ICIEMC 2021
International Conference on Innovation and Entrepreneurship in Marketing and Consumer Behavior
July 1 - 2, Aveiro, Portugal (virtual format)

The role of Open Innovation and University-Industry Collaboration in the Pandemic- driven Changes in Businesses

Pedro Freire[1] (pedro.freire@ua.pt) & Joana Costa[1,2] (joanacosta@ua.pt)

[1] Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), University of Aveiro; [2] Research Unit on Governance, Competitiveness and Public Policies (GOVCOPP)

Abstract

This research aims at exploring the relationship between open innovation and university-collaboration (UIC) in promoting a growth in firm performance (turnover). As the covid-19 is a public health emergency and hit very hard on the world economies, conducting firms to deep downturns due to drastic change in socioeconomic life of people. We analyse the direct effect of inbound open innovation as well university-industry absolute number of contacts on turnover growth, as a cluster for the financial recovery of companies. We test our hypotheses on a sample of 878 Portuguese companies that previous respond to an open innovation survey and conducting a multi-nominal regression. The results show the moderating effects of inbound, UIC through contacts and hiring graduates' employees.

Keywords: open Innovation, university-industry collaboration, firm performance, covid-19

1. INTRODUCTION

The world is facing the biggest challenge of the decade, with the coronavirus disease 2019 (Covid-19) that rapidly became a global pandemic (Im, Kim, & Choeh, 2021). The covid-19 has crippled the economy with impact in many economic sectors (Nurhayati, Endri, Aminda, & Muniroh, 2021), even with government intervention with the awareness, information, and prevention on the battle against the virus, lead to precautionary measures and lockdowns (Im et al., 2021; Khan, Niazi, Nasir, Hussain, & Khan, 2021). This measure led to an uncertainty period influencing the threat of unemployment, fear of a job loss and financial instability that even the fear of losing their ongoing jobs was higher than the fear of being infected, peoples' lifestyle was heavily impacted on their health, social and financial condition (Im et al., 2021; Khan et al., 2021). Drastic changes in socioeconomic life of the community, conduct to a contraction of the market supply and demand, guide to industries have experienced deep downturns (Donthu & Gustafsson, 2020), with several companies suffered a heavy blow in their financial aspects, with many businesses failed to survive due to the economic pressure posed by the pandemic (Khan et al., 2021).

The effects of the covid-19 have led to a major recession in the world's economies, due not only the economic perspective, but of the society with dramatic changes in business acts and consumer behaviours (Cullen, Gulati, & Kelly, 2020). The surviving industry faces hard challenges and implement innovative business models as solution, despite some reported downsides and other cost-cutting mechanisms (Khan et al., 2021). But innovation will have an important role in the recovery from the aftermath of the covid-19 (H. Chesbrough, 2020).

Innovation has already been involved in the pandemic war, in the hospitality industry, with the technological innovation and risk reduction strategies (Shin & Kang, 2020), the mobilization of scientist, pharmaceutical companies and the government launching scientific initiatives to response to the virus, with the share of datasets through scientific and research in open platforms around the world (H. Chesbrough, 2020).

These developments are settled in the open innovation theory. The openness unleashes collaborative networks, around the globe, leveraging human capital knowledge to tackle the disease, as raising funds to the health system (H. Chesbrough, 2020). The open innovation practices will allow to rapid absorption of the science, "distributing and involving the purpose knowledge flows across organizational boundaries for monetary or non-monetary reasons" (Bogers, Chesbrough, & Moedas, 2018), so this practicing not only will response to the virus, but as the development of technology and widespread experimentation that may undergirds many businesses(H. Chesbrough, 2020) will possibly help in a financial recovery. As open innovation has demonstrated their positive impact over the financial performance (Caputo, Lamberti, Cammarano, & Michelino, 2016; Moretti & Biancardi, 2020) across different industries and sectors, and with firm-level analysis of the real effect of the virus is scares, represents a data limitation, so we represent the Portuguese reality before the pandemic and the significant of open innovation adoption increase can lead a recover of the firms in the long-term (Fu, Liu, & Zhou, 2019).

The growth of collaboration between organizations, stakeholders, NGOS, universities and individuals, represents a big advance to virus response. There are incentives encourage the collaboration between university and industry, in releasing portions of their intellectual property, as the "providing of access to critical scientific information in return to compulsory licensing for essential information"(H. W. Chesbrough, 2006). Demonstrated in the following section the positive significance of this collaborations to the firm level.

In detail, the empirical model was built with the objective of investigating the relationship of the first level of openness that is inbound (outside-in) in the firm performance (the growth of the medium turnover between 2015 and 2019), as a financial recovery driver to the firms and the role of the university-industry collaboration in the knowledge, project share, as a cost and time reduction into a better monetary performance.

2. METHODOLOGY

This empirical study was conducted using two main sources of data to collected in-formation relatively to Portuguese openness of the firm and their financial information.

The first database was a survey conducted by four students and two professors, that initial was proposed to Portuguese firms with more than 10 employees and focused more on manufacturing firms and knowledge intensive business firms where R&D is more present. The survey was a pioneer project to understand Portuguese firms' openness, R&D investment, and links with universities that received 910 answers, with a 3% response ratio, and after analysis reduce to 908.

The second main source of data was extracted from SABI, database of Bureau van Dijk, which contemplates financial and organizational information from companies of Spain and Portugal. The data collected from this database, was mostly financial data relatively to the balance sheet, income statement and the number of employees from the firms that answer the initial survey, from 2015 until 2019.

The sample of the survey answers was reduced to 878 companies, because of the missing financial data on SABI database through more than 3 years of analysis and firms with missing years were filled using moving averages, to guarantee the robustness and validity of the statistical procedures as well econometric estimations. Needs to be acknowledge the randomness of sample and the difficult to conduct a cross-sectional study through different sectorial and territorial representatives.

The following tables represents the variables descriptions used to measure the multinomial regressions, with the turnover being the financial degree, the independent variables inbound measuring the openness of the firms and the UIC and education intensity, measuring the number collaborations with universities, as the percentage number of hired staff from the academia. We control for a set of firms characteristics such size, age and the technological regime followed by Bogliacino (2016). Table 2, presents the descriptive data and the correlation table of the variables.

Table 1 – Variable Description

Variables	Description	Measurement
Ln_turnover	Logarithm of medium turnover of 5 years	logarithm of turnover
Inbound	Performing Inbound innovation	binary
UIC	Overall number of contacts with universities	number
Edu_intensity	% of undergraduates over total staff	decimal
Size	Nº of employees	1 = micro; 2 = small; 3 = medium; 4 = large.
Age	Age	absolute figure
Tech_Reg	Technological regime of the firm (according to Boliacino and Pianta)(2016)	1 = supplier dominated; 2 = scale intensive; 3 = specialized supplier; 4 = science based

Table 2 – Descriptive and correlations

Variables	Mean	Std.dev	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Ln_turnover	7.458	1.507	4.580	14.720	1						
(2) Inbound	0.408	0.492	0	1	0.296 **	1					
(3) UIC	12.368	65.698	0	1680	0.242 **	0.160 **	1				
(4) Edu_intensity	0.292	0.305	0	1	0.004	0.169 **	0.112 **	1			
(5) Size	2.227	0.621	1	4	0.730 **	0.190 **	0.180 **	-0.048	1		
(6) Age	22.608	15.464	2	126	0.414 **	0.070 *	0.029	-0.183 **	0.321 **	1	
(7) Tech_Reg	2.166	1.156	1	4	-0.052	0.047	0.109 **	0.445 **	-0.062	-0.187 **	1

****. p < 0.01 (2 tailed); *. p < 0.05 (2 tailed)**

3. LITERATURE REVIEW

3.1. OPEN INNOVATION AND FIRM PERFORMANCE

Chesbrough (2003) introduced open innovation, reformulating how research and development (R&D) in innovation was idealize at that time. With globalization, useful knowledge and ideas had become widespread, so a logic that embrace external ideas and knowledge flows in conjunction with the internal R&D, was introduce as introduce (H. W. Chesbrough, 2003).

The initial traditional vertical integration model, compose by a self-reliance internal R&D lead to internally develop products and services that were distribute by the firm (H. W. Chesbrough, 2006) and the so the profits could be reinvested conducting more R&D (H. W. Chesbrough, 2003).

Open innovation is a paradigm that assumes the combination of both internal and external ideas, internal and external pathways, to the innovation process (Bogers et al., 2018; H. W. Chesbrough, 2003; West, Salter, Vanhaverbeke, & Chesbrough, 2014).The boundaries between firm and its surrounding environment are porous (H. W. Chesbrough, 2003) so technology can enter the process at various stage and projects can be commercialized throughout licensing, technological spin-offs or even the firm market(Bogers et al., 2018; H. W. Chesbrough, 2006).

The process of open innovation has evolved with the definition of this flows, to inbound, outbound, or coupled(Bogers et al., 2018). Inbound is refers to the search and absorptive capacity to explore external knowledge sources, to complement and strengthen in-house R&D (de Jong, Kalvet, & Vanhaverbeke, 2010). Outbound refers the commercialisation of internal innovations that are not used on the innovation process (Stanislawski, 2020) and coupled to the used of both strategies.

Open innovation 2.0 is launched, with the integration of the quadruple helix where government, industry, academia, and civil participants work together with a shared vision and share valued is created(Curley & Salmelin, 2013). The new model based now on the networking and collaboration along all value chain, creating added value to the innovation ecosystem of the helix(Curley & Salmelin, 2013).

Studies have tried to address the relationship between openness and firm financial performance (Bigliardi, Ferraro, Filippelli, & Galati, 2020; Caputo et al., 2016; Chabbouh & Boujelbene, 2020; Greco, Grimaldi, & Cricelli, 2016; Hung & Chou, 2013; Kim & Kim, 2018; Moretti & Biancardi, 2020). Moretti(2020) shows that both the development of internal R&D, as acquisition are positively and significant correlated with firm turnover, while Caputo (2016) finds sales growth a positive trend with the respect to openness, but operating profit und turnover decrease with open innovation adoption.

The outsourcing for commercialisation also finds a probability to a sales growth, as outsourcing reduces costs and time (Kim & Kim, 2018). Hung (2013) also finds external technological acquisition and external technological exploitation positively related to firm performance (sales). A study that analyses the use of inbound and outbound directions in the long term, finds that enterprises should maintain reasonable inbound levels of inbound to achieve long-term performance maximisation, as the outbound finds a negative effect on firm performance in the short term, but in the long term the higher the level, better the performance, because the outflow requires time and is financial costly in the short-term(Fu et al., 2019). These findings suggest that open innovation and special inbound helps firm performance in the short-term and facing the uncertain of the future, this strategy can be a cluster to the growth in the firm financial performance.

Hypothesis (H1). Open Innovation enhances business performance.

3.2. UNIVERSITIES – INDUSTRY COLLABORATION (UIC)

University research plays an important role in industrial innovation and an engine of knowledge production promoting technological pushes (Costa, Neves, & Reis, 2021). The interaction between universities, industry and technologies have been existing for a long time, as the scientific literature and contacts with academia been showed a direct supportive role, by advising solutions, specialist information and “translating” relevant information (Perkmann & Walsh, 2009). However, the establishment of persistence of this relationship and partnerships between university and industry, have shown little evidence how this correspondence might take place (Person & Rosenbaum, 2006).

The traditional role of the universities is education, as essential in the human capital development and industry hiring graduate students (Perkmann et al., 2013). As the academia boast the appropriate physical facilities and staff expertise to make scientific discoveries and technological breakthroughs, the outcomes of this research must take into applications with economic and social repercussion belief besides production and transmission (Berbegal-Mirabent, Sánchez García, & Ribeiro-Soriano, 2015).

The academia faces the duality of basic projects that generates more academia output, but leaves less cross-boundary learning opportunities, as the industry find less relevant, or the applied projects is hampered by secrecy and complementary problems, but that offer more learning opportunities during highly interdependent interactions with industry (Perkmann & Walsh, 2009). The channel that attracted major attention has been the commercialisation of the academic knowledge, from patenting, licensing inventions, as the academic entrepreneurship (establishing incubators, science parks, etc), to generate an academic impact on the market (Perkmann et al., 2013).

The entrepreneurial academia perfectly finds the combine between science and commerce (Perkmann & Walsh, 2009), for facilitating the transfer of knowledge with industry, where the relationships are more pro-active, involved with the local community, benefiting a collaborative environment with companies where

work is complementary, generating win-win situation (Berbegal-Mirabent et al., 2015) and promoting possible spin-off to the local actors (Costa et al., 2021; Perkmann & Walsh, 2009). The academic entrepreneurship also benefits for faculty, who can secure more research funding for academic projects and stability of the research labs, for continuously develop(Ranga & Etzkowitz, 2013). The linkage between the triple-helix, benefits from the continuous different institutional strategies, for the exploitation of the technological knowledge or innovation (Costa et al., 2021). The intensity of this collaborations is dependent on the attractivity academia research interests, the resources available and the interest of the commercialization of the university (D'Este & Patel, 2007). Some suggest the U-shape relationship between the size of the university department and the volume of interactions with medium-size companies (D'Este & Patel, 2007).

The increase interaction between universities and industry, have been in an increasing away through legislative forms, through governmental initiatives or public-private partnerships, as political pressure, to pressure universities to help businesses and so improve the national economic competitiveness(Costa et al., 2021). The collaborations between universities and industry are fundamental for the national innovation system and such collaboration are important into build a long-term inter-organizational network to guarantee persistence innovation, leading to firm resilience and a cluster to face uncertain economic period (Costa, Teixeira, & Botelho, 2020).

H2. University-industry collaboration enhance the firm financial performance.

4. EMPIRICAL COMPONENT

The following econometric analysis aimed empirically test the validity of the hypotheses theoretically constructed. In order to appraise the determinants of the business performance for innovation and links with university a multinominal model was run being presented in the following table 3.

It encompasses the logarithm of the medium value of the total turnover during 2015 until 2019. The model analyses the importance of UIC and OI in firm performance, as clusters for its growth. Table 3, presents the multinominal regression with evidence of the impact of an exogenous change in the predictors of performance.

Table 3 – Econometric Estimation – Financial performance

Variables	Ln_Turnover
Inbound	0.434*** (0.068)
UIC	0.002*** (0.001)
Edu_intensity	0.200* (0.12)
Size	1.506*** (0.056)
Age	0.020*** (0.002)

Variables	Ln_Turnover
Tech_Reg	-0.012 (0.031)
Constant	3.411*** (0.141)
Observations	877
R-squared	0.605

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The present estimation includes explanatory variables inbound innovation and universities collaborations, both play a positive impact in the growth of the firms' turnover. When adopting inbound practices from open innovation, firms' turnover growths in medium and approximately 1.5 thousand of euros, and when establishing a contact with universities to a firm's turnover growth in medium and approximately in 1 thousand euros.

All other predictors also appear with a positive and significant impact, except for the technological regimes, leveraging the business performance; being "size" the one that represent a higher impact on the firm's growth turnover. Also, the education of the human capital being at least undergraduate, reinforce the importance of the education to improve business performance by 1.2 thousand euros (but only significant at p>0,10).

5. Discussion

Since integration of the quadruple-helix in open innovation, the importance of establish networks, that allows multi-directional flows of knowledge are showing increasing in rechanging business models.

Open innovation studies that focus on the impact inbound and outbound strategies have shown positive impact in firm performance (Moretti & Biancardi, 2020; Wang, Chang, & Shen, 2015). SMEs have shown to be pivotal in the innovation systems (H. W. Chesbrough, 2006) and the inbound practices to enrich their internal development from sources along their value chain into driving lower costs development, lower risks, and faster time-to-market (2-2.3). In line with other studies inbound practices have shown a positive and very significant relation with the growth in the firm turnover (Moretti & Biancardi, 2020), representing the Portuguese firm absorptive capacity in their innovation activities.

This finding support H1 reviling the inbound open innovation to enhance firm performance.

Regardless of the UIC literature the knowledge emerging from universities to the industries can be from the form of the education and the hiring of graduate to their companies and have shown a positive but only at 10% significance that reveals the importance of education in firm performance. The connection with the academia can be addressed in different forms, but all shows a positive effect over firm performance. Establishing more complex relations also raise performance and has expected the intensity of contacts shows a positive and significant impact in the total turnover (Costa et al., 2021).

This result evidence a support to H2 withstanding the importance of the UIC in the firm performance.

The control variables reveal impressive results, with the notice of the size variable that appears with the most positive relation with the growth in the firm turnover, this may be due to higher developed firms already have a strong internal R&D and are more capable of producing leverage in the innovation process and consequence the growth in the turnover. The analyses of the age variable appear positive and significant relating the possibility of a more compound value chain, business operations and network during the aging of the

companies relating to the positive impact on firm performance. In this model the technological regimes appear insignificant.

6. CONCLUSIONS

As covid-19 harmed the world and corporate performance. The uncertainty growing in towards the future recover of the firms is very important as the pandemic had a negative impact on the production, operation, and sales of industries, decreasing turnover and revenue (Hu & Zhang, 2021).

Innovation always have been a determinant on firm capacity to be resilient in the long-term and to find ways to improve their business with the regard of financial indicators, as the corresponding pressure from stakeholders in adopting sustainable practices. At the present living conditions the need of firms to recover from the financial stress situations, brings the importance of the open innovation paradigm and the use of the quadruple-helix as enhancer for firm performance.

The open innovation paradigm reveals the importance of boundary-spanning activities in the research and providing external knowledge collaboration in the internal development, strengthen the in-house innovation practices and processes(Wang et al., 2015). Firms must take concerted efforts to build and refine relationships between their external knowledge sources with the innovation outcome, so the importance of refine their absorptive capacity is pivotal, to tackle expensive efforts. The positive results concerning inbound practices reveals the direction that SMEs must adopt, and as previous study finds relating a longitudinal approach of open innovation and firm performance, revealing a U-shape relationship, enterprises should maintain relations with its value chain in order to achieve a long-term maximisation (Fu et al., 2019), so negative short-term can be expected as open innovation must be seen as long-term strategy and the use of outflows or coupled must be also be taken into consideration.

The relationship between all players from the quadruple helix is very important so the innovation ecosystem be viable. Relating the academia, their role has been proved important not only through the collaborative activities that enhance R&D processes efficiency, but also as knowledge provider source enabling firm to apply to their market request, as front-edge information, and universities can have a closer encounter with the industry. The methods analysed in the model reveal the significance of the hiring from educational university staff to obtain increase financial results, as the collaborations established between universities and industry reveals a positive significance allowing firm to minimize their internal R&D efforts obtaining transfer of knowledge. The type of the link established between both must be analysed in order that collaborative mechanism is been correctly apply(Howells, Ramlogan, & Cheng, 2012) and the diversification of collaborative multi-university links is not considered but reveals to be significant (Costa et al., 2021) and future research must take this into account.

In the role of other agent of the helix the government should encourage the practices of the open innovation, concerning the entrepreneurial university as a cluster for innovation outcome and the incentives to the establish of the UIC and support the negative short-term results in order that in the future the economic competitiveness is stronger and resilient.

The present study faces the limitation a longitudinal data approach, as the cross-sectional analyse concerning open innovation is steal in developing so other financial performance indicators must be taken into account in future research.

BIBLIOGRAPHICAL REFERENCES

Berbegal-Mirabent, J., Sánchez García, J. L., & Ribeiro-Soriano, D. E. (2015). University-industry partnerships for the provision of R&D services. *Journal of Business Research*, *68*(7), 1407–1413. https://doi.org/10.1016/j.jbusres.2015.01.023

Bigliardi, B., Ferraro, G., Filippelli, S., & Galati, F. (2020). The influence of open innovation on firm performance. *International Journal of Engineering Business Management*, *12*, 1–14. https://doi.org/10.1177/1847979020969545

Bogers, M., Chesbrough, H., & Moedas, C. (2018). Open innovation: Research, practices, and policies. *California Management Review*, *60*(2), 5–16. https://doi.org/10.1177/0008125617745086

Bogliacino, F., & Pianta, M. (2016). The Pavitt Taxonomy, revisited: patterns of innovation in manufacturing and services. *Economia Politica*, *33*(2), 153–180. https://doi.org/10.1007/s40888-016-0035-1

Caputo, M., Lamberti, E., Cammarano, A., & Michelino, F. (2016). Exploring the impact of open innovation on firm performances. *Management Decision*, *54*(7), 1788–1812. https://doi.org/10.1108/MD-02-2015-0052

Chabbouh, H., & Boujelbene, Y. (2020). Open innovation in SMEs: The mediating role between human capital and firm performance. *Journal of High Technology Management Research*, *31*(2). https://doi.org/10.1016/j.hitech.2020.100391

Chesbrough, H. (2020). To recover faster from Covid-19, open up: Managerial implications from an open innovation perspective. *Industrial Marketing Management*, *88*(April), 410–413. https://doi.org/10.1016/j.indmarman.2020.04.010

Chesbrough, H. W. (2003). The Era of Open Innovation. *MIT Sloan Management Review*, 35–42.

Chesbrough, H. W. (2006). Open Innovation: A new paradigm for understading Industrial Innovation. In *Oxford University Press Oxford*: *Vol. Open Innov* (p. Chapter 1). Retrieved from http://www.doaj.org/doaj?func=openurl&issn=20086520&genre=journal&uiLanguage=en

Costa, J., Neves, A. R., & Reis, J. (2021). Two Sides of the Same Coin. University-Industry Collaboration and Open Innovation as Enhancers of Firm Performance. *Sustainability*, *13*(7), 3866. https://doi.org/10.3390/su13073866

Costa, J., Teixeira, A. A. C., & Botelho, A. (2020). Persistence in innovation and innovative behavior in unstable environments. *International Journal of Systematic Innovation*, *6*(1), 1–19.

Cullen, W., Gulati, G., & Kelly, B. D. (2020). Mental health in the COVID-19 pandemic. *Qjm*, *113*(5), 311–312. https://doi.org/10.1093/QJMED/HCAA110

Curley, M., & Salmelin, B. (2013). Open Innovation 2.0: A New Paradigm. *OISPG White Paper*, 1–12.

D'Este, P., & Patel, P. (2007). University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry? *Research Policy*, *36*(9), 1295–1313. https://doi.org/10.1016/j.respol.2007.05.002

de Jong, J. P. J., Kalvet, T., & Vanhaverbeke, W. (2010). Exploring a theoretical framework to structure the public policy implications of open innovation. *Technology Analysis and Strategic Management*, *22*(8), 877–896. https://doi.org/10.1080/09537325.2010.522771

Donthu, N., & Gustafsson, A. (2020). Effects of COVID-19 on business and research. *Journal of Business Research*, *117*(June), 284–289. https://doi.org/10.1016/j.jbusres.2020.06.008

Fu, L., Liu, Z., & Zhou, Z. (2019). Can open innovation improve firm performance? An investigation of financial information in the biopharmaceutical industry. *Technology Analysis and Strategic Management*, *31*(7), 776–790.

https://doi.org/10.1080/09537325.2018.1554205

Greco, M., Grimaldi, M., & Cricelli, L. (2016). An analysis of the open innovation effect on firm performance. *European Management Journal*, *34*(5), 501–516. https://doi.org/10.1016/j.emj.2016.02.008

Howells, J., Ramlogan, R., & Cheng, S. L. (2012). Innovation and university collaboration: Paradox and complexity within the knowledge economy. *Cambridge Journal of Economics*, *36*(3), 703–721. https://doi.org/10.1093/cje/bes013

Hu, S., & Zhang, Y. (2021). COVID-19 pandemic and firm performance: Cross-country evidence. *International Review of Economics and Finance*, *74*(2020), 365–372. https://doi.org/10.1016/j.iref.2021.03.016

Hung, K. P., & Chou, C. (2013). The impact of open innovation on firm performance: The moderating effects of internal R&D and environmental turbulence. *Technovation*, *33*(10–11), 368–380. https://doi.org/10.1016/j.technovation.2013.06.006

Im, J., Kim, J., & Choeh, J. Y. (2021). COVID-19, social distancing, and risk-averse actions of hospitality and tourism consumers: A case of South Korea. *Journal of Destination Marketing and Management*, *20*(March), 100566. https://doi.org/10.1016/j.jdmm.2021.100566

Khan, K. I., Niazi, A., Nasir, A., Hussain, M., & Khan, M. I. (2021). The effect of COVID-19 on the hospitality industry: The implication for open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(1), 1–17. https://doi.org/10.3390/joitmc7010030

Kim, H., & Kim, E. (2018). How an open innovation strategy for commercialization affects the firm performance of Korean healthcare IT SMEs. *Sustainability (Switzerland)*, *10*(7). https://doi.org/10.3390/su10072476

Moretti, F., & Biancardi, D. (2020). Inbound open innovation and firm performance. *Journal of Innovation and Knowledge*, *5*(1), 1–19. https://doi.org/10.1016/j.jik.2018.03.001

Nurhayati, I., Endri, E., Aminda, R. S., & Muniroh, L. (2021). Impact of covid-19 on performance evaluation large market capitalization stocks and open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(1), 1–16. https://doi.org/10.3390/joitmc7010056

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., … Sobrero, M. (2013). Academic engagement and commercialisation: A review of the literature on university-industry relations. *Research Policy*, *42*(2), 423–442. https://doi.org/10.1016/j.respol.2012.09.007

Perkmann, M., & Walsh, K. (2009). The two faces of collaboration: Impacts of university-industry relations on public research. *Industrial and Corporate Change*, *18*(6), 1033–1065. https://doi.org/10.1093/icc/dtp015

Person, A. E., & Rosenbaum, J. E. (2006). Educational outcomes of labor-market linking and job placement for students at public and private 2-year colleges. *Economics of Education Review*, *25*(4), 412–429. https://doi.org/10.1016/j.econedurev.2005.09.005

Ranga, M., & Etzkowitz, H. (2013). Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society. *Industry and Higher Education*, *27*(4), 237–262. https://doi.org/10.5367/ihe.2013.0165

Shin, H., & Kang, J. (2020). Reducing perceived health risk to attract hotel customers in the COVID-19 pandemic era: Focused on technology innovation for social distancing and cleanliness. *International Journal of Hospitality Management*, *91*(June), 102664. https://doi.org/10.1016/j.ijhm.2020.102664

Stanislawski, R. (2020). Open innovation as a value chain for small and medium-sized enterprises: Determinants of the use of open innovation. *Sustainability (Switzerland)*, *12*(8). https://doi.org/10.3390/SU12083290

Wang, C. H., Chang, C. H., & Shen, G. C. (2015). The effect of inbound open innovation on firm performance: Evidence from

high-tech industry. *Technological Forecasting and Social Change*, *99*, 222–230. https://doi.org/10.1016/j.techfore.2015.07.006

West, J., Salter, A., Vanhaverbeke, W., & Chesbrough, H. (2014). Open innovation: The next decade. *Research Policy*, *43*(5), 805–811. https://doi.org/10.1016/j.respol.2014.03.001