.

4.3 Variables

Outcome variables. All outcome measures rely on survey data and capture information on the 12 months before the respective survey round. Based on the objective of the innovation voucher program, we consider three groups of outcomes. First, we try to replicate the findings from previous studies that have found positive (short-term) effects of similar subsidies on external collaborations (e.g., Cornet et al. 2006). External collaborations are measured by the probability of having received any external support for innovation activities, the proportion of innovation activities conducted with the help of external partners, and the total number of external partners within innovation activities that the firm worked with within its innovation activities.

Second, in line with the aim of the voucher program to support beneficiaries to conduct an innovation-related project, we measure innovation outcomes at the project level. In

particular, we analyze the number of minimum viable products (MVPs), the number of new products and services, and the number of new patent, design right, and trademark applications, as well as the number of newly established internal processes. This is in line with other papers studying innovation performance in both manufacturing and service firms (Criscuolo et al., 2012; Leiponen & Helfat, 2010)

Third, on a broader scale, we also measure the potential impact at the company level. We look at innovation activity, which is measured by the total amount spent on innovation and the proportion of employees working on innovation activities. Furthermore, we study the effect of the voucher on overall business outcomes captured by turnover, profit, and the number of employees. Since the majority of our firms are small companies, we rely on dummies indicating whether a firm is generating turnover or is making any profit.

Explanatory variables. The most important explanatory variable in this study is of course the indication whether or not a firm was awarded an innovation voucher. This is captured by a binary variable (treatment effect) that is equal to one if the firm was randomly assigned to receiving the subsidy and passed the eligibility check and zero if it passed the eligibility check but was not assigned the voucher. Note that the treatment group also includes 107 firms that were assigned to the voucher, passed the eligibility checks but then failed the due diligence test. We had to include these firms in the treatment group, because due to legal reasons, firms in the control group could not be subjected to a due diligence check.

As in many randomized controlled trials, participation is voluntary among those randomly assigned to the treatment group. In our case, another 335 firms that were randomly assigned to receiving an innovation voucher ultimately did not redeem it (33.5% of those offered the voucher). We elaborate on the reasons for this in section 5.3. Since we do not know, which of the firms in the control group would have redeemed the voucher if they had been offered the subsidy, we cannot restrict the treatment group to those that eventually redeemed the voucher. Consequently, we base our evaluation on the initial treatment assignment and not on the treatment actually received, thus applying an intention-to-treat analysis. Hence, the treatment effect we estimate in this paper is the effect of being offered a voucher. Since governments can also only offer certain programs but will not be able to force people to actually take-up and use them, we feel that this effect is also the most interesting from a policy perspective.

In addition, in our main specifications, we include some control variables in our analyses. The firm's age controls for the fact that older firms may already be better connected to the external knowledge base. In a similar vein, older firms might be less financially constrained

compared to younger firms. Furthermore, we include a binary variable indicating whether a firm is active in the service industry to account for industry effects. Service firms have been shown to be more likely to engage the services of external partners (especially consultants) compared to manufacturers (Tether & Tajar, 2008). The firm size is clustered in four groups according to the number of employees at the time of application (cf. Panel B in Table 2) and takes possible size-effects into account (e.g., larger firms should have more relationships, all else equal). In our main specifications, we further include round fixed effects to control for the selection into one of the three subsidy rounds that are being analyzed in this study.

Interaction variables. As previously discussed, the innovation voucher program has a broad scope with respect to how the funding of the 5,000 GBP should be used. The regulations lay out that the program aims to support SMEs to collaborate with knowledge-based institutions across the public or private sector. However, it can be assumed that the project-level outcomes are strongly interrelated with the specific objective of the innovation project. In line with this argumentation, Belderbos et al. (2004a, 2004b) point out that the goals and thus the determinants of R&D collaborations differ depending on the type of innovation project. Therefore, we will analyze specific project-level outcomes conditional on the type of innovation project planned. Therefore, an independent classifier manually classified all project descriptions from the application form in order to assign one of the following project categories: products and services (incl. MVPs, new and improved products or services), IP protection, sales- and marketing-related projects, conceptual projects (e.g. business planning, feasibility studies), as well as internal processes. This classification was done for all firms (both treatment and control groups), but the classifier was unaware of the treatment status of the firms. Table 3 provides an overview of the number of firms by innovation project category.

Table 3: Innovation project categories

Innovation project category	Survey 1	Survey 2	Total	*%*	Unique firms
Products and services	235	143	378	49,7%	283
IP	80	55	135	17,8%	103
Sales and marketing	78	49	127	16,7%	95
Conceptual	38	36	74	9,7%	54
Internal processes	28	18	46	6,1%	35
Total	459	301	760	*100%*	570

Based on the project's objective, diverse outcomes are to be expected from the innovation voucher program. We expect effects on new MVPs as well as new products and services to be strongest among those firms that aimed to conduct a product- or service-related project. Hence, we will analyze the voucher's effect on these outcomes separately for these companies.[7] Businesses that were planning to conduct IP-related projects are expected to apply for new patents, trademarks, or design rights. Thus, we will analyze IP-related outcomes for firms with these projects separately. Note that the IP-related subgroup analysis relies on a relatively small number of observations and should thus be interpreted with caution.[8] Unfortunately, the number of observations is even more limited for the other project categories and the project-related goals tend to be very heterogeneous, for instance within the sales and marketing category and the conceptual category. Hence, we refrain from subgroup analyses on these project categories.

4.4 Empirical Strategy

We analyze the effect of innovation vouchers on collaboration activities, project-level innovation outcomes, firm-level innovation activities and firm performance. Of course, we are interested in the main effect of the innovation voucher program on the different outcome variables. Yet, in particular when it comes to outcomes at the project level, we expect diverging outcomes and we further expect some of the effects to be particularly strong for the subgroup of firms that pursued similar project goals. Accordingly, for these analyses, we will conduct both analyses, those studying the main effect on the full sample and those unbundling the effect of the particular subgroup of interest from the other groups.

Most of our outcome variables are count variables and highly skewed. Hence, for these outcome variables we apply Poisson regressions. In our robustness checks, we will also rely on negative binomial regressions. In case of continuous outcomes variables, we will investigate ordinary least squares (OLS) regressions; for binary outcome variables, we apply Probit regressions.

[7] The survey sample within the product- and service-related project category consists 218 respondents in the treatment group and 65 respondents in the control group. See the category-specific randomization check in Table A.1 of the Appendix. Since the categorization by innovation project has been conducted for the survey sample only, we cannot assess response biases by project category.

[8] The survey sample within the IP-related project category consists of 84 respondents in the treatment group and 19 respondents in the control group. See the category-specific randomization check in Table A.1 of the Appendix.

Whenever we study the main effect on the full sample, we will estimate the following equation (example of a Poisson regression):

$$\mathrm{E}[Y_i] = \exp[\alpha + \beta_0 T_i + \boldsymbol{\gamma X}_i + \delta_r + \epsilon_i] \quad (1)$$

T_i indicates whether an observation is from the treatment group. Accordingly, β_0 represents the treatment effect on the full sample. We further include control variables $\boldsymbol{X}$ and round dummies δ_r. ϵ_i refers to the random error. The control variables that are included in all models are: firm size (measured by the number of employees), the age of the firm, whether the firm is active in the service sector (dummy), and subsidy round (dummy).

Whenever we are interested in subgroup specific effects, we will estimate the following equation.[9]

$$\mathrm{E}[Y_i] = \exp[\alpha + \beta_0 T_i\{1|S_i = \dot{S}_i\} + \beta_1 T_i\{1|S_i \neq \dot{S}_i\} + \beta_2 \dot{S}_i + \boldsymbol{\gamma X}_i + \delta_r + \epsilon_i] \quad (2)$$

Here, β_0 represents the treatment effect for companies that planned to conduct a project falling under the project category of interest $\dot{S}$. For instance, for product- and service-related outcomes, we focus on the sub-samples that have announced to conduct product- and service-related projects and β_0 captures the treatment effect for this subgroup. For IP outcomes, we examine firms that planned to conduct IP-related projects. The coefficient β_1 of the second interaction term reveals the treatment effect on all other project categories $S \neq \dot{S}$ whereas β_2 shows the coefficient for firms with the project category of interest ($\dot{S}$) in the control group. The other variables are the same as in the specification above.

5 Results

5.1 Descriptive Statistics and Comparison of Means

Table 4 presents descriptive statistics for the full survey sample, and by treatment and control group separately. Firms that responded to the first survey round were on average 6 years old and mostly active in the service industry (72%). They were further characterized by innovation outcomes that on average amounted to 2 new MVPs and 2 new products and services within 12 months after the subsidy was awarded. The number of applications for new patents, design rights, and trademarks varied from 0.2 for design right applications to 0.5 for patent and

[9] For a similar estimation model, see Galasso & Schankerman's (2018) instrumental variables regressions, which also consider differential effects.

trademark applications within the year following the voucher's award. Furthermore, our data indicates that 80% of the companies received external support for their last year's innovation activities and conducted 40% of their overall innovation activities with the help of external partners. The average total amount spent on innovation activities was 85,000 GBP, 32% of the firms' employees were working more than 50% of their time on innovation activities, most companies generated turnover (66%), and had an average of 8 employees. 41% of the respondents to the first survey round indicated that they generated profit in the year right after the innovation voucher was awarded.

The firms that replied to the second survey round are comparable to the respondents of the first round in terms of age (mean: 7 years), industry classification (68% were active in the service industry), and measures such as new products, IP, collaboration, innovation activities, and business turnover. An average increase from year 1 to year 2 can be observed when looking at the total amount spent on innovation (year 1: 85,000 GBP; year 2: 133,000 GBP). Overall, it is important to note that most of the variables are characterized by a high variance, which is an indication for the heterogeneity of the firms that applied for the innovation voucher program.

Treatment and control comparisons of the sample means show that there are some substantial positive average differences, for instance, for project-related outcomes in year 1 (new products and services, product and service awards, new internal processes) and for new MVPs in year 2. Yet, in simple comparisons of means, these results are not significant. In the next section, we will analyze these effects more closely and additionally unbundle the effect of innovation vouchers for subgroups according to their project goals.

5.2 Main Results

In line with our theoretical framework, we first test if the innovation voucher indeed has the desired effect on external collaborations. Once we have established that, we will analyze the causal effect of the innovation voucher program on innovation outcomes in terms of the creation of MVPs and new products and services, as well as its effect on firms' intellectual property and newly established internal processes.

Table 4: Descriptive statistics by treatment and control group

		Overall			Treatment (T)			Control (C)			T=C
	Type	Mean	St.D.	Obs.	Mean	St.D.	Obs.	Mean	St.D.	Obs.	T-C
Survey data year 1											
Control variables											
Age	Cont.	6.40	11.38	459	6.35	10.89	364	6.56	13.14	95	-0.20
Service industry	0-1	0.72	0.45	459	0.73	0.44	364	0.67	0.47	95	0.06
Innovation project outcomes											
New MVPs	Count	2.02	4.41	442	2.04	4.63	349	1.97	3.51	93	0.07
New products and services	Count	2.01	4.60	442	2.12	5.07	349	1.61	2.09	93	0.50
Product and service awards	Count	0.60	3.10	442	0.68	3.46	349	0.30	0.69	93	0.38
New patent applications	Count	0.51	1.82	442	0.49	1.80	349	0.59	1.91	93	-0.10
New design right applications	Count	0.21	1.50	442	0.23	1.68	349	0.14	0.41	93	0.09
New trademark applications	Count	0.46	1.74	442	0.46	1.87	349	0.45	1.16	93	0.01
New internal processes	Count	1.37	3.23	442	1.48	3.49	349	0.97	1.87	93	0.51
Collaboration and innovation level											
External innovation support	0-1	0.80	0.40	459	0.83	0.37	364	0.66	0.48	95	0.18***
Proportion inno. with partner (%)	Cont.	40.43	35.01	451	41.04	34.52	358	38.06	36.94	93	2.98
Partners	Count	56.60	941.41	451	68.27	1058	357	12.29	20.72	94	55.98
Amount spent on inno. (in 1000)	Cont.	84.99	192.59	454	79.88	162.53	343	104.05	277.76	92	-24.17
Employees on inno. activities (%)	Cont.	32.08	39.98	454	33.53	40.73	360	26.52	36.65	94	7.02
Business success											
Turnover (0-1)	0-1	0.66	0.47	440	0.65	0.48	349	0.70	0.46	91	-0.06
Profit (0-1)	0-1	0.41	0.49	395	0.39	0.49	315	0.45	0.50	80	-0.06
Employees	Count	7.96	26.76	458	8.00	27.25	363	7.80	24.97	95	0.20
Survey data year 2											
Control variables											
Age	Cont.	7.44	10.84	298	7.34	10.63	237	7.82	11.70	61	-0.48
Service industry	0-1	0.68	0.47	297	0.68	0.47	236	0.69	0.47	61	-0.01
Innovation project outcomes											
New MVPs	Count	2.40	7.36	272	2.63	8.11	215	1.56	3.08	57	1.07
New products and services	Count	1.91	3.58	272	1.93	3.62	215	1.81	3.45	57	0.13
Product and service awards	Count	0.51	1.65	272	0.52	1.77	215	0.47	1.07	57	0.05
New patent applications	Count	0.47	1.15	272	0.44	1.03	215	0.58	1.52	57	-0.14
New design right applications	Count	0.27	1.23	272	0.19	0.90	215	0.58	2.02	57	-0.39**
New trademark applications	Count	0.34	0.97	272	0.34	0.91	215	0.35	1.17	57	-0.01
New internal processes	Count	1.84	4.44	272	1.84	4.44	215	2.19	6.82	57	-0.44
Collaboration and innovation level											
External innovation support	0-1	0.92	0.27	205	0.92	9.27	162	0.93	0.26	43	0.05
Inno. activities with partner (%)	Cont.	35.10	36.48	272	34.38	36.60	217	37.93	36.18	55	-3.55
Partners	Count	9.70	14.29	279	9.74	15.04	223	9.57	10.94	56	0.16
Amount spent on inno. (in 1000)	Cont.	133.19	326.25	263	136.23	332.55	211	120.86	302.05	52	15.37
Employees on inno. activities (%)	Cont.	34.35	40.54	282	33.63	39.71	226	37.25	44.03	56	-3.62
Business success											
Turnover	0-1	0.73	0.45	261	0.74	0.44	209	0.67	0.47	52	0.07
Profit	0-1	0.46	0.50	241	0.46	0.50	195	0.50	0.51	46	-0.04
Employees	Count	10.75	42.97	292	9.48	39.13	233	15.78	55.75	59	-6.30

*/**/*** indicates significance at the 10%/5%/1%-level.

Collaborations. Table 5 shows the treatment effect on collaboration outcomes. We observe that the innovation voucher significantly increases the probability of having received any external innovation support in year 1 after the innovation voucher award (Model (1)). Hence, the voucher has a positive short-term effect on establishing innovation collaborations. This result is robust to other model specifications such as a probit regression without control

variables or logit regressions.[10] However, this 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 (Model (4)). Beyond the effect on the probability of having received any external support, we do not observe any significant differences on other collaboration indicators such as the overall proportion of innovation activities with external partners or the total number of partners. This applies to the short-term perspective (Models (2) and (3)) as well as the medium-term perspective (Models (5) and (6)).

Table 5: Treatment effects on collaboration outcomes

	Collaboration outcomes					
	Year 1			Year 2		
	External innovation support (dummy)	Proportion of innovation activities with partner	Total Number of Partners	External innovation support (dummy)	Proportion of innovation activities with partner	Total Number of Partners
Model	(1)	(2)	(3)	(4)	(5)	(6)
Treatment effect	0.553***	2.368	1.095	-0.067	-6.441	0.117
	(0.167)	(4.509)	(0.780)	(0.326)	(5.765)	(0.231)
Constant	1.261***	51.113***	-1.579	1.613***	33.930***	1.995***
	(0.419)	(8.746)	(2.158)	(0.375)	(10.510)	(0.378)
Observations	459	442	451	203	270	275

Models 1 and 4: Probit Regressions; Models 2 and 5: OLS regressions; Models 3 and 6: Poisson regressions. Controls for firm size (not for Model 4 because of perfect prediction), age and service industry (dummy); innovation voucher round fixed effects (not for Model 4 because of perfect prediction). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Product- and service-related effects. Table 6 summarizes the effects of the subsidy on newly created or significantly improved MVPs and products and services – on the full survey sample (Models (1) to (4)) and with a particular emphasis on those firms that had planned projects on product and service development (Models (5) to (8)). Each outcome variable is shown for the first and second survey round (i.e., one year and two years after the voucher's award, respectively). Hence, short- to medium-term effects of the program are being evaluated.

The analysis of the full sample shows significant positive short-term innovation voucher effects for newly created or significantly improved products and services: the positive coefficient of 0.289 corresponds to an estimated 33.5%[11] more created or improved products

[10] The results are available from the authors upon request.

[11] Taking the exponential of a Poisson regression coefficient and subtracting one yields the estimated percentage change of the dependent variable for a unit change of the independent variable (*here*: for changing from control group (0) to treatment group (1)).

and services for those that were offered a voucher compared to the control group (Model (2)). In the medium run, the voucher is also estimated to increase the number of new or improved MVPs on average by 47% ($\beta_0 = 0.386$), yet for the full sample, this difference is not statistically significant (Model (3)). In the analysis of the subsample of companies that particularly aimed to conduct product- and service-related projects we observe even more robust results – here, both above discussed effects are stronger and significant (Models (6) and (7)). This implies that firms that applied for the voucher with the aim to develop or improve their products or services and were offered the voucher are significantly more likely to be able to reach this innovation outcome compared to firms that had the same intention at application, but were part of the control group.

Furthermore, we observe no negative effects throughout both survey rounds, neither for the full survey sample nor for the subgroup. This indicates that the reported effect is net positive and not due to a speeding up effect of projects that is negated later on. Lastly, we would also like to mention a side-effect that further underlines the innovation voucher success in stimulating product and service development: In the short run, the innovation voucher significantly increases the firms' number of awards received for innovations or new products or services (cf. Table A.3 in the Appendix).

We also test the robustness of the above findings by estimating the effects without control variables (cf. Table A.4 in the Appendix) and by applying negative binomial regressions (cf. Table A.5 in the Appendix). These analyses confirm all results of the subgroup analysis. The short-term effect on new or improved products and services on the full sample is robust to applying a negative binomial model specification, but not significant when running a poisson regression without control variables.

Intellectual property related effects. Next, we evaluate the effect of the innovation voucher on IP outcomes. Due to the specificity of this outcome measure, the analysis of the full sample yields no interesting findings. Therefore, we focus on firms that applied for the innovation voucher in order to conduct an IP-related project. Table 7 shows a significant treatment effect of the innovation voucher on the number of new patent applications in the first year after the voucher was awarded (cf. Model (1)). The effects are huge – firms that applied for IP-related projects and were offered an innovation voucher, are estimated to have almost 4 times more patent applications in the first year than firms that applied to conduct an IP-related project, but were not offered a voucher. We do not find a significant short-term treatment effect for the number of trademark or design right applications in the first year after the voucher's award

(Models (2) and (3)). Models (5) to (8) report no treatment effects of the innovation voucher on the number of patent, trademark, or design right applications two years after the award of the voucher. Accordingly, the positive effect of the voucher on patent application in the first year does not continue in the second year, yet it does not revert either.

The result on positive effects on the number of patent applications is also robust when applying negative binomial regressions (Table A.6 in the Appendix) or Poisson regressions without control variables (Table A.7 in the Appendix). Overall, our findings indicate that the relatively small treatment of the innovation voucher successfully supports SMEs in carrying out their plan to improve on their IP protection in the short run.

Internal processes related effects. As a final innovation outcome, we look at new or significantly improved internal processes. The number of firms specifically targeting at internal processes is too low for causal inferences (survey 1: N=28; survey 2: N=18), therefore we rely on the full sample analysis, only. Table 8 shows that both in the short and medium term the innovation voucher is estimated to increase the number of newly created or significantly improved internal processes by about 47% ($\text{Model (1)}: \beta_0 = 0.389; \text{Model (2)}: \beta_0 = 0.386$); yet the estimates are significant for year 1, only. This short-term positive effect is also significant in our robustness checks (Tables A.8 and A.9 in the Appendix).

Firm-level outcomes. Even though it is not the core of our study, we still thought it would be interesting to briefly look at the effect of the innovation voucher on firm-level outcomes with respect to innovation activities and business outcomes.

Innovation activity outcomes are as measured by the total amount spent on innovation and the proportion of employees working on innovation activities (cf. Table A.10 in the Appendix). We do not find any significant difference between the treatment and the control group in either of the surveys. The same holds true for business outcomes. There are no treatment differences for any of the business outcome measures, i.e., the probability of having turnover, the probability of making profit or for the number of employees, in either of the years (cf. Table A.11 in the Appendix).

Table 6: Treatment effects on product and service outcomes

	Product and service outcomes							
	Overall effect				Treatment effect for companies with product and service projects			
	Year 1		Year 2		Year 1		Year 2	
	Number of new MVPs	Number of new products and services	Number of new MVPs	Number of new products and services	Number of new MVPs	Number of new products and services	Number of new MVPs	Number of new products and services
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment effect	0.063	0.289*	0.386	0.157				
	(0.200)	(0.171)	(0.383)	(0.348)				
Treatment effect for companies with product and service projects					0.068	0.596**	0.996**	0.183
					(0.312)	(0.259)	(0.411)	(0.336)
Treatment effect for all others					0.100	0.020	-0.131	0.093
					(0.207)	(0.214)	(0.534)	(0.428)
Companies with product and service projects (0-1)					0.269	-0.480**	-0.612	-0.668
					(0.321)	(0.240)	(0.465)	(0.455)
Constant	0.806**	-0.111	0.063	-1.156**	0.607*	0.107	0.166	-0.722
	(0.365)	(0.311)	(0.654)	(0.588)	(0.338)	(0.337)	(0.717)	(0.619)
Observations	442	442	269	269	442	442	269	269

Poisson regressions. Controls for firm size, age and service industry (dummy); innovation voucher round fixed effects. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

25

Table 7: Treatment effects on IP outcomes

	Treatment effect for companies with IP projects					
	Year 1			Year 2		
	Number of new patent applications	Number of new design right applications	Number of new trademark applications	Number of new patent applications	Number of new design right applications	Number of new trademark applications
Model	(1)	(2)	(3)	(4)	(5)	(6)
Treatment effect for companies with IP projects	1.363**	0.254	0.137	-0.056	-1.010	1.032
	(0.688)	(1.070)	(0.509)	(0.752)	(1.080)	(0.654)
Treatment effect for all others	-0.321	0.445	0.020	-0.165	-0.764	0.083
	(0.343)	(0.511)	(0.336)	(0.406)	(0.659)	(0.482)
Companies with IP projects (0-1)	-1.226*	-0.571	-0.287	0.146	0.937	-0.378
	(0.716)	(1.062)	(0.526)	(0.795)	(0.977)	(0.747)
Constant	-0.404	-1.880***	-1.477**	-0.411	-21.436**	-15.826***
	(0.444)	(0.653)	(0.632)	(0.652)	(10.811)	(0.634)
Observations	442	442	442	269	270	269

Poisson regressions. Controls for firm size, age and service industry (dummy); innovation voucher round fixed effects. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

26

Table 8: Treatment effects on processes outcomes

	Number of new processes	
	Overall effect	
	Year 1	Year 2
Model	(1)	(2)
Treatment effect	0.389*	0.386
	(0.229)	(0.383)
Constant	-1.107**	-0.157
	(0.430)	(0.519)
Observations	442	269

Poisson regressions. Controls for firm size, age and service industry (dummy); innovation voucher round fixed effects. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

5.3. Exploring Underlying Mechanisms

Now that we have established these main effects, in particular the project-level innovation outcomes, it would be valuable to understand the underlying mechanism that is driving our results. To this end, we look at how different types of behavior could potentially moderate the effect of the voucher on innovation outcomes. It is important to note, however, that our research design does not allow us to make any causal inferences about these mechanisms since we lack exogeneous variation in these measures. Therefore, all the results presented in this section are merely exploratory in nature and show correlations rather than causal effects.

Some of the strongest and most lasting effects that we find in the analyses presented above are those related to new products and services in year 1 and new MVPs in year 2. Given the literature on the importance of external collaborations on product and service development for SMEs (Spithoven et al., 2013; van de Vrande et al., 2009), we test if our main effect is particularly strong for firms with more intense forms of collaborations. To this end, we estimate the differential treatment effect for the subgroup of firms that indicated to have also established a new joint venture, technology alliance or supply chain arrangement in the year they have received the voucher. The results in Table 9 show that there seems to be a strong and significant positive correlation between having established an intense form of collaboration and introducing new products and services in the year the voucher was awarded. This is true for the full sample and for the subsample of firms with product or services projects.

Since we do not find a longer lasting impact of the voucher on collaborations beyond the first year, it is unlikely that the development of MVPs in year 2 is strongly correlated with

collaboration activities. We tested this and find that there is no evidence that collaborations are correlated with the development of MVPs in year 2.[12]

Table 9: Differential treatment effects by an intense form of collaboration

	Year 1	
	Number of new products and services	Number of new products and services
Model	(1)	(2)
Treatment effect for companies with newly established joint venture	0.740**	
	(0.294)	
Treatment effect for companies without newly established joint venture	0.046	
	(0.223)	
Treatment effect for companies with product and service projects and newly established joint venture		1.068**
		(0.445)
Treatment effect for other companies with newly established joint venture		0.331
		(0.248)
Treatment effect for companies with product and service projects without newly established joint venture		0.250
		(0.265)
Treatment effect for other companies without newly established joint venture		-0.101
		(0.266)
Newly established joint venture (0-1)	-0.043	0.009
	(0.244)	(0.235)
Companies with product and service projects (0-1)		-0.486**
		(0.235)
Constant	-0.056	0.196
	(0.362)	(0.394)
Observations	442	442

Poisson regressions. Controls for firm size, age and service industry (dummy); innovation voucher round fixed effects. The variable "newly established joint venture" (0-1) indicates whether a company has entered any joint venture, technology alliance or supply chain arrangement in year 1. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

An alternative explanation for the medium-term treatment effect could be that firms in the treatment group are now more likely to apply for and receive follow-up funding. This could either be due to the fact that having received the innovation voucher provides a positive signal to other financial partners or potential investors, or it could be due to the fact that voucher recipients have come to realize that subsidies, grants and other governmental funding opportunities provide a useful source of additional financing for their innovation activities. To

[12] The results are available by the authors upon request.

investigate this, we test if the medium-term treatment effect is particularly strong for SMEs that report to have received follow-up funding in the year after they received the voucher (year 2). The findings in Table 10 show that while there is no indication of a positive correlation between further grant and subsidy application in the full sample, there is a strong and significantly positive correlation for the subgroup of firms with product and services projects.

Table 10: Differential treatment effects by follow-up funding

	Year 2	
	Number of new MVPs	Number of new MVPs
Model	(1)	(2)
Treatment effect for companies with further grant applications	0.812	
	(0.570)	
Treatment effect for companies without further grant applications	-0.053	
	(0.381)	
Treatment effect for companies with product and service projects and further grant applications		1.580***
		(0.546)
Treatment effect for other companies with further grant applications		0.006
		(0.749)
Treatment effect for companies with product and service projects without further grant applications		0.349
		(0.562)
Treatment effect for other companies without further grant applications		-0.134
		(0.405)
Further grant applications (0-1)	0.538	0.642
	(0.523)	(0.541)
Companies with product and service projects (0-1)		-0.673
		(0.497)
Constant	-0.121	-0.042
	(0.648)	(0.663)
Observations	269	269

Poisson regressions. Controls for firm size, age and service industry (dummy); innovation voucher round fixed effects. The variable "further grant applications" (0-1) refers to grant applications in the year after voucher completion. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Taken together these findings suggest that there might be a limit to nudging SMEs into increasing external collaborations for their innovation activities. The voucher seems to be effective when it comes to pushing forward a particular innovation project in collaboration with a certain partner. However, these connections do not seem to last or spur new relationships with external partners. Rather it seems that having been successful at receiving governmental

support for innovation activities once, opens up this route for the execution of other innovation activities.

5.4 Behavior of Non-awarded and Non-redeeming Firms

In this section, we provide some descriptive evidence to what extent and how firms from the control group conduct the project with which they applied for the innovation voucher. Moreover, we offer answers to the same question for the large group of firms that decided not to redeem the voucher despite being awarded one. For this group we also investigate the reasons for not redeeming the innovation voucher. Understanding their problems within the innovation voucher program may be useful in order to reduce the rate of non-redeemers and ultimately to improve for the effectiveness of future innovation voucher programs. In order not to contaminate the main analysis of program effects with the mentioning of questions that make the connection to the innovation voucher program particularly salient, we decided to ask the respective questions only at the very end of the second survey.[13]

Non-awarded firms. Of the firms that replied to the second survey, about half the firms in the control group, i.e., that were not offered an innovation voucher, still manage to conduct the project for which they applied (51%). In 70% of these cases, the project is financed by own funds. Importantly, for many of these conducted projects, firms decided to move on without any collaboration partner (in 38% of these cases). Those who do collaborate, do so with a large variety of partners, the most popular being university partners, IP advisors, suppliers and design collaborators. This finding is in line with the above-mentioned treatment difference in the probability of having had short-term external support. Behavior of the control group suggests that this collaboration effect may not only be driven by those firms that did not conduct the project they aimed for, but also by those conducting the project on their own.

Non-redeeming firms. Amongst those companies that were offered a voucher but did not redeem it, 62% still conduct the project they applied for – a slightly higher rate than the firms in the control group. As for the control group, those firms that conducted the project mostly finance the project themselves (80%). In this group, fewer firms conduct the project on their

[13] We base this analysis on those companies that correctly self-indicated at the end of the second survey whether they were offered an innovation voucher (N=231) and do not consider those firms that failed to do so (N=37).

own (26%); prominent collaboration partners are universities, research and technology organizations, and users.

When being asked about the reasons for not redeeming the voucher, firms could choose from a diversity of different aspects, amongst them are listed complicated voucher processes, other funding opportunities, lack of a suitable collaboration partner and lack of project completion time. Multiple answers were possible as well as the indication of other reasons not particularly listed in the survey items. Strikingly, about half of the respondents indicate that the project completion time of six months was too short in order to redeem. Moreover, 27% of them state that the process was too complicated.

6 Discussion and Conclusion

Policymakers around the globe use public funding and government policies to support SMEs in their innovation activities. The rationale behind these policy measures is that these ventures have been shown to contribute substantially to economic growth (e.g., Haltiwanger et al., 2013; Scherer & others, 1986) and are more likely to introduce radical innovations (Criscuolo et al., 2012; Hottenrott & Lopes-Bento, 2015). However, due to their size, SMEs are also more likely to face financial constraints and have limited access to innovation-relevant knowledge (Lerner, 2000; van de Vrande et al., 2009). To ease knowledge constraints, firms of all sizes increasingly rely on external collaborations for their innovation activities. Yet, here again, SMEs seem to be at a disadvantage to implement these collaborations successfully, for example, due to a lack of available resources to search for the right partner. In this paper, we examine a policy instrument, called innovation voucher, that promotes R&D collaboration between SMEs and external partners in order to increase innovation outcomes. The aim of this program is to mitigate the downside risk of external collaborations by stimulating the use of external knowledge providers by SMEs for a specific innovation project. While there is some evidence showing that innovation vouchers lead to more collaboration (Bakhshi et al., 2015; Chapman & Hewitt-Dundas, 2018; Cornet et al., 2006), it remains an open question whether innovation vouchers are an effective tool to translate these activities into measurable innovation outcomes.

In order to test the theorized benefits of subsidized R&D collaboration, we conduct a large-scale RCT of an innovation voucher program to understand its causal effect on SMEs' innovation outcomes. Our findings provide evidence that the innovation voucher program successfully fosters the execution of innovation projects with short- and medium-term effects on innovation outcomes. First, it fosters the creation of products and service in the short term

and the development of MVPs in the medium term amongst those firms with product- and service-related projects. Second, it improves IP-related outcomes in terms of patent applications for those firms executing IP-related projects. Third, it increases the number of new or improved internal processes for all firms in the treatment group.

We do not find measurable impacts of the voucher on several other objectives that the subsidy was targeted at. While we find evidence for the innovation voucher to increase the likelihood of interaction with external partners in the short term, we do not observe a significant impact on ongoing collaborations. This is in line with previous studies that find no evidence for medium-term network externalities (Bakhshi et al., 2015). Moreover, and perhaps unsurprisingly given the relatively short time frame of our study, our results do not provide any evidence for a broader effect on innovation activities or business outcomes.

Our results contribute to the innovation policy literature by supporting and extending previous findings on the positive impact of the innovation voucher on the innovativeness of SMEs (e.g., Bakhshi et al., 2015; Sala et al., 2016). While other studies mainly focused on collaboration outcomes or a more narrow scope of the subsidy in terms of type of collaboration partner or location (Bakhshi et al., 2015; Cornet et al., 2006), we present evidence for large treatment effects on innovation outcomes of a nationwide, all-industry program with a broad scope of potential partners. The use of an RCT with two follow-up surveys enables us to estimate the causal impact of external collaborations on innovation outcomes in the short and medium term. Moreover, prior research has highlighted the importance of investigating heterogeneous effects depending on project goals (e.g., Belderbos, Carree, & Lokshin, 2004; Belderbos, Carree, Diederen, et al., 2004; Hottenrott & Lopes-Bento, 2014). Our study addresses this call for action by differentiating project-level outcomes accordingly. Finally, we report conservative estimates of the treatment by focusing on the intention-to-treat effect. Given that more than 30% of the vouchers in our population were offered but not redeemed, the treatment effect on the treated is likely to be even larger.

From a policy perspective, our results provide causal evidence on the effectiveness of the voucher scheme and thus strengthen the rationale for this type of governmental funding. Hence, our study adds to the policy debate on how to support innovation activities of SMEs. Our results also provide guidance on how to increase the effectiveness of innovation voucher programs. For example, our results indicate that there are limits to the behavioral change in terms of long-term external collaborations. Our results show that the short-term positive impact of the voucher is positively correlated to more intense collaborations, such as joint ventures or strategic alliances. We further note that these correlations between innovation performance and

collaborations only show up in the immediate treatment period. This indicates that other factors are more likely to contribute to the positive medium-term effect of the voucher, i.e., MVP development. We find tentative evidence that the medium-term impact on MVP development could be driven by firms seeking follow-up governmental support. This suggests that, even though the innovation voucher provides a promising first step, more is needed to increase the innovation outcomes of SMEs in the long-term. Furthermore, given the low take-up rate of the voucher it is important to understand the reasons for non-redemption. We infer from survey responses of the non-redeemers that short project execution deadlines seem to be the major reason for not using the voucher. To some extent, firms also state complicated processes to be another reason. In this light, an innovation voucher program that allows for longer project execution phases and further reduces administrative barriers could be advisable.

We also acknowledge several limitations of our study. First, our analyses build on self-reported data and thus our approach could be supplemented in future research by analyses of other data from governmental entities such as patent applications and grants at the national and international level. Second, we only observe short- to medium-term effects by examining innovation outcomes one and two years after the award of the voucher. Even though our analysis extends the timeframe of existing studies, we might still miss potential medium- and long-term effects of the voucher scheme. In fact, already in our analyzed timeframe we find some effects, for instance the development of MVPs, to unfold in the second year after voucher award, only. Since R&D projects can take several years until measurable results can be identified, our analysis might miss more of those effects. Third, except for our results on awards received for innovations or newly introduced products and services, we only assess the quantity of innovation outcomes without examining the quality of the developed products or patent applications (e.g., commercial success of products or number of patent citations if being granted). Inferences about these measures would require several years to materialize. Following this line of reasoning, a promising endeavor may be to evaluate subsidies over longer time periods with additional data from governmental databases on patents, business outcomes, or subsequent applications for other governmental grants. Finally, even though our analysis broadens the scope from existing literature from a regional to a national level (Bakhshi et al. 2015), the question remains whether our findings will be transferable to similar programs in other countries. By and large, we are confident that our findings can be translated to other developed countries. Given the small financial intervention, innovation vouchers might also represent an efficient instrument for emerging economies. We must leave it to future research to investigate if this is indeed the case.

References

Audretsch, D. B., Keilbach, M. C., & Lehmann, E. E. (2006). *Entrepreneurship and economic growth*. Oxford University Press.

Bakhshi, H., Edwards, J. S., Roper, S., Scully, J., Shaw, D., Morley, L., & Rathbone, N. (2015). Assessing an experimental approach to industrial policy evaluation: Applying RCT+ to the case of Creative Credits. *Research Policy*, *44*(8), 1462–1472. https://doi.org/10.1016/j.respol.2015.04.004

Belderbos, R., Carree, M., Diederen, B., Lokshin, B., & Veugelers, R. (2004). Heterogeneity in R&D cooperation strategies. *International Journal of Industrial Organization*, *22*(8–9), 1237–1263. https://doi.org/10.1016/j.ijindorg.2004.08.001

Belderbos, R., Carree, M., & Lokshin, B. (2004). Cooperative R&D and firm performance. *Research Policy*, *33*(10), 1477–1492. https://doi.org/10.1016/j.respol.2004.07.003

Cassiman, B., & Veugelers, R. (2002). R&D Cooperation and Spillovers: Some Empirical Evidence from Belgium. *American Economic Review*, *92*(4), 1169–1184.

Chapman, G., & Hewitt-Dundas, N. (2018). The effect of public support on senior manager attitudes to innovation. *Technovation*, *69*, 28–39.

Chesbrough, H., Vanhaverbeke, W., & West, J. (2006). *Open innovation: Researching a new paradigm*. Oxford University Press on Demand.

Cornet, M., Vroomen, B., der Steeg, M., & others. (2006). *Do innovation vouchers help SMEs to cross the bridge towards science?* (Vol. 58). CPB Netherlands Bureau for Economic Policy Analysis.

Criscuolo, P., Laursen, K., Reichstein, T., & Salter, A. (2018). Winning combinations: search strategies and innovativeness in the UK. *Industry and Innovation*, *25*(2), 115–143. https://doi.org/10.1080/13662716.2017.1286462

Criscuolo, P., Nicolaou, N., & Salter, A. (2012). The elixir (or burden) of youth? Exploring differences in innovation between start-ups and established firms. *Research Policy*, *41*(2), 319–333. https://doi.org/10.1016/j.respol.2011.12.001

Czarnitzki, D., & Delanote, J. (2015). R&D policies for young SMEs: input and output effects. *Small Business Economics*, *45*(3), 465–485.

Czarnitzki, D., & Hottenrott, H. (2011). R&D investment and financing constraints of small and medium-sized firms. *Small Business Economics*, *36*(1), 65–83. https://doi.org/10.1007/s11187-009-9189-3

Galasso, A., & Schankerman, M. (2018). Patent rights, innovation, and firm exit. *The RAND*

Journal of Economics, *49*(1), 64–86. https://doi.org/10.1111/1756-2171.12219

George, G., Zahra, S. A., & Wood Jr, D. R. (2002). The effects of business--university alliances on innovative output and financial performance: a study of publicly traded biotechnology companies. *Journal of Business Venturing*, *17*(6), 577–609.

Haltiwanger, J., Jarmin, R. S., & Miranda, J. (2013). Who creates jobs? Small versus large versus young. In *Review of Economics and Statistics* (Vol. 95, Issue 2, pp. 347–361). The MIT Press . https://doi.org/10.1162/REST_a_00288

Haus-Reve, S., Fitjar, R. D., & Rodríguez-Pose, A. (2019). Does combining different types of collaboration always benefit firms? Collaboration, complementarity and product innovation in Norway. *Research Policy*, *48*(6), 1476–1486. https://doi.org/10.1016/j.respol.2019.02.008

Hossain, M., & Kauranen, I. (2016). Open innovation in SMEs: a systematic literature review. *Journal of Strategy and Management*, *9*(1), 58–73. https://doi.org/10.1108/JSMA-08-2014-0072

Hottenrott, H., & Lopes-Bento, C. (2014). (International) R&D collaboration and SMEs: The effectiveness of targeted public R&D support schemes. *Research Policy*, *43*(6), 1055–1066. https://doi.org/10.1016/j.respol.2014.01.004

Hottenrott, H., & Lopes-Bento, C. (2015). Quantity or quality? Knowledge alliances and their effects on patenting. *Industrial and Corporate Change*, *24*(5), 981–1011.

Howell, S. T. (2017). Financing innovation: Evidence from R&D grants. *American Economic Review*, *107*(4), 1136–1164. https://doi.org/10.1257/aer.20150808

Keupp, M. M., & Gassmann, O. (2013). Resource constraints as triggers of radical innovation: Longitudinal evidence from the manufacturing sector. *Research Policy*, *42*(8), 1457–1468. https://doi.org/10.1016/j.respol.2013.04.006

Laursen, K., & Salter, A. (2004). Searching high and low: What types of firms use universities as a source of innovation? *Research Policy*, *33*(8), 1201–1215. https://doi.org/10.1016/j.respol.2004.07.004

Laursen, K., & Salter, A. J. (2014). The paradox of openness: Appropriability, external search and collaboration. *Research Policy*, *43*(5), 867–878. https://doi.org/10.1016/j.respol.2013.10.004

Leiponen, A., & Helfat, C. E. (2010). Innovation objectives, knowledge sources, and the benefits of breadth. *Strategic Management Journal*, *31*(2), 224–236. https://doi.org/10.1002/smj.807

Lerner, J. (2000). The government as venture capitalist: the long-run impact of the SBIR

program. *The Journal of Private Equity*, *3*(2), 55–78.

Maietta, O. W. (2015). Determinants of university--firm R&D collaboration and its impact on innovation: A perspective from a low-tech industry. *Research Policy*, *44*(7), 1341–1359.

McKenzie, D. (2015). *Tools of the Trade: a joint test of orthogonality when testing for balance*. World Bank Blogs. https://blogs.worldbank.org/impactevaluations/tools-trade-joint-test-orthogonality-when-testing-balance

Mina, A., Bascavusoglu-Moreau, E., & Hughes, A. (2014). Open service innovation and the firm's search for external knowledge. *Research Policy*, *43*(5), 853–866. https://doi.org/10.1016/j.respol.2013.07.004

Parida, V., Westerberg, M., & Frishammar, J. (2012). Inbound Open Innovation Activities in High-Tech SMEs: The Impact on Innovation Performance. *Journal of Small Business Management*, *50*(2), 283–309. https://doi.org/10.1111/j.1540-627X.2012.00354.x

Sala, A., Landoni, P., & Verganti, R. (2016). Small and Medium Enterprises collaborations with knowledge intensive services: an explorative analysis of the impact of innovation vouchers. *R&D Management*, *46*(S1), 291–302.

Schade, S., & Grigore, C. (2009). Availability and focus on Innovation Voucher schemes in European regions. *Enterprise and Industry Directorate General, Brussels: European Commission*, *326*.

Scherer, F. M., & others. (1986). Innovation and growth: Schumpeterian perspectives. *MIT Press Books*, *1*.

Spithoven, A., Vanhaverbeke, W., & Roijakkers, N. (2013). Open innovation practices in SMEs and large enterprises. *Small Business Economics*, *41*(3), 537–562. https://doi.org/10.1007/s11187-012-9453-9

Tether, B. S., & Tajar, A. (2008). Beyond industry-university links: Sourcing knowledge for innovation from consultants, private research organisations and the public science-base. *Research Policy*, *37*(6–7), 1079–1095. https://doi.org/10.1016/j.respol.2008.04.003

van de Vrande, V., de Jong, J. P. J., Vanhaverbeke, W., & de Rochemont, M. (2009). Open innovation in SMEs: Trends, motives and management challenges. *Technovation*, *29*(6–7), 423–437. https://doi.org/10.1016/j.technovation.2008.10.001

Appendix

Supplementary Figures

Figure A.1: Innovation voucher's logic chain (as developed by InnovateUK).

Inputs	Activities	Outputs	Outcomes	Impacts
Public investment	**Collaboration**	**Knowledge**	**Innovation**	**Growth**
Voucher	R&D	Technology/business questions answered	Investment in R&D and innovation	GVA
	Technology advice	Increased innovation capabilities	Product/process/service development	Employment
	Design	New relationships developed	Increased engagement with knowledge providers	Productivity
	IP advice		Increased awareness of innovation support programs	

Supplementary Tables

Table A.1: Randomization checks with test for joint orthogonality

Sample	Total sample	Eligibility sample	Survey sample (after lottery and eligibility check)	Product- and service-related survey subgroup (after lottery and eligibility check)	IP-related survey subgroup (after lottery and eligibility check)
Dependent variable: IV lottery assigned (0-1)					
Model	(1)	(2)	(3)	(4)	(5)
Number of employees	0.002	0.002	0.001	0.019	-0.090
	(0.002)	(0.002)	(0.004)	(0.018)	(0.111)
Balance sheet total	-0.000	-0.000	0.000	0.000	0.002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
Turnover	-0.000	-0.000	-0.000	-0.000	0.003
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
Parent company (0-1)	0.019	0.089	0.061	0.804	
	(0.156)	(0.200)	(0.356)	(0.602)	
Defined R&D strategy (0-1)	0.096	0.111	-0.003	-0.169	0.600*
	(0.068)	(0.082)	(0.133)	(0.180)	(0.350)
R&D tax credits (0-1)	0.051	0.044	0.270	0.210	0.033
	(0.094)	(0.110)	(0.186)	(0.293)	(0.505)
Exporting (0-1)	-0.022	-0.021	0.005	0.050	-0.965**
	(0.080)	(0.098)	(0.160)	(0.256)	(0.460)
Patent Holder/Applicant (0-1)	-0.143*	-0.246***	-0.241	0.003	-0.240
	(0.084)	(0.095)	(0.146)	(0.212)	(0.354)
Trademark Holder/Applicant (0-1)	0.026	0.030	-0.150	0.051	0.102
	(0.074)	(0.089)	(0.140)	(0.206)	(0.501)
Design Right Holder/Applicant (0-1)	0.109	0.099	0.111	0.102	0.209
	(0.100)	(0.116)	(0.192)	(0.261)	(0.801)
Constant	0.596***	0.666***	0.816***	0.671***	0.869***
	(0.043)	(0.056)	(0.096)	(0.138)	(0.301)
Observations	2064	1405	550	272	101
Log likelihood	-1178.313	-775.370	-287.021	-146.783	-42.504
Chi^2 test for joint orthogonality	7.61	8.77	5.56	5.57	12.66
p-value of Chi^2 test	0.667	0.554	0.851	0.850	0.179

Probit regressions. Standard errors in parentheses. The Parent company coefficient in Model 5 is omitted because of perfect prediction.
*** p<0.01, **p<0.05, * p<0.1.

Table A.2: Check for response bias with test for joint orthogonality

Dependent variable: Survey respondent (0-1)	Any survey to population	Survey 1 to population	Survey 2 to population	Any survey treatment respondent to treatment population	Any survey control group respondent to control group population
Model	(1)	(2)	(3)	(4)	(5)
Number of employees	-0.000	0.001	-0.003	-0.001	0.001
	(0.002)	(0.002)	(0.003)	(0.003)	(0.005)
Balance sheet total	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turnover	0.000	-0.000	0.000*	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Parent company (0-1)	-0.128	0.046	-0.466**	-0.128	-0.103
	(0.182)	(0.185)	(0.234)	(0.205)	(0.424)
Defined R&D strategy (0-1)	0.022	0.008	0.008	-0.023	0.180
	(0.076)	(0.078)	(0.086)	(0.087)	(0.162)
R&D tax credits (0-1)	-0.133	-0.245**	-0.020	-0.039	-0.497**
	(0.101)	(0.106)	(0.113)	(0.114)	(0.227)
Exporting (0-1)	0.068	0.157*	0.048	0.083	-0.018
	(0.090)	(0.093)	(0.100)	(0.102)	(0.203)
Patent Holder/Applicant (0-1)	0.203**	0.232**	0.234**	0.212**	0.265
	(0.089)	(0.091)	(0.097)	(0.102)	(0.185)
Trademark Holder/Applicant (0-1)	0.020	-0.078	0.055	-0.051	0.299*
	(0.081)	(0.084)	(0.091)	(0.093)	(0.179)
Design Right Holder/Applicant (0-1)	-0.142	-0.184*	-0.192	-0.133	-0.226
	(0.106)	(0.111)	(0.121)	(0.121)	(0.234)
Constant	-0.303***	-0.475***	-0.857***	-0.246***	-0.493***
	(0.053)	(0.054)	(0.059)	(0.060)	(0.108)
Observations	1,405	1,405	1,405	1,063	342
Log likelihood	-936.384	-869.660	-706.363	-713.745	-217.602
Chi^2 test for joint orthogonality	8.24	15.18	15.30	6.36	9.24
p-value of Chi^2 test	0.61	0.13	0.12	0.78	0.51

Probit regressions. Comparison of eligible firms. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.3: Treatment effects on awards for innovations or new products or services

	Awards for innovations or new products or services			
	Overall effect		Treatment effect for companies with product and service projects	
	Year 1	Year 2	Year 1	Year 2
Model	(1)	(2)	(3)	(4)
Treatment effect	0.845**	0.020		
	(0.366)	(0.373)		
Treatment effect for companies			0.615	0.073
with product and service projects			(0.454)	(0.615)
Treatment effect for all others			1.426***	-0.030
			(0.478)	(0.441)
Companies with product and			1.248***	-0.084
service projects (0-1)			(0.470)	(0.614)
Constant	-1.580**	-0.299	-2.499***	-0.259
	(0.646)	(1.214)	(0.665)	(1.067)
Observations	442	269	442	269

Poisson regressions. Controls for firm size, age and service industry (dummy); innovation voucher round fixed effects. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

40

Table A.4: Treatment effects on product and service outcomes (no control variables)

	Product and service outcomes							
	Overall effect				Treatment effect for companies with product and service projects			
	Year 1		Year 2		Year 1		Year 2	
	Number of new MVPs	Number of new products and services	Number of new MVPs	Number of new products and services	Number of new MVPs	Number of new products and services	Number of new MVPs	Number of new products and services
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment effect	0.035	0.272	0.521	0.068				
	(0.221)	(0.185)	(0.334)	(0.281)				
Treatment effect for companies					0.019	0.576**	1.109***	0.138
with product and service projects					(0.351)	(0.287)	(0.417)	(0.337)
Treatment effect for all others					0.072	-0.003	-0.027	0.026
					(0.194)	(0.212)	(0.445)	(0.381)
Companies with product and					0.236	-0.529**	-0.591	-0.673
service projects (Dummy)					(0.327)	(0.254)	(0.464)	(0.451)
Constant	0.677***	0.478***	0.446*	0.592**	0.543***	0.727***	0.693*	0.867**
	(0.184)	(0.133)	(0.260)	(0.251)	(0.147)	(0.186)	(0.362)	(0.338)
Observations	442	442	272	272	442	442	272	272

Poisson regressions. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

41

Table A.5: Treatment effects on product and service outcomes (negative binomial regressions)

	Product and service outcomes							
	Overall effect				Treatment effect for companies with product and service projects			
	Year 1		Year 2		Year 1		Year 2	
	Number of new MVPs	Number of new products and services	Number of new MVPs	Number of new products and services	Number of new MVPs	Number of new products and services	Number of new MVPs	Number of new products and services
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment effect	0.083	0.347*	0.385	0.048				
	(0.190)	(0.188)	(0.355)	(0.306)				
Treatment effect for companies with product and service projects					0.104	0.577**	0.939**	0.145
					(0.283)	(0.263)	(0.396)	(0.348)
Treatment effect for all others					0.119	0.064	-0.023	-0.005
					(0.215)	(0.203)	(0.470)	(0.384)
Companies with product and service projects (Dummy)					0.246	-0.433*	-0.645	-0.641
					(0.305)	(0.239)	(0.455)	(0.447)
Constant	0.795**	-0.165	-0.041	-1.137**	0.593*	0.035	0.200	-0.702
	(0.348)	(0.312)	(0.597)	(0.507)	(0.352)	(0.339)	(0.681)	(0.545)
Observations	442	442	269	269	442	442	269	269

Negative binomial regressions. Controls for firm size, age and service industry (dummy); innovation voucher round fixed effects. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

42

Table A.6: Treatment effects on IP outcomes (negative binomial regressions)

	Treatment effect for companies with IP projects					
	Year 1			Year 2		
	Number of new patent applications	Number of new design right applications	Number of new trademark applications	Number of new patent applications	Number of new design right applications	Number of new trademark applications
Model	(1)	(2)	(3)	(4)	(5)	(6)
Treatment effect for companies with IP projects	1.361*	0.164	-0.001	-0.203	-1.036	1.281*
	(0.750)	(1.154)	(0.540)	(0.805)	(0.983)	(0.661)
Treatment effect for all others	-0.360	0.514	-0.071	-0.200	-0.634	0.254
	(0.335)	(0.460)	(0.318)	(0.426)	(0.590)	(0.448)
Companies with IP projects (0-1)	-1.148	-0.170	-0.219	0.264	1.256	-0.383
	(0.758)	(1.135)	(0.555)	(0.841)	(1.040)	(0.693)
Constant	-0.290	-1.431*	-1.389**	-0.433	-18.210***	-17.077***
	(0.453)	(0.794)	(0.637)	(0.645)	(0.742)	(0.618)
Observations	442	442	442	269	269	269

Poisson regressions. Controls for firm size, age and service industry (dummy); innovation voucher round fixed effects.

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

43

Table A.7: Treatment effects on IP outcomes (no control variables)

	Treatment effect for companies with IP projects					
	Year 1			Year 2		
	Number of new patent applications	Number of new design right applications	Number of new trademark applications	Number of new patent applications	Number of new design right applications	Number of new trademark applications
Model	(1)	(2)	(3)	(4)	(5)	(6)
Treatment effect for companies with IP projects	1.424**	0.390	0.220	-0.192	-1.309	0.906
	(0.723)	(1.061)	(0.536)	(0.721)	(1.017)	(0.700)
Treatment effect for all others	-0.397**	0.537*	0.013	-0.313	-1.097	-0.252
	(0.164)	(0.312)	(0.184)	(0.440)	(0.673)	(0.532)
Companies with IP projects (0-1)	-1.368*	-0.575	-0.342	0.170	0.841	-0.523
	(0.720)	(1.041)	(0.526)	(0.776)	(1.002)	(0.790)
Constant	-0.424***	-1.910***	-0.757***	-0.575	-0.736	-0.981**
	(0.137)	(0.289)	(0.162)	(0.396)	(0.541)	(0.483)
Observations	442	442	442	272	272	272

Poisson regressions. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

44

Table A.6: Treatment effects on new processes (no controls)

	Number of new processes	
	Overall effect	
	Year 1	Year 2
Model	(1)	(2)
Treatment effect	0.422*	-0.226
	(0.236)	(0.432)
Constant	-0.033	0.785*
	(0.199)	(0.409)
Observations	442	272

Poisson regressions. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

Table A.7: Treatment effects on new processes (negative binomial regressions)

	Number of new processes	
	Overall effect	
	Year 1	Year 2
Model	(1)	(2)
Treatment effect	0.431*	-0.202
	(0.229)	(0.403)
Constant	-1.101**	0.333
	(0.432)	(0.589)
Observations	442	269

Negative binomial regressions. Controls for firm size, age and service industry (dummy); innovation voucher round fixed effects. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.10: Treatment effects on innovation activity outcomes

	Innovation activity outcomes			
	Year 1		Year 2	
	Total amount spent on innovation	Proportion of employees working on innovation activities	Total amount spent on innovation	Proportion of employees working on innovation activities
Model	(1)	(2)	(3)	(4)
Treatment effect	-0.262	4.107	0.100	-6.505
	(0.229)	(4.539)	(0.387)	(6.462)
Constant	3.679***	4.578	5.053***	23.726**
	(0.496)	(8.565)	(1.175)	(11.724)
Observations	435	454	260	278

Models 1 and 3: Poisson regressions, Models 2 and 4: OLS regressions. Controls for firm size, age and service industry (dummy); innovation voucher round fixed effects. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.11: Treatment effects on business outcomes

	Business outcomes					
	Year 1			Year 2		
	Turnover (0-1)	Profit (0-1)	Number of employees	Turnover (0-1)	Profit (0-1)	Number of employees
Model	(1)	(2)	(3)	(4)	(5)	(6)
Treatment effect	-0.245	-0.119	-0.163	0.194	-0.104	-0.416**
	(0.169)	(0.174)	(0.165)	(0.237)	(0.212)	(0.194)
Constant	0.050	-0.438**	1.193*	-0.406	-0.522*	0.534
	(0.246)	(0.207)	(0.660)	(0.358)	(0.299)	(0.685)
Observations	440	395	458	258	238	286

Models 1, 2, 4, 5: Probit regressions; Models 3 and 6: Poisson regressions. Controls for firm size (not in Models 1, 2, 3, 4 because of perfect prediction), age and service industry (dummy); innovation voucher round fixed effects. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Note, that the significant negative effect for the number of employees is not robust to other specifications (e.g., without control variables or when applying negative binomial regressions).

Supplementary Information

Appendix X.1: Innovation vouchers survey

Information needed from contact file (respondent will not see this)
Application reference
Unique reference
Respondent name
Business name
Business postcode
Company registration number
Project title
Round and Type (treatment vs. control)
Treatment group (redeemed, accepted, selected, not known)
Email
Contact number

NB: RESPONDENTS CAN SKIP QUESTIONS. IF THEY DO, PROMPT AS FOLLOWS:
[DEFAULT SKIP] **Can I just check, did you intend to skip the last question? Please be assured that all information you give will be treated as entirely confidential, and we only need you to give an approximate answer.**

Yes – CONTINUE
No – RETURN TO PREVIOUS QUESTION

ASK ALL
Thank you for participating in this survey. It is concerned with your innovation processes, inputs and outcomes, but firstly we would like to ask six short questions about your business that will help us to classify your answers. All information will be treated in the strictest confidence, and responses will not be attributed to any individual or business. The survey should take 10 minutes to complete.

ASK ALL

Q1. **How many years has your business been trading? This includes under all ownerships and legal statuses. Trading is defined as your business having sold goods or services for the first time.** PLEASE WRITE IN THE BOX BELOW. NB: IF TRADING LESS THAN ONE YEAR, PLEASE ENTER ZERO [ALLOWED RANGE 0-99]

Not trading yet ☐

[DEFAULT SKIP]

ASK ALL

Q2. **Does your business have a parent company or are you part of a group of linked enterprises?** PLEASE SELECT ONE ANSWER ONLY

Yes – have a parent company	1
Yes – part of a group of linked enterprises	2
Neither of these	3

[DEFAULT SKIP]

ASK ALL

Q3. **What is the principal activity of your business?** PLEASE WRITE IN THE BOX

[DEFAULT SKIP]

ASK ALL

Q4. **How many employees do you have?** PLEASE WRITE IN THE BOX BELOW. PLEASE INCLUDE PART-TIME AND TEMPORARY/CASUAL EMPLOYEES. PLEASE EXCLUDE AGENCY STAFF, SELF-EMPLOYED CONTRACTORS AND OWNERS/PARTNERS.
[ALLOWED RANGE 0-999]

[DEFAULT SKIP]

DO NOT ASK IF NOT YET TRADING AT Q1

Q5. **What was the approximate sales turnover of your business in the last 12 months? Please be reassured that your answer will remain entirely confidential.** PLEASE WRITE IN THE BOX BELOW. [ALLOWED RANGE £0-£999,999,999]

£								

[DEFAULT SKIP]

[Q5 CHECK 1 – ASK IF 0 AT Q5]

Can we just check that you had no sales in the last 12 months?

Yes – no sales in last 12 months	1	CONTINUE
No – return to previous question	2	RETURN TO Q5

Prefer not to give turnover figure	3	CONTINUE

[Q5 CHECK 2 – ASK IF 1-1000 AT Q5]

Your sales turnover in the last 12 months was £(AMOUNT AT Q5)? **Can we just check that this is the right figure, or should additional zeros be added?**

Yes – correct amount	1	CONTINUE
Not correct – return to previous question	2	RETURN TO Q5

ASK ALL

Q6. **Approximately how much gross profit or loss did your business make in the last 12 months? Please be reassured that your answer will remain entirely confidential.** PLEASE WRITE IN ONE THE BOXES BELOW. [ALLOWED RANGE £0-£999,999,999]

Profit	£								

Loss	£								

[DEFAULT SKIP]

[Q6 CHECK 1 – ASK IF 0 AT Q6]

Can we just check that you had no (profit/loss) **in the last 12 months?**

Yes – no (profit/loss) in last 12 months	1	CONTINUE
No – return to previous question	2	RETURN TO Q6
Prefer not to give profit/loss figure	3	CONTINUE

[Q6 CHECK 2 – ASK IF 1-1000 AT Q6]

Your (profit/loss) **in the last 12 months was £(**AMOUNT AT Q5)? **Can we just check that this is the right figure, or should additional zeros be added?**

Yes – correct amount	1	CONTINUE
Not correct – return to previous question	2	RETURN TO Q6

In the following questions, we would like to ask you about innovation activities in particular. Innovation activities are defined as all scientific, technological, organisational, financial and commercial steps, which actually, or are intended to, lead to the implementation of innovations.

ASK ALL

Q7. **How many of your company's employees work more than 50% of their time on innovation activities?** PLEASE WRITE IN THE BOX BELOW. [ALLOWED RANGE 0-999]

[DEFAULT SKIP]

ASK ALL

Q8. **Within the last 12 months, approximately what amount did your business spend on innovation activities?** PLEASE WRITE IN THE BOX BELOW.
[ALLOWED RANGE £0-£999,999,999]

£								

[DEFAULT SKIP]

[Q8 CHECK – ASK IF 1-1,000 AT Q8]

The amount spent on innovation activities in the last 12 months was £(AMOUNT AT Q8)? **Can we just check that this is the right figure, or should additional zeros be added?**

Yes – correct amount	1	CONTINUE
Not correct – return to previous question	2	RETURN TO Q8

[DEFAULT SKIP]

DO NOT ASK IF NOT YET TRADING AT Q1, LEAVES Q1 BLANK OR IF TURNOVER AT Q5 IS ZERO

Q9. **Approximately what proportion of your turnover generated within the last 12 months has come from new or improved products or services that you introduced in the last 12 months?** PLEASE WRITE IN THE BOX BELOW. [ALLOWED RANGE 0-100%]

[DEFAULT SKIP]

ASK ALL

Q10. **Within the last 12 months, with how many of each of the following types of external partners did your business have a formal relationship? This refers to any of your innovation activities, including ongoing relationships. If you have not had a formal relationship with any of these types of external partner, please can you enter a zero (0) in that box. For each external partner you have had, please only enter them into one category.** PLEASE WRITE IN EACH BOX [0-999].

	Number		
University or further education colleges			
Research/technology org., or technical consultancies			

Intellectual property advisers			
Design advisers			
Trade associations			
Chambers of Commerce			
Knowledge brokers/consultants			
Another business in your enterprise group			
Suppliers of equipment/materials/ software			
End users/customers/clients			
Other type of external partner (SPECIFY)			

[DEFAULT SKIP]

ASK IF VALUES HAVE BEEN GIVEN AT ANY PART OF Q10 (1+)

Q10a. **Based on your answers, the number of relationships you have with external partners comes to** [SUM AT Q10]**? How many of these relationships involved multiple interactions in the last 12 months?** [ALLOWED RANGE 0-SUM AT Q10]

[DEFAULT SKIP]

ASK IF VALUES HAVE BEEN GIVEN AT ANY PART OF Q10 (1+)

Q10b. **And how many of these** [SUM AT Q10] **relationships were with partners that you only started working with in the last 12 months, and had not worked with previously?** [ALLOWED RANGE 0-SUM AT Q10]

[DEFAULT SKIP]

ASK IF ANY EXTERNAL PARTNERS ACROSS Q10 (Q10 = 1+)

Q11. **Within the last 12 months, approximately what proportion of your innovation activities was conducted with the help of external partners (as defined in the previous question)?** PLEASE WRITE IN THE BOX BELOW. [ALLOWED RANGE 0-100%]

[DEFAULT SKIP]

ASK ALL

Q12. **Within the last 12 months, please indicate the number of the following outcomes that have occurred for your business? If any of these outcomes have not occurred, please can you enter a zero (0) in the appropriate box.** PLEASE WRITE IN EACH BOX [0-999]

	Number		
Prototypes/minimum viable products (MVP) introduced			
New or significantly improved products introduced			
New or significantly improved services introduced			
New patent applications			
New trademarks applications			
New design rights applications			
New or significantly improved internal processes introduced			
Applications for innovation subsidies/grants/vouchers			
Awards for your firm's innovations or new/improved products/services			
Published articles about your firm's innovations or new products/services			
Accelerators/incubators your firm participated in			
VCs/angel investors that invested in your firm			
Newly formed joint ventures, technology alliances or supply chain arrangements			

[DEFAULT SKIP]

ASK ALL

Q13. **Within the last 12 months, have you done any of the following?** PLEASE SELECT ONE FOR EACH OUTCOME.

	Yes	No
Entered new markets in the UK	1	2
Established an innovation/R&D department	1	2
Entered new export markets	1	2

[DEFAULT SKIP]

ASK ALL

Q14. **Within the last 12 months, did your business receive any of the following types of support for your innovation activities?** PLEASE SELECT ALL THAT APPLY

Business process consultancy	1
Cybersecurity audit	2
Design advice, including initial prototyping/concept development	3
Field testing	4
IP advice	5
IT consultancy	6
Laboratory/technical testing	7
Literature review/desk research	8
Manufacture of production prototype	9
Market assessment	10
R&D advice, usually highly innovative with technical risks	11
Other (SPECIFY)	12
None of the above	13

[DEFAULT SKIP]

ASK ALL

Q15. **Please consider the total amount your firm spent on innovation activities within the last 12 months. What amount of spending for these innovation activities came from each of the following sources? Please give an approximate amount in £ sterling, not a proportion. Please be assured that all answers you give will be treated in strictest confidence. If you did not use any of these sources, please can you enter a zero (0) in the appropriate box.** PLEASE WRITE IN FOR EACH SOURCE. [ALLOWED RANGE £0-£99,999,999]

	Value	
Your own business's funds	£	
Funds from related companies (subsidiaries or associated companies)	£	
Funds from other (non-financial) enterprises	£	
Funds from financial companies (e.g. bank loans, venture capital etc.)	£	
Funds from government organisations (e.g. grants/loans/innovation vouchers	£	
Funds from supranational and international organisations (EU etc.)	£	
Other sources (SPECIFY)	£	

[DEFAULT SKIP]

[Q15 CHECK – ASK IF 1-1,000 AT ANY OF Q15]

Your expenditure on innovation activity funded by [TYPE OF FINANCE AT Q15] **in the last 12 months was £(**AMOUNT AT Q15)? **Can we just check that this is the right figure, or should additional zeros be added?**

Yes – correct amount	1	CONTINUE
Not correct – return to previous question	2	RETURN TO Q15

[DEFAULT SKIP]

Note: The following questions (Q16 to Q21) were added for the second survey round (two years after the voucher was awarded).

ASK ALL

Q16. **Can I check, were you offered an innovation voucher by Innovate UK or the Technology Strategy Board in the past four years, irrespective of whether you accepted it or redeemed it?**

Yes	1
No	2

[DEFAULT SKIP]

ASK IF OFFERED A VOUCHER (Q18/1)

Q17. **Did you redeem the voucher?**

Yes	1
No	2

[DEFAULT SKIP]

ASK ALL EXCEPT FOR THOSE THAT REDEEMED THEIR VOUCHER (Q17/1)

Q18. **Did you execute the project that was the reason for applying for innovation vouchers?**

Yes	1
No	2

[DEFAULT SKIP]

ASK IF EXECUTED PROJECT (Q18/1)

Q19. **What was the total cost of the project?** [ALLOWED RANGE £0-£9,999,999]

PLEASE WRITE IN THE BOX BELOW		Not sure	Prefer not to say
£			

[DEFAULT SKIP]

ASK IF EXECUTED PROJECT (Q18/1)

Q20. **How was the project funded?** PLEASE WRITE IN THE PERCENTAGE FUNDED FROM EACH OF THE FOLLOWING SOURCES. [IF FIGURES ENTERED SHOULD COME TO 100%]

	%
Your own business's funds	
Funds from related companies (subsidiaries or associated companies)	
Funds from other (non-financial) enterprises	
Funds from financial companies (e.g. bank loans, venture capital etc.)	
Funds from government organisations (e.g. grants/loans/innovation vouchers)	
Funds from supranational and international organisations (EU etc.)	
Other sources (SPECIFY)	
Not sure	X
Prefer not to say	Y

[DEFAULT SKIP]

ASK IF EXECUTED PROJECT (Q18/1)

Q21. **Did you work with an external partner on this project? If you did, what type (s) of external partner did you work with.** PLEASE SELECT ALL THAT APPLY [MULTICODE 2-12]

Did not have an external partner	1
University or further education colleges	2
Research/technology organisations, or technical consultancies	3
Intellectual property advisers	4
Design advisers	5
Trade associations	6
Chambers of Commerce	7
Knowledge brokers/consultants	8
Another business in your enterprise group	9
Suppliers of equipment/materials/ software	10
End users/customers/clients	11
Other type of external partner (SPECIFY)	12
Not sure	13
Prefer not to say	14

[DEFAULT SKIP]

ASK IF DID NOT REDEEM VOUCHER (Q17/2)

Q22. **Which of the following reasons, if any, explain why you did not redeem the voucher offered by Innovate UK?**
PLEASE SELECT ALL THAT APPLY [MULTICODE 1-12]

The process was too complicated	1
You found other finance for the project	2
The voucher was not worth enough money	3
The project did not go ahead	4
Could not find a suitable external partner	5
Lack of time/missed deadline to redeem voucher	6
Other reason (SPECIFY)	7
Not sure	8
Prefer not to say	9

[DEFAULT SKIP]

Thank you very much for your time. If you do have any further comments or queries relating to this project, you can contact the research agency.
