

The Effect of the Covid-19 Pandemic on Economic Growth and R&D Spending in the EU Countries

Iouri Kotorov ^{a, b}, Yuliya Krasyl'nykova ^b, Jaroslav Demel ^{c*},
Petr Blaschke ^c

^a University of Toulouse, Computer Science Research Institute of Toulouse, Toulouse, France

^b North Karelia University of Applied Sciences, Department of International Business, Joensuu, Finland

^c Technical University of Liberec, Faculty of Economics, Department of Marketing and Trade, Liberec, Czech Republic

email: iouri.kotorov@karelia.fi; * jaroslav.demel@tul.cz

Abstract

The article deals with the issue of economic growth and R&D spending in the EU-27 countries during the Covid-19 pandemic. Using time series analysis, the article examines whether the pandemic and the associated restrictive measures and bailout packages have impacted economic growth and R&D funding. To answer this research question, the development of GDP and GERD Eurostat data was taken, and the period of 2011–2021 was analysed. Besides the development of the monitored indicators (GDP, GERD, GERD as a percentage of GDP), the chain index was constructed to compare year-on-year changes and to analyse the growth rate of the indicators further. The research shows that Covid-19 impacted GDP as well as the field of R&D. Talking in absolute numbers, the impact of the pandemic can be seen in the decrease of both GDP and GERD in 2020. However, since the GDP of the EU-27 countries decrease reached 4 % in 2020 while GERD only reduced by 1 % in the same year, the overall effect on the R&D intensity was positive. However, while the GDP and GERD resumed their growth in 2021 – annual change of 8 % (GDP) and 6 % (GERD) – R&D intensity declined by 2 % compared to 2020. This decline was caused by a more significant growth of GDP than GERD in the same year. However, based on the analysis performed, it can be concluded that the impact of the Covid-19 pandemic on GDP and GERD of the EU-27 countries was neither significant nor had a long-term nature.

Key Words

GDP, GERD, R&D, innovation, EU, Covid-19

JEL Classification: F43, O32

Introduction

The article deals with the issue of GDP and R&D spending changes in the EU-27 countries before and during the Covid-19 pandemic, which represents one of the most significant challenges ever faced by modern medicine (Agarwal & Gaule, 2022). The paper aims to find out wherever restrictive measures taken in the vast majority of the EU-27 countries to combat the Covid-19 pandemic affected their GDP and the financial support of R&D.

The Covid-19 pandemic has significantly changed our everyday lives and how businesses operate. Governments worldwide have implemented various measures to slow the spread of the virus, such as lockdowns, distance learning, travel restrictions, and social distancing guidelines (Aslam et al., 2023). These measures have profoundly impacted businesses across all sectors, with many experiencing significant disruption to their operations. In

addition to the operational challenges, businesses have also had to deal with an uncertain economic environment.

The pandemic has caused significant economic disruption, and businesses have had to adapt quickly to demand and supply chain changes. Despite the challenges, many companies have shown resilience and innovation in response to the pandemic. Innovations in business have also been significant. Businesses have had to quickly adapt to new ways of working, selling, and delivering goods and services. This has led to the rapid adoption of new technologies and digital platforms, such as e-commerce, contactless payments, and remote work tools. In addition, many businesses have pivoted their operations to address unique needs arising from the pandemic. Overall, Covid-19 pandemic has brought about significant changes and challenges for businesses, but it has also provided an opportunity for innovation and adaptation in response to new circumstances (Kotorov et al., 2022). Many countries have implemented significant bailout packages to support businesses during the Covid-19 pandemic. These packages have provided financial support to companies in a variety of sectors.

Innovations, knowledge and R&D are considered essential drivers of economic growth that increase the standard of living and economic performance (Raymond et al., 2015; Savrul & Incekara, 2015). The positive effect of R&D on innovation output and productivity has been confirmed by plenty of studies (e.g. (Baumann & Kritikos, 2016; Griffith et al., 2006; Hall et al., 2010; Mairesse & Mohnen, 2004). It is the technology that helps businesses gain a competitive advantage in the market (Porter, 1985; Van et al., 2022). Therefore, businesses invest in R&D to increase their productivity and profitability.

The authors have addressed the role of innovations within the development process in many research papers (Blaschke et al., 2021a, 2021b; Blaschke & Demel, 2019). In this paper, the topic of innovations is placed in the still current issue of Covid-19. Its objective is to examine how this pandemic has affected not only the field of R&D funding but also countries' economic performance in general.

Roper & Turner (2020) believe that Covid-19 effect is stronger in terms of SMEs, whose financial health is weaker, and their willingness or ability to invest in R&D is disrupted. However, businesses that are able to sustain this investment will have a better chance to survive and achieve stronger economic growth and higher profitability. Also Biswas (2022) confirms that R&D investment can reduce the negative impact of a pandemic on a company. Guan et al. (2022) adds that the ability to adopt digital technology plays a crucial role in becoming resistant to the pandemic – the higher the business's R&D investment, the higher its digital technology level, and thus the greater resistance to the external crisis.

1. Methods of Research

In this part of the paper, the research methodology is introduced. According to Eurostat (2022), R&D intensity may be measured at macroeconomic and microeconomic levels. At a macroeconomic level, the R&D intensity refers to an indicator constructed as a share of R&D gross expenditure (GERD) on countries' gross domestic product (GDP). At a microeconomic level, it represents the percentage of companies' revenues reinvested in their R&D. Since the authors want to analyse the effect of the pandemic on countries' GDP and R&D funding, the first from the afore-introduced approaches will be used (1).

$$R\&D\ intensity = \frac{GERD}{GDP} \quad (1)$$

where *GERD* is gross domestic expenditure and *GDP* is gross domestic product.

Tab. 1 provides an overview of indicators and data sources used, as well as the time series under review within the conducted research.

Tab. 1: Data used in the research

Indicator		Source	Time series
GDP	Gross domestic product	Eurostat (2023a)	2011–2021
GERD	Gross domestic expenditure on R&D	Eurostat (2023b)	
R&D intensity	GERD as % of GDP		

Source: authors' own processing

Since the first case of the Covid-19 disease appeared at the end of 2019 and the restrictive measures in the EU-27 countries were taken in 2020, within this research, the development in the period from 2011 to 2019 is seen as "pre-covid", the year 2020 is taken as "covid" and 2021 as the first "post-covid" year.

Even though the research covers the period of 2011–2021 and the United Kingdom left the EU in January 2020, it was excluded from the analysis. The research works with data covering 27 current EU member countries (EU-27), and the data of the UK were not taken into account for the entire period covered by the research.

Firstly, the development of GDP, GERD and R&D intensity was separately analysed (see Fig. 1, 2, 3 in section 2). Moreover, to compare the development of all the studied indicators (GDP, GERD and R&D intensity), the chain index (2) of the time series was calculated for all the variables. This index compares two immediately consecutive values – year-on-year changes and thus, it enables to analyse the growth rate of the indicators.

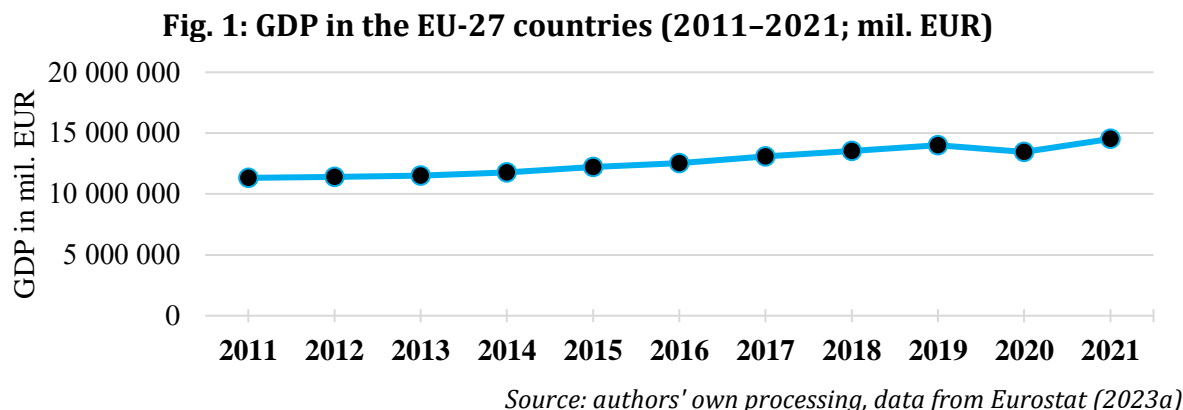
$$Ti = \frac{x_{i+1}}{x_i} \quad (2)$$

where *Ti* is the chain index in the year *i*, and *x* is the value of the analysed indicator.

2. Results of the Research

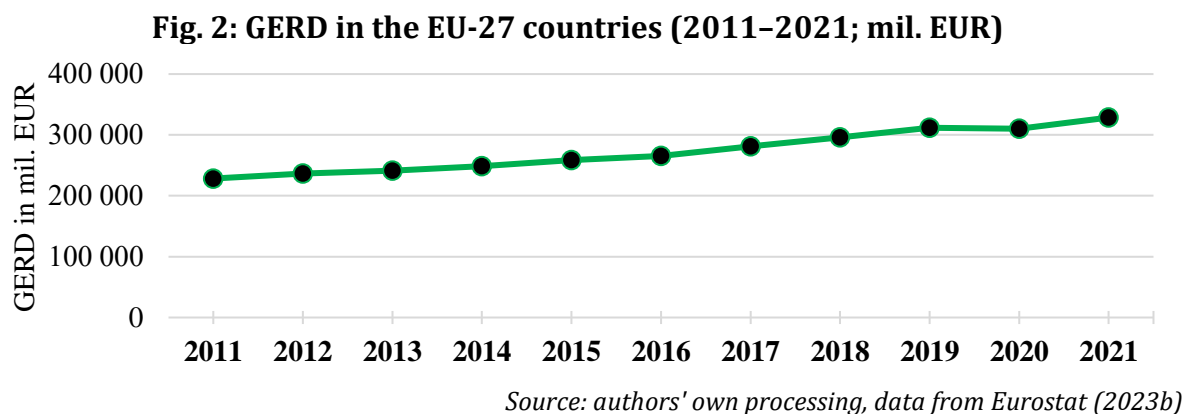
In this part of the paper, the research results are further presented. The research findings are summarised in four figures on the development of gross domestic product (GDP), gross domestic expenditure on R&D (GERD), R&D intensity and the chain index development in the analysed period (2011–2021).

Fig. 1 presents the development of GDP in the EU-27 countries over the examined period (2011–2021).



The EU-27 countries' GDP grew slowly until 2020 (average annual growth rate of 3 %, with the strongest growth of 4 % recorded in 2017, and 2018). Even though there was a noticeable decline of 4 % in 2020, GDP growth was revived right away in 2021, with an 8 % year-on-year change compared to the previous "pandemic year" 2020.

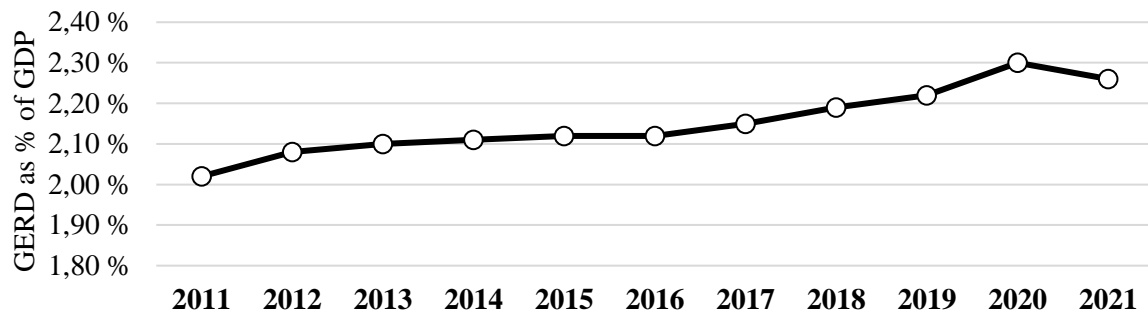
Fig. 2 captures the development of GERD in the EU-27 countries (2011–2021).



The development of GERD largely follows changes in GDP. As presented in Fig. 2, GERD grew at an average annual growth rate of 4 % until 2020, with a growth of 5 % in 2018 and 2019. However, in 2020, the development of GERD was slightly negative – with a year-on-year decrease of 1 %. In 2021, as in the case of GDP, the recovery came, but at a slightly lower rate – an annual increase of 6 % (compared to the GDP growth of 8 %).

The data presented in the previous two figures are further used in Fig. 3, where GERD as a percentage of GDP is expressed using the formula 1 presented in section 1.

Fig. 3: R&D intensity in the EU-27 countries (2011–2021; % of GDP)

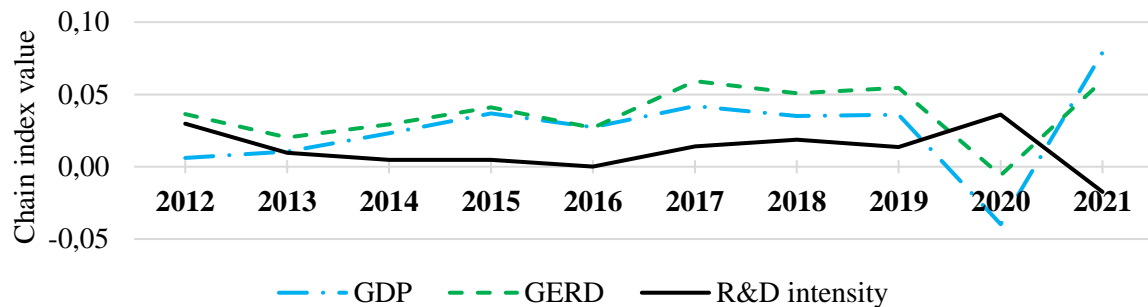


Source: authors' own processing, data from Eurostat (2023b)

As can be seen in Fig. 3, the share of GERD in GDP increased slowly over the period under review until 2019. This slightly rising increase results from a more significant increase in GERD relative to GDP. In 2020, GDP declined much more than GERD (4 % vs. 1 %). This is the reason behind the strong increase in the share of GERD in GDP, thus the growth of R&D intensity. GDP and GERD declined in 2020, while R&D intensity increased by 4 % in the same year. In contrast, the reduction in R&D intensity in 2021 is due to a relatively stronger recovery in GDP compared to GERD (8 % vs. 6 %).

Fig. 4 compares the evolution of the chain index (i.e. the annual growth rate) of the three analysed indicators – GDP, GERD, and R&D intensity.

Fig. 4: Chain index – GDP, GERD, R&D intensity (2011–2021)



Source: authors' own processing, data from Eurostat (2023a, 2023b)

The comparison made in Fig. 4 confirms the aforementioned findings. Regarding the development of GDP and GERD, a significant year-on-year decline can be seen in 2020. However, since GDP dropped by 4 % and GERD only by 1 %, the share of GERD on GDP increased by 4 % year-on-year. On the other hand, the stronger recovery in GDP relative to GERD in 2021 led to the year-on-year development of the R&D intensity indicator turning negative for the first time (-2 %).

3. Discussion

According to OECD (2021), R&D investments are procyclical, prone to contracting or falling sharply in periods of crisis and rising in periods of recovery. Thus, the normal functioning of innovation systems was disrupted. However, the effect of the pandemic may differ across industries – there are businesses that were expanding their R&D activities during the crisis (digital and pharmaceutical sectors), while others reduced their R&D investment (automotive, aerospace, defence).

This research used EU-wide data across economic sectors. However, as Eurostat (2023b) also tracks the data used in this research separately for each country and each sector, it will then be possible to examine the impact of the pandemic on R&D funding in different EU countries as well as sectors of the national economy (business, government, higher education, private non-profit).

It is quite obvious that the crisis accelerated the use of digital means enabling to work remotely, and has also created opportunities for R&D in certain areas. For example, there has been a significant focus on developing vaccines and treatments for Covid-19, which has led to an increased R&D activity in the healthcare and pharmaceutical sectors.

In addition, the pandemic has highlighted the importance of digital technologies and has led to increased investment in areas such as e-commerce, remote work and online education (Kloos et al., 2021). It also illustrates the importance of cooperation with higher education institutions, which continue to play a vital role in research activities in the EU countries and contribute to the development of new knowledge and technologies, the growth of industries and the training of highly qualified personnel (Kotorov et al., 2020). Such close cooperation between higher education institutions, businesses and other stakeholders is essential for the successful implementation of research and development and for the further growth and development of the EU economy, whether we are in forced lockdown or not (Kotorov et al., 2021).

Conclusion

The paper focused on the evolution of GDP and R&D funding and the impact of the Covid-19 pandemic on them. The issue was examined in the environment of the EU-27 current member countries.

Since the Covid-19 pandemic spread across Europe at the beginning of 2020 and the countries took various restrictive measures during that year, we looked at 2020 as the pandemic year. The findings obtained in this research confirm that the Covid-19 pandemic impacted both GDP and GERD of the EU-27 countries. Both GDP and GERD grew slowly throughout the period under review (since 2011). As the growth rate was a bit higher in the case of GERD, also R&D intensity (the share of GERD on GDP) increased. However, during the pandemic year of 2020, there was a significant decline in GDP (by 4 %), and also GERD decreased (by 1 %). However, in 2021, both GDP and GERD recovered again – GDP more significantly than GERD (8 % vs. 6 %), resulting in the year-on-year negative development of R&D intensity (-2 %) for the very first time during the analysed period.

Based on the research findings, it is possible to conclude that the impact of the Covid-19 pandemic on the EU-27 countries' economic growth (measured by the changes in the development of GDP) and R&D funding (measured by GERD) was neither significant nor had a long-term nature. This is confirmed by the analysis of the development of both indicators, where despite the declines in the pandemic year 2020, there is a significant increase again immediately in 2021. Although the evolution of both variables (GDP and GERD) suggests that R&D spending is dependent on economic development, it will be interesting to test this hypothesis with a longer time lag, not only in the context of the pandemic but also in the context of another major economic shock – the consequences of the ongoing war in Ukraine.

The Covid-19 pandemic has significantly impacted the R&D activities of businesses and institutions in the EU countries. While some companies and institutions have continued to invest in R&D activities, others have faced financial difficulties and have had to reduce or postpone their R&D spending.

One factor that has affected R&D intensity in the EU is the economic impact of the pandemic. The pandemic has caused a significant economic downturn, which has led to budget cuts and reductions in R&D spending for some businesses and institutions. In addition, the pandemic has caused supply chain disruptions and changes in consumer behaviour, which may have affected the direction and focus of R&D activities.

Overall, the effect of the Covid-19 pandemic on R&D intensity in the EU countries has been mixed, with some sectors experiencing increased R&D activity and others facing challenges due to budget constraints and disruptions in the economic environment. However, the long-term impact of the pandemic on R&D activities in the EU will depend on a range of factors, including the duration of the pandemic, the speed of the economic recovery, and the future priorities of businesses and institutions.

References

- AGARWAL, R., & GAULE, P. (2022). What Drives Innovation? Lessons From COVID-19 R&D. *Journal of Health Economics*, 82, 102591. <https://doi.org/10.1016/j.jhealeco.2022.102591>
- ASLAM, H., NAUMCHEVA, M., ZHDANOV, P., KOTOROV, I., MAZZARA, M., AKHMETGARAEVA, E., VALIEV, R., & KRASYLNYKOVA, Y. (2023). Perception of the Internationalization Process by the University Employees: The Case Study of Innopolis University. In M. E. Auer, W. Pachatz, & T. Rüttemann (Eds.), *Learning in the Age of Digital and Green Transition* (pp. 873–883). Springer International Publishing. https://doi.org/10.1007/978-3-031-26190-9_89
- BAUMANN, J., & KRITIKOS, A. S. (2016). The Link Between R&D, Innovation and Productivity: Are Micro Firms Different? *Research Policy*, 45(6), 1263–1274. <https://doi.org/10.1016/j.respol.2016.03.008>
- BISWAS, S. (2022). Can R&D Investment Reduce the Impact of COVID-19 on Firm Performance?—Evidence from India. *Journal of Public Affairs*, 22(S1), e2773. <https://doi.org/10.1002/pa.2773>
- BLASCHKE, P., & DEMEL, J. (2019). *Innovation Activities of Foreign Companies Presented in the Liberec Region. Liberec Economic Forum 2019*. Technical University of Liberec, Liberec, 102–110. ISBN 978-80-7494-482-6.
- BLASCHKE, P., DEMEL, J., & KOTOROV, I. (2021a). *Innovation Performance of Small, Medium-Sized, and Large Enterprises in Czechia and Finland. Liberec Economic Forum 2021*. Technical University of Liberec, 21–29. ISBN 978-80-7494-578-6.
- BLASCHKE, P., DEMEL, J., & KOTOROV, I. (2021b). Innovation Performance of Czech and Finnish Manufacturing Enterprises and their Position in the EU. *ACC Journal*, 27(2), 7–21. <https://doi.org/10.15240/tul/004/2021-2-001>
- EUROSTAT. (2022). *Glossary: R&D intensity*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:R_%26_D_intensity
- EUROSTAT. (2023a). *Statistics / Eurostat*. Gross Domestic Product at Market Prices. https://ec.europa.eu/eurostat/databrowser/view/TEC00001_custom_4943644/default/table

- EUROSTAT. (2023b). *Statistics / Eurostat*. GERD by Sector of Performance. https://ec.europa.eu/eurostat/databrowser/view/RD_E_GERDTOT_custom_4941267/default/table
- GRIFFITH, R., HUERGO, E., MAIRESSE, J., & PETERS, B. (2006). Innovation and Productivity Across Four European Countries. *Oxford Review of Economic Policy*, 22, 483–498. <https://doi.org/10.1093/oxrep/grj028>
- GUAN, F., TIENAN, W., & TANG, L. (2022). Organizational Resilience Under COVID-19: The Role of Digital Technology in R&D Investment and Performance. *Industrial Management & Data Systems*, 123(1), 41–63. <https://doi.org/10.1108/IMDS-04-2022-0220>
- HALL, B. H., MAIRESSE, J., & MOHNEN, P. (2010). Measuring the Returns to R&D. In B. H. Hall & N. Rosenberg (Eds.), *Handbook of the Economics of Innovation* (Vol. 2, pp. 1033–1082). North-Holland. [https://doi.org/10.1016/S0169-7218\(10\)02008-3](https://doi.org/10.1016/S0169-7218(10)02008-3)
- KLOOS, C. D., ALARIO-HOYOS, C., MORALES, M., ROCAEL, H. R., JEREZ, Ó., PÉREZ-SANAGUSTÍN, M., KOTOROV, I., FERNÁNDEZ, S. A. R., OLIVA-CÓRDOVA, L. M., SOLARTE, M., JARAMILLO, D., TEIXEIRA, A. M., & LÓPEZ, A. H. G. (2021). PROF-XXI: Teaching and Learning Centers to Support the 21st Century Professor. *2021 World Engineering Education Forum/Global Engineering Deans Council (WEEF/GEDC)*, 447–454. <https://doi.org/10.1109/WEEF/GEDC53299.2021.9657301>
- KOTOROV, I., KRASYLNYKOVA, Y., ZHDANOV, P., & MAZZARA, M. (2020). Internationalization Strategy of Innopolis University. In J.-M. Bruel, A. Capozucca, M. Mazzara, B. Meyer, A. Naumchev, & A. Sadovykh (Eds.), *Frontiers in Software Engineering Education* (pp. 327–340). Springer International Publishing. https://doi.org/10.1007/978-3-030-57663-9_21
- KOTOROV, I., KRASYLNYKOVA, Y., ZHDANOV, P., MAZZARA, M., ASLAM, H., AKHMETGARAEVA, E., NAUMCHEVA, M., & BROWN, J. A. (2021). Institutional Commitment and Leadership as Prerequisites for Successful Comprehensive Internationalization. In G. Succi, P. Ciancarini, & A. Kruglov (Eds.), *Frontiers in Software Engineering* (pp. 1–11). Springer International Publishing. https://doi.org/10.1007/978-3-030-93135-3_1
- KOTOROV, I., PÉREZ-SANAGUSTÍN, M., MANSILLA, F., KRASYLNYKOVA, Y., HADAOU, F. T., & BROISIN, J. (2022). Supporting the Monitoring of Institutional Competency in Learning Innovation: The PROF-XXI Tool. *2022 XVII Latin American Conference on Learning Technologies (LACLO)*, 01–08. <https://doi.org/10.1109/LACLO56648.2022.10013323>
- MAIRESSE, J., & MOHNEN, P. (2004). The Importance of R&D for Innovation: A Reassessment Using French Survey Data. *The Journal of Technology Transfer*, 30(1–2), 183–197. <https://doi.org/10.1007/s10961-004-4365-8>
- OECD. (2021). *Business Research and Innovation Have Been Affected Unevenly by the Crisis—OECD*. <https://www.oecd.org/sti/science-technology-innovation-outlook/crisis-and-opportunity/businessresearchandinnovationhavebeenaffectedunevenlybythecrisis.htm>
- PORTER, M. E. (1985). Technology and Competitive Advantage. *Journal of Business Strategy*, 5(3), 60–78. <https://doi.org/10.1108/eb039075>
- RAYMOND, W., MAIRESSE, J., MOHNEN, P., & PALM, F. (2015). Dynamic Models of R & D, Innovation and Productivity: Panel Data Evidence for Dutch and French Manufacturing. *European Economic Review*, 78, 285–306. <https://doi.org/10.1016/j.euroecorev.2015.06.002>
- ROPER, S., & TURNER, J. (2020). R&D and Innovation After COVID-19: What Can We Expect? A Review of Prior Research and Data Trends After the Great Financial

- Crisis. *International Small Business Journal*, 38(6), 504–514.
<https://doi.org/10.1177/0266242620947946>
- SAVRUL, M., & INCEKARA, A. (2015). The Effect of R&D Intensity on Innovation Performance: A Country Level Evaluation. *Procedia - Social and Behavioral Sciences*, 210, 388–396. <https://doi.org/10.1016/j.sbspro.2015.11.386>
- VAN, B. T., VAN, D. V., & TRANG, T. L. N. (2022). The Role of R&D Intensity on the Export Intensity of Enterprises in Transition Economy: The Case of Vietnam. *Asian Journal of Business and Accounting*, 15(1), 281–309.
<https://doi.org/10.22452/ajba.vol15no1.9>