Isaraj, Loreta

Article

Navigating Complexity: Firm Age and Multi-Project Participation of SMEs in Horizon 2020

Intereconomics

Suggested Citation: Isaraj, Loreta (2025) : Navigating Complexity: Firm Age and Multi-Project Participation of SMEs in Horizon 2020, Intereconomics, ISSN 1613-964X, Sciendo, Warsaw, Vol. 60, Iss. 4, pp. 235-242, https://doi.org/10.2478/ie-2025-0045

This Version is available at:
https://hdl.handle.net/10419/325280

DOI: 10.2478/ie-2025-0045

Innovation Policy

sciendo

Intereconomics, 2025, 60(4), 235-242

JEL: O32, L26, O38.

Loreta Isaraj

Navigating Complexity: Firm Age and Multi-Project Participation of SMEs in Horizon 2020

This paper investigates the role of firm age in shaping the funding efficiency of Italian small and medium-sized enterprises (SMEs) participating in Horizon 2020, the EU's flagship research and innovation programme. Using a comprehensive dataset covering 1,593 SMEs, the analysis distinguishes between firms engaged in a single project and those involved in multiple projects over the programme's duration. A novel project-level measure – contribution per project – is introduced to assess how effectively firms secure and utilise public research and development funding. The econometric analysis reveals that younger SMEs achieve higher funding efficiency in single-project contexts, reflecting their agility and innovation focus. However, they face significant challenges in multi-project participation due to limited administrative capacity and structural constraints. In contrast, older SMEs perform better in complex, multi-project environments, benefiting from accumulated experience and organisational maturity. These findings underscore the importance of firm age as a determinant of absorptive capacity and funding success, offering critical insights for the design of targeted innovation policies that support SMEs at different stages of development.

The capacity of firms to absorb and apply external knowledge is a fundamental driver of innovation and competitiveness. As defined by Cohen and Levinthal (1990), absorptive capacity entails recognising, assimilating and commercially exploiting external knowledge – a capability especially vital for small and medium-sized enterprises (SMEs), which often operate under significant resource constraints (Spithoven et al., 2011). Enhanced absorptive capacity enables SMEs to participate more effectively in research and development (R&D) projects and achieve stronger returns on innovation investment.

Horizon 2020, the European Union's flagship research and innovation programme (2014–2020), was designed to support such engagement, offering substantial funding to foster collaborative innovation across sectors and regions (Kim & Yoo, 2019; Kalisz & Aluchna, 2012). Despite efforts to ensure broad access, structural inequalities remain. The European Innovation Scoreboard continues to reveal significant disparities in innovation capacity across EU member states.

For Italian SMEs – which are central to the national economy – participation in Horizon 2020 has been both a strategic opportunity and a systemic challenge. Italy, classified as a "moderate innovator" (Murea, 2013), expanded its presence in the programme but saw its funding success rate decline, reflecting increased competition and difficulties in fully exploiting available support.

While the net benefits of framework programme participation are well documented (Åström et al., 2012), the ability of firms to convert public R&D support into effective innovation outcomes varies. Public funding helps correct market failures by enhancing firms' capacity to invest in high-risk, high-reward projects (Hanel, 2008), but outcomes depend heavily on firm-specific factors. Among these, firm age appears critical. Older SMEs may possess stronger administrative capacity and networks, which facilitate success in complex, multi-project environments (Autio et al., 2000). Conversely, younger SMEs often exhibit greater agility and innovation potential but struggle with the resource and organisational demands of sustained project participation (Sørensen & Stuart, 2000).

Open Access funding provided by ZBW – Leibniz Information Centre for Economics.

Loreta Isaraj, Italian National Research Council (CNR), Rome; and Institute for Research on Sustainable Economic Growth, Rome, Italy.

Despite growing research on firm-level determinants of innovation, limited attention has been paid to how firm age shapes funding efficiency – the ability to secure and effectively utilise public funds – particularly within multi-project contexts. This study addresses that gap by analysing the role of firm age in the Horizon 2020 participation of Italian SMEs, distinguishing between single and multiple-project engagement. The findings contribute to the evidence base for designing more targeted support mechanisms that align with the needs of SMEs at different stages of development.

Literature review

A substantial body of research has explored the effects of public funding on firm-level innovation, with a particular emphasis on R&D subsidies. Numerous studies find that public subsidies positively impact innovation activities by fostering technological advancement and enhancing firms' capacity to innovate (Almus & Czarnitzki, 2003; González & Pazó, 2008; Hussinger, 2008; Busom & Fernández-Ribas, 2008; Aerts & Schmidt, 2008; Gussoni & Mangani, 2010; Foreman-Peck, 2013). However, this positive narrative is not universal. Other studies point to limited or mixed outcomes, noting that subsidies may increase R&D investment without always translating into successful innovation outputs (Catozzella & Vivarelli, 2011; Cerulli & Potì, 2008; Hashi & Stojčić, 2013). For instance, Callejon and García-Quevedo (2005) stress sector-specific differences, while Cerulli and Potì (2012) identify crowding-out effects, especially among smaller firms. Bronzini and Piselli (2016) observe that subsidies boost patenting primarily in small firms, with less impact on larger enterprises.

Within the EU context, research indicates that European framework programmes like Horizon 2020 play a critical role in driving innovation. Firms benefiting from a mix of regional, national and EU-level subsidies tend to engage more effectively in radical innovation (Czarnitzki & Lopes-Bento, 2014; Mulligan et al., 2019), while reliance on single-source funding often proves less effective (Garcia & Mohnen, 2010). Despite this, relatively few studies focus specifically on SMEs, which often lack the internal capacity and resources to optimise such funding opportunities. SMEs in newer EU member states appear to gain significantly from EU innovation support. Čučković and Vučković (2021) show that these firms not only improve innovation output but also attract more private investment. Piątkowski (2020) similarly finds that EU funds positively affect Polish SMEs in terms of product innovation and business performance.

A key mechanism for SME support under Horizon 2020 is the SME Instrument, modelled on the US Small Business Innovation Research Program. While it offers structured phases for funding innovation and commercialisation, its highly competitive nature limits access. Previous experience with EU projects emerges as a major advantage; firms with prior participation demonstrate higher success rates (Di Minin et al., 2016; Vidmar & Vukasinović, 2019; Enger & Castellacci, 2016). This is consistent with findings by Wanzenböck et al. (2020), who emphasise the importance of strategic networking and consortium experience in improving application outcomes.

Evidence suggests that SMEs that secure Horizon 2020 funding often experience growth in employment, turnover and patent activity (Mulier & Samarin, 2021; Basosi et al., 2021). However, structural and administrative challenges persist. Surveys reveal barriers such as complex rules, limited administrative capacity and difficulties identifying relevant calls for proposals (Åström et al., 2017). Geographic disparities and wage differences also hinder participation in lower-income regions (Puukka, 2018).

Finally, participation in Horizon 2020 is not only about overcoming barriers but also about capitalising on critical success factors. Effective project management, leadership capacity and collaboration in diverse teams are shown to significantly influence outcomes in EU research, development and innovation projects (Tenhunen-Lunkka & Honkanen, 2024). While much attention has been paid to macro-level analyses or the performance of large firms and research institutions (Enger, 2018; Bērziņa, 2020), micro-level dynamics within SMEs remain underexplored. Participation trends are often examined at the country level (Folea, 2017; Bralić, 2017; Ferrer-Serrano et al., 2021; Gallo et al., 2021; Sekerci & Alp, 2023), which means that firm-level characteristics such as age, sector and prior funding experience are insufficiently studied. Larger enterprises dominate the literature (Børing et al., 2020), while SMEs – and particularly their heterogeneity – receive less attention (Abreu et al., 2023). This gap is critical because SME characteristics such as age may influence absorptive capacity, administrative efficiency and strategic readiness, especially in multi-project contexts. Our study aims to fill this gap by focusing on how firm age shapes SME engagement and funding efficiency in Horizon 2020, distinguishing between single and multiple-project participation.

Research hypotheses

Existing literature has extensively examined the role of firm age in shaping innovation capacity and performance, but from different angles. Older firms often benefit from accumulated experience, stable routines and stronger networks, which enhance their ability to manage complex

projects and secure funding (Autio et al., 2000; Sørensen & Stuart, 2000). In contrast, younger firms, while more flexible and innovative, frequently lack the organisational maturity and financial infrastructure needed to fully capitalise on R&D opportunities.

Research has also highlighted structural disadvantages faced by younger firms in accessing public funding. Studies by Veugelers et al. (2015) and Čučković and Vučković (2021) underscore their limited access to early-stage financing and weaker presence in high-intensity R&D sectors. Coad et al. (2018) emphasise the "liability of newness", which constrains younger firms' ability to convert innovation into financial performance, while noting that advantages gained through maturity can eventually diminish due to organisational rigidity (liability of old age). Mabenge et al. (2022) further show that younger firms benefit more from marketing innovation, given their proactive and agile business strategies.

The financing gap for young, innovation-driven firms has also been explored. Veugelers (2008) notes that young innovative companies, despite being central to radical innovation, face considerable barriers in securing support for sustained, multi-project engagement.

While these studies examine age-related differences in innovation and performance, there is limited empirical research on how firm age affects funding efficiency – defined here as the average contribution per project. This measure captures both the ability to secure funding and the firm's effectiveness in managing it within complex R&D settings. By shifting the focus from overall firm performance to project-level outcomes, this study aims to assess whether the agility of younger firms or the experience of older ones results in more effective use of EU research funding. To explore this, we propose the following hypotheses:

- Among SMEs with single-project participation, younger firms will have lower funding efficiency than older firms;
- Among SMEs with single-project participation, younger firms will have higher funding efficiency than older firms;
- Among SMEs with multiple-project participation, older firms will have higher funding efficiency;
- Among SMEs with multiple-project participation, older firms will have lower funding efficiency.

These competing hypotheses enable a structured analysis of how firm age shapes funding outcomes under different levels of project complexity, offering a more nuanced understanding of absorptive capacity and strategic behaviour in EU innovation programmes like Horizon 2020.

Data and variables

This study draws on data from the CORDIS[1] open-access database, accessed in December 2022, which documents participation in Horizon 2020 projects. The dataset includes 1,593 Italian SMEs, each involved in at least one project, representing approximately 79% of the total SME participation (2,021 unique participations). A subset of 428 firms was excluded due to missing firm-level information. From CORDIS, we collected the following data: the tax identification number (TIN) as an identifier for each SME, project ID for aggregating total amount of funds (net EU contribution) and the total number of projects in which an SME participated, the geographic location, Horizon 2020 pillars, and prior participation in FP7. We performed web scraping from Ufficio Camerale,[2] gathering valuable firm-level data to complement the existing dataset, including years of operation,[3] the number of employees,[4] legal form[5] and core business activity.[6] In all data sources used, firms were identified by their TIN, which was used to link the datasets. For each SME, we calculated the average funds received from Horizon 2020, referred to as "contribution per project", by dividing the total funds received – calculated as the aggregated net EU contribution across all projects in which the SME participated – by the total number of projects it was involved in. The distribution of Italian SMEs participating in Horizon 2020, shown in Table 1, is analysed for the entire sample (1,593 SMEs), for SMEs that participated in one project (1,096 SMEs) and for SMEs engaged in two or more projects (497 SMEs).

The distribution indicates a high degree of similarity across the variables age, size, location, legal form and

1 CORDIS is the Community Research and Development Information Service of the European Union. It is the primary source of information for the European Commission on the results of projects funded by the EU's research programmes.
2 https://www.ufficiocamerale.it/
3 Years of operation are grouped into four categories by the author, ranging from fewer years (1-5 years) to more than 25 years, without reference to any specific categorisation.
4 The number of employees refers to the SME categories defined by EU Recommendation 2003/36. Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises (notified under document number C(2003) 1422) (Text with EEA relevance) (2003/361/EC).
5 The classification is based on the distribution of data across categories, emphasising the categories with the highest number of participants, while grouping all other forms with lower participation into the "other" category.
6 Based on the NACE code level (SIC2007), this variable is divided into four categories, following the same rationale as the classification used for the legal form.

Table 1
SME distribution in Horizon 2020 across subsamples

	All SMEs		1 Project		> 1 Project	
	No	%	No.	%	No.	%
Age						
1-5 years	89	6	67	6	22	4
6-15 years	704	44	488	45	216	43
16- 25 years	392	25	241	22	151	30
Over 25 years	408	26	300	27	108	22
Size						
Micro SME (0-9)	740	46	527	48	213	43
Small SME (10-49)	579	36	386	35	193	39
Medium SME (50-250)	274	17	183	17	91	18
Location						
Centre	366	23	228	21	138	28
Islands	35	2	26	2	9	2
Northeast	435	27	302	28	133	27
South	170	11	110	10	60	12
Northwest	587	37	430	39	157	32
Legal form						
JSC	254	16	177	16	77	15
LLC	1271	80	866	79	405	81
Other	68	4	53	5	15	3
Sector						
I&C services	326	20	208	19	118	24
PS&T activities	517	32	296	27	221	44
Other	180	11	141	13	39	8
Manufacturing	570	36	451	41	119	24
H2020 pillar						
Excellent science + other	na	na	101	9	na	na
Industrial leadership	na	na	439	40	na	na
Societal challenges	na	na	556	51	na	na
FP7 participation						
Yes	370	23	251	23	119	24
No	1223	77	845	77	378	76
Total SMEs	1593	100	1096	100	497	100

Notes: JSC: joint-stock company; LLC: limited liability company; I&C: information and communication; PS&T: professional, scientific and technical.

Source: CORDIS dataset, December 2022.

FP7 participation, with only the sector showing a notable difference between the subsamples. Manufacturing SMEs dominate in the one-project subsample, representing 41% of SMEs. In contrast, SMEs in professional, scientific and technical (PS&T) activities dominate in the multi-project subsample, rising from 27% to 44%. This sectoral shift indicates that manufacturing SMEs are more likely to participate in one project, possibly reflecting resource limitations or sector-specific constraints. PS&T activities SMEs are more likely to engage in multiple projects, probably due to their higher absorptive capacity, innovation orientation and R&D focus.

Econometric model

Given the presence of heteroskedasticity in the dataset, a set of generalised least squares (GLS) models was estimated. To address potential outliers and skewed funding distributions, the dependent variable is the log of the average contribution per project. The primary objective of the analysis is to assess whether younger firms are more or less efficient than older firms in securing and utilising Horizon 2020 funding, while controlling for other firm-specific and contextual characteristics that might bias the estimated effect of firm age, such as: size (micro, small and medium), location (centre, islands, northeast, south, northwest), legal form (JSC, LLC, other), sector (I&C services, PS&T activities, other, manufacturing), H2020 pillar (strategic focus of the Horizon 2020 project, included only for single-project participants) and FP7 participation (binary indicator of whether the firm previously participated in FP7, reflecting prior experience and reputation). The econometric model is specified as follows:

$$Log\left(\frac{Contribution}{Project}\right) = \alpha + \beta_1 Age_i + \sum_{j=2}^{k} B_j Controls_{ji} + \varepsilon_i \quad (1)$$

Three separate GLS models were estimated to distinguish the effect of firm age across different levels of project complexity and engagement. Model 1 (baseline model) includes the full sample of SMEs participating in Horizon 2020, providing a general overview of the relationship between firm age and funding efficiency. Model 2 includes only SMEs that participated in a single project under Horizon 2020, allowing for the analysis of funding efficiency in a low complexity setting where firms face fewer administrative and operational challenges. Model 3 includes only SMEs that participated in multiple projects over the seven-year period of the programme, capturing the impact of increased administrative and operational complexity on funding efficiency. This approach allows for a detailed examination of how firm age influences funding efficiency under different project participation structures.

Results

The results of the analysis provide important insights into the relationship between firm age and funding efficiency in Horizon 2020 projects, distinguishing between single

Table 2
GLS regression models

	(1)		(2)		(3)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Age						
1-5 years	0.0229 **	0.0560	0.1211 ***	0.0680	-0.1812 ***	0.0820
6-15 years	0.0325 **	0.0320	0.0716 ***	0.0400	-0.0475 **	0.0450
16- 25 years	0.0660 ***	0.0330	0.0882 ***	0.0420	-0.0336 **	0.0450
Over 25 years	Ref.		Ref.		Ref.	
Size						
Micro SME (0-9)	-1.2040 ***	0.0360	-0.0974 **	0.0470	-0.0795 **	0.0480
Small SME (10-49)	-0.0265 **	0.0330	0.0094 **	0.0430	-0.0370 *	0.0450
Medium SME (50-250)	Ref.		Ref.		Ref.	
Location						
Centre	-0.0151	0.0300	-0.0379	0.0390	-0.0121	0.0400
Islands	0.0449	0.0780	0.0594	0.0940	-0.0068	0.1160
Northeast	-0.0572 **	0.0280	-0.0780 ***	0.0350	-0.0558 **	0.0400
South	-0.0496 *	0.0390	-0.0953 ***	0.0500	-0.0492	0.0510
Northwest	Ref.		Ref.		Ref.	
Legal form						
JSC	-0.0464	0.0610	-0.0834	0.0740	-0.0760	0.0950
LLC	-0.1046 **	0.0560	-0.1661 **	0.0670	0.0031	0.0890
Other	Ref.		Ref.		Ref.	
Sector						
I&C services	0.0361 *	0.0330	0.0441 *	0.0410	-0.1376 ***	0.0470
PS&T activities	0.0521 **	0.0300	0.0215 *	0.0390	-0.1310 ***	0.0440
Other	-0.1203 ***	0.0390	-0.1010 ***	0.0460	-0.2372 ***	0.0630
Manufacturing	Ref.		Ref.		Ref.	
H2020 pillar						
Excellent science + other			0.0763 *	0.0510		
Industrial leadership			-0.0943 ***	0.0300		
Societal challenges	Ref.		Ref.		Ref.	
FP7 participation	-0.0021	0.0270	0.0103	0.0340	-0.0276	0.0350
Intercept	5.3073 ***	0.0630	5.2903 ***	0.0770	5.5582 ***	0.0990
Adj. R^2		0.0220		0.0330		0.0470
F-statistic		3.4290		3.1650		2.6330
Prob. (F-statistic)		0.0000		0.0000		0.0008
AIC		1952		1446		339
BIC		2038		1436		406
No. SMEs		1593		1096		497

Notes: ***p < 0.01, **p < 0.05, *p < 0.1. JSC: joint-stock company; LLC: limited liability company; I&C: information and communication; PS&T: professional, scientific and technical.

Source: Author's calculation.

and multi-project participation. The three GLS models presented in Table 2 provide detailed insights into how firm age influences funding efficiency (measured as contribution per project) under different levels of Horizon 2020 participation.

Model 1 provides a general overview of how firm age influences funding efficiency. On average, younger firms are more efficient in securing and utilising funding compared to older firms. The positive effect increases with firm age up to 16-25 years, suggesting that moderately

experienced firms benefit the most from Horizon 2020 funding. The result contradicts the traditional view that older firms have an advantage due to accumulated experience – younger and mid-aged firms appear to perform better in securing and using funding. Model 2 isolates the impact of firm age on funding efficiency when the complexity of multi-project management is not a factor. The coefficients for age are higher in Model 2 compared to Model 1 – younger firms (especially those aged 1-5 years) achieve the highest funding efficiency when participating in a single project, suggesting that younger firms benefit from the focus and lower complexity of single-project engagement. This supports the idea that younger firms have a strategic advantage when they are not burdened by the complexity of managing multiple projects. The increase in the size of the coefficients compared to Model 1 confirms that younger firms capitalise more effectively on single-project participation due to their innovative flexibility and agility.

Model 3 represents a setting where firms face greater complexity and administrative demands. All negative coefficients signal that younger firms perform worse than older firms when participating in multiple projects. The strongest negative effect is for the youngest firms (1-5 years), suggesting that younger firms face the greatest challenges in managing the complexity and operational burden of multiple projects. This reflects the "liability of newness", i.e. while younger firms are flexible and innovative, they struggle with administrative and managerial demands when participating in multiple projects.

While the focus of this analysis is on age, the models reveal additional insights regarding other control variables. Sectoral patterns reflect similar changes to those associated with age differences. For SMEs participating in one project, sectors like I&C services and PS&T activities exhibit significant positive effects on contribution per project. However, in multi-project participation, the positive effects for both sectors decline significantly and turn negative. SMEs in knowledge-intensive sectors like I&C services and PS&T activities perform strongly when engaged in single projects. The increased complexity and administrative burden associated with multiple projects may outweigh the advantages of specialised expertise and innovative capacity in these sectors.

Larger SMEs benefit from greater organisational capacity, better access to networks, and established processes that enable them to absorb and manage larger funding amounts efficiently. Micro SMEs, on the other hand, face substantial resource constraints that limit their absorptive capacity. SMEs located in the northwest appear to benefit from better infrastructure, innovation ecosystems and institutional support, which are critical for absorbing Horizon 2020 funding. Regional disparities highlight the need for targeted policies to improve funding outcomes in less competitive areas. While LLCs dominate the SME landscape, their contribution per project is lower, particularly in the single-project group. This may reflect structural inefficiencies or reduced flexibility compared to other legal forms when managing Horizon 2020 funds.

The inclusion of Horizon 2020 pillars in Model 2 provides critical insights. The positive association with Horizon 2020 pillars "excellent science" highlights the value of fundamental research and knowledge generation projects. The negative effect for "industrial leadership" may reflect the higher competition or resource-intensive nature of such projects, reducing the per-project contribution efficiency. Across all models, FP7 participation does not appear to significantly influence the contribution per project, as evidenced by small and statistically insignificant coefficients. Prior participation in FP7 does not automatically translate into better funding absorption under Horizon 2020.

Conclusions

Despite the quantitative success of Horizon 2020 in involving SMEs, achieving high-quality and sustainable SME participation remains a significant challenge. Structural barriers, particularly for young firms, continue to limit the effectiveness of public R&D funding in fully realising its innovation potential (Simonelli, 2016).

This study investigated the role of firm age in shaping funding efficiency among Italian SMEs participating in Horizon 2020, introducing a project-level metric, i.e. average contribution per project, to assess absorptive capacity and engagement outcomes. Unlike prior research focused mainly on total funding levels (Børing et al., 2020; Heimonen, 2012; Hussinger, 2008), this approach provides a more granular understanding of how firm-level characteristics influence funding utilisation.

The empirical analysis, based on GLS models, confirms that firm age affects funding efficiency in distinct ways depending on the complexity of participation. Younger firms demonstrate higher efficiency in single-project contexts, underscoring their agility and innovation focus. However, their performance declines in multi-project settings, where older firms – benefiting from experience, established routines and stronger administrative capacity – outperform younger counterparts. These findings highlight a structural tension: while young SMEs are key drivers of innovation, they often lack the institutional maturity needed to sustain engagement across multiple projects.

As Veugelers et al. (2015) argue, a comprehensive innovation policy must go beyond funding targets to address deeply rooted barriers faced by young, high-R&D-intensity firms. These barriers include limited access to early-stage financing, underdeveloped risk capital markets and administrative burdens that hinder long-term participation. The evidence of lower funding efficiency among young firms in complex project settings reinforces the case for targeted early-stage support mechanisms, such as dedicated grant schemes and mentoring networks.

Policy implications are clear. Enhancing access to tailored financial and managerial support for younger SMEs could improve their capacity to participate in and benefit from multi-project engagements. Facilitating inter-firm knowledge transfer – especially between younger and older SMEs – may also help younger firms build internal capabilities and increase their absorptive capacity. Addressing regional disparities, particularly in structurally weaker areas such as the islands, is equally critical to ensuring equitable access and utilisation of EU R&D resources (Veugelers et al., 2015). Furthermore, aligning public funding with private investment incentives (Veugelers, 2008) can strengthen the overall impact and sustainability of EU innovation programmes.

Ultimately, this study highlights the dual role of firm age: younger SMEs contribute agility and innovation potential but require support to manage the complexity of sustained R&D engagement; older SMEs are better positioned to scale and manage complex participation due to accumulated capacity. Recognising and addressing these age-related dynamics is essential for designing more effective and inclusive innovation policies under future European framework programmes.

References

Abreu, R., Antunes, J., Escada, M., Pádua, M., & Teresa, M. (2023, September). R&D Cooperation and Innovation Networks: Lessons From SME Participation in H2020. In *ECKM 2023 24th European Conference on Knowledge Management* (Vol 1). Academic Conferences and publishing limited.

Aerts, K., & Schmidt, T. (2008). Two for the price of one?: Additionality effects of R&D subsidies: A comparison between Flanders and Germany. *Research policy*, *37*(5), 806–822.

Almus, M., & Czarnitzki, D. (2003). The effects of public R&D subsidies on firms' innovation activities: the case of Eastern Germany. *Journal of Business & Economic Statistics*, *21*(2), 226–236.

Åström, T., Jansson, T., Melin, G., Håkansson, A., Boekholt, P., & Arnold, E. (2012). *On motives for participation in the Framework Programme*. Technopolis Group.

Åström, T., Brown, N., Mahieu, B., Håkansson, A., Varnai, P., & Arnold, E. (2017). *Norwegian participation in Horizon 2020 in health, ICT and industry: A study on the potential for increased participation*. Technopolis Group.

Autio, E., Sapienza, H. J., & Almeida, J. G. (2000). Effects of age at entry, knowledge intensity, and imitability on international growth. *Academy of management journal*, *43*(5), 909–924.

Basosi, R., Ceracchi, M., D'Amore, F., Finardi, G., Masulli, M., Pocaterra, C. (2021). *L'impatto della partecipazione al programma horizon 2020 sulle imprese italiane: un'analisi per il settore energia*. Zenodo.

Bērziņa, D. (2020, April). Baltic-Nordic Universities in the EU Research and Innovation Programme Horizon 2020. In *6th International Conference on Higher Education Advances (HEAd'20)* (No. 30-05-2020, pp. 255–263). Editorial Universitat Politècnica de València.

Børing, P., Fevolden, A. M., Mark, M. S., & Piro, F. N. (2020). Bringing home the bacon: the relationship between firm characteristics and participation in EU Horizon 2020 projects. *Applied Economics Letters*, *27*(19), 1556–1561.

Bralić, A. (2017). Social network analysis of country participation in Horizon 2020 Programme. In *Central European Conference on Information and Intelligent Systems* (pp. 285–291). Faculty of Organization and Informatics Varazdin.

Bronzini, R., & Piselli, P. (2016). The impact of R&D subsidies on firm innovation. *Research Policy*, *45*(2), 442–457.

Busom, I., & Fernández-Ribas, A. (2008). The impact of firm participation in R&D programmes on R&D partnerships. *Research policy*, *37*(2), 240–257.

Callejon, M., & García-Quevedo, J. (2005). Public subsidies to business R&D: do they stimulate private expenditures?. *Environment and Planning C: Government and Policy*, *23*(2), 279–293.

Catozzella, A., & Vivarelli, M. (2011). Beyond additionality: Are innovation subsidies counterproductive? IZA Discussion Paper No. 5746. Institute for the Study of Labor (IZA).

Cerulli, G., & Poti, B. (2008). *Evaluating the effect of public subsidies of Firm R & D activity: An application to Italy using the community innovation survey*. Rome, Italy: Ceris-CNR.

Cerulli, G., & Poti, B. (2012). Evaluating the robustness of the effect of public subsidies on firms' R&D: an application to Italy. *Journal of Applied Economics*, *15*(2), 287–320.

Coad, A., Holm, J. R., Krafft, J., & Quatraro, F. (2018). Firm age and performance. *Journal of Evolutionary Economics*, *28*(1), 1–11.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative science quarterly*, *35*(1), 128–152.

Čučković, N., & Vučković, V. (2021). The effects of EU R&I funding on SME innovation and business performance in new EU member states: Firm-level evidence. *Economic Annals*, *66*(228), 7–42.

Czarnitzki, D., & Lopes-Bento, C. (2014). Innovation subsidies: Does the funding source matter for innovation intensity and performance? *Empirical evidence from Germany. Industry and Innovation*, *21*(5), 380–409.

Di Minin, A., De Marco, C. E., & Karaulova, M. (2016). SME Instrument–so far so good. *Berkeley Roundtable on the International Economy*, (4).

Enger, S. G. (2018). Closed clubs: Network centrality and participation in Horizon 2020. *Science and Public Policy*, *45*(6), 884–896.

Enger, S. G., & Castellacci, F. (2016). Who gets Horizon 2020 research grants? Propensity to apply and probability to succeed in a two-step analysis. *Scientometrics*, *109*, 1611–1638.

European Commission: Directorate-General for Research and Innovation. (2024). *European Innovation Scoreboard 2024*. Publications Office of the European Union.

Ferrer-Serrano, M., Latorre-Martínez, M. P., & Fuentelsaz, L. (2021). The European research landscape under the Horizon 2020 Lenses: The interaction between science centers, public institutions, and industry. *The Journal of Technology Transfer*, *46*(3), 828–853.

Folea, V. (2017). EU Funding for Research and Innovation Actions in Horizon 2020. *Global Economic Observer*, *5*(2), 23–30.

Foreman-Peck, J. (2013). Effectiveness and efficiency of SME innovation policy. *Small Business Economics*, *41*, 55–70.

Gallo, F., Seniori Costantini, A., Puglisi, M. T., & Barton, N. (2021). Biomedical and health research: an analysis of country participation and research fields in the EU's Horizon 2020. *European journal of epidemiology*, *36*(12), 1209–1217.

Garcia, A., & Mohnen, P. (2010). Impact of government support on R&D and innovation. UNU-MERIT, Maastricht Economic and Social Research and Training Centre on Innovation and Technology. *UNU-MERIT Working Papers*, No. 034.

González, X., & Pazó, C. (2008). Do public subsidies stimulate private R&D spending?. *Research Policy*, *37*(3), 371–389.
Gussoni, M., & Mangani, A. (2010). R&D cooperation, appropriability and public funding: an empirical investigation. *Research Policy*, *39*(10), 1451–1462.
Hanel, P. (2008). *Productivity and innovation: an overview of the issues*. Centre interuniversitaire de recherche sur la science et la technologie.
Hashi, I., & Stojčić, N. (2013). The impact of innovation activities on firm performance using a multi-stage model: Evidence from the Community Innovation Survey 4. *Research Policy*, *42*(2), 353–366.
Heimonen, T. (2012). What are the factors that affect innovation in growing SMEs? *European Journal of Innovation Management*, *15*(1), 122–144.
Hussinger, K. (2008). R&D and subsidies at the firm level: An application of parametric and semiparametric two-step selection models. *Journal of applied econometrics*, *23*(6), 729–747.
Kalisz, D. E., & Aluchna, M. (2012). Research and innovation redefined. Perspectives on the European union initiatives on horizon 2020. *European integration studies*, (6).
Kim, J., & Yoo, J. (2019). Science and technology policy research in the EU: from Framework Programme to HORIZON 2020. *Social Sciences*, *8*(5), 153.
Mabenge, B. K., Ngorora-Madzimure, G. P. K., & Makanyeza, C. (2022). Dimensions of innovation and their effects on the performance of small and medium enterprises: The moderating role of firm's age and size. *Journal of Small Business & Entrepreneurship*, *34*(6), 684–708.
Mulier, K., & Samarin, I. (2021). Sector heterogeneity and dynamic effects of innovation subsidies: Evidence from Horizon 2020. *Research Policy*, *50*(10), 104346.
Mulligan, K., Lenihan, H., & Doran, J. (2019). More subsidies, more innovation? Evaluating whether a mix of subsidies from regional, national and EU sources crowds out firm-level innovation. *Regional Studies, Regional Science*, *6*(1), 130–138.
Murea, M. M. (2013). Towards what Horizon is EU headed by 2020?. An overview of the new EU financial program. *Romanian Economic Journal*, *16*, 50.
Piątkowski, M. (2020). Implementation of innovations in enterprises using the EU funds: A comparative analysis. *Journal of International Studies*, *13*(2), 109–126.
Puukka, J. (2018). *Spreading excellence & widening participation in Horizon 2020. Analysis of FP Participation Patterns and Research and Innovation Performance of Eligible Countries*.
Sekerci, D., & Alp, S. (2023). Investigation of European Union Horizon 2020 information and communication technology projects with the social network analysis method. *Engineering, technology & applied science research*, *13*(4), 11182–11190.
Simonelli, F. (2016). *Is Horizon 2020 Really More SME-friendly?: A Look at the Figures*. Centre for European Policy Studies.
Sørensen, J. B., & Stuart, T. E. (2000). Aging, obsolescence, and organizational innovation. *Administrative science quarterly*, *45*(1), 81–112.
Spithoven, A., Clarysse, B., & Knockaert, M. (2011). Building absorptive capacity to organise inbound open innovation in traditional industries. *Technovation*, *31*(1), 10–21.
Tenhunen-Lunkka, A., & Honkanen, R. (2024). Project coordination success factors in European Union-funded research, development and innovation projects under the Horizon 2020 and Horizon Europe programmes. *Journal of Innovation and Entrepreneurship*, *13*(1), 7.
Veugelers, R. (2008). The role of SMEs in innovation in the EU: A case for policy intervention. *Review of business and economics*, *53*(3), 239–262.
Veugelers, R., Cincera, M., Frietsch, R., Leijten, J., Montalvo, C., Pelle, A., Rammer, C., Renda, A., & Schubert, T. (2015). The impact of horizon 2020 on innovation in Europe. *Intereconomics*, *50*(1), 4–30.
Vidmar, U., & Vukasović, T. (2019). A model for a successful approach to applying for Horizon 2020. *International Journal of Value Chain Management*, *10*(1), 26–52.
Wanzenböck, I., Lata, R., & Ince, D. (2020). Proposal success in Horizon 2020: A study of the influence of consortium characteristics. *Quantitative Science Studies*, *1*(3), 1136–1158.