

**ECONOMICS***Sociology*

Samoilikova, A., Kuryłowicz, M., Lyeonov, S., & Vasa, L. (2023). University-industry collaboration in R&D to reduce the informal economy and strengthen sustainable development. *Economics and Sociology*, 16(3), 339-353. doi:10.14254/2071-789X.2023/16-3/18

**UNIVERSITY-INDUSTRY  
COLLABORATION IN R&D TO  
REDUCE THE INFORMAL  
ECONOMY AND STRENGTHEN  
SUSTAINABLE DEVELOPMENT****Anastasiia Samoilikova**

*Sumy State University,  
Sumy, Ukraine*

*E-mail:*

*a.samoilikova@biem.sumdu.edu.ua  
ORCID 0000-0001-8639-5282*

**Mariusz Kuryłowicz**

*Academy of Justice,  
Warsaw, Poland*

*E-mail:*

*mariusz.kurylowicz@aws.edu.pl  
ORCID: 0000-0001-8995-6516*

**Serhiy Lyeonov**

*Sumy State University,  
Sumy, Ukraine*

*E-mail:*

*s.lyeonov@uabs.sumdu.edu.ua  
ORCID 0000-0001-5639-3008*

**László Vasa\***

*Széchenyi István University  
Hungary*

*E-mail: vasalaszlo@gmail.com*

*ORCID 0000-0002-3805-0244*

*\* corresponding author*

**ABSTRACT.** University-industry collaboration in R&D has great potential as a partnership that promotes sustainable development. This article aims to confirm that university-industry collaboration in R&D contributes to reducing the size of informal economy and strengthening sustainable development. Correlation and causal analysis are applied to achieve this goal: Shapiro-Wilk test, Pearson's and Spearman correlation methods, vector autoregression and Granger causality test are used on the basis of STATA software for a cross-country sample of 10 countries with the highest Sustainable Development Index over 2011-2018. Research results show that stronger university-industry R&D collaboration contributes to more robust sustainable development in 6 out of 10 sample countries and shrinking informal economy in 4 out of 10 countries. In turn, growth of the informal economy leads to a decrease in university-industry R&D collaboration in 5 out of 10 countries and inhibits sustainable development in 7 out of 10 countries. In conclusion, policymakers should transform the national policy and strategy to emphasize and strengthen R&D cooperation between the universities and the industry.

*Received:* December, 2022

*1st Revision:* March, 2023

*Accepted:* June, 2023

DOI: 10.14254/2071-789X.2023/16-3/18

**JEL Classification:** I23, O17, Q01.

**Keywords:** business, education, informal sector, partnership, R&D cooperation, R&D investment, SDG.

## Introduction

Given the global significance and importance of sustainability, sustainable development is the most discussed issue in any sphere of human relationships and activities, government policies and strategies today (Naomi & Akbar, 2021; Skvarciany et al., 2021; Chien, 2023; Kozubikova et al., 2023).

At the global level, the principles of partnership and collaboration for sustainable development have been formalized under the 17th Sustainable Development Goal set out by the UN. SDG17 also relates to the relevance and timeliness of developing collaboration in the field of R&D (Ankrah & Tabbaa, 2015; Barbosa et al., 2023). University-industry collaboration affects economic development (Xiaodi et al., 2021), innovation development (Novikova et al., 2022; Liu, 2023), countries' competitiveness (Sart & Artar, 2021; Vasanicova, 2022), productivity growth of business (Medda et al., 2005; Mark et al., 2014; Šeligová & Košťuríková, 2022), innovative business performance (Cecilia et al., 2019; Costa et al., 2021; Kharchenko, 2023), financial performance (Gerard et al., 2002), and research performance (Abramo et al., 2009). It also has great socioeconomic impact (João et al., 2021) and societal effect (Cohen et al., 2023).

University-industry cooperation is seen as a new form of technological innovation (Xiaodi et al., 2021) and R&D investment is crucial nowadays (Dou et al., 2022; Rigelsky et al., 2022). The transfer of innovations (which occurs during and as a result of the collaboration of education, science, and business) is an important catalyst for innovation development and has the potential to influence the sustainable development of a country as a whole. However, although the University-Industry R&D Collaboration indicator is included in the Global Innovation Index, it is not considered in the assessment of the Sustainable Development Index in any way. This emphasizes the relevance of research in this area. Moreover, it is important to analyse the causal links between university-industry collaboration in R&D and sustainable development in connection with the relationship and influence of informal economy.

Therefore, the purpose of this article is to confirm that university-industry collaboration in research and development contributes to reductions in the informal economy and stronger sustainable development.

## 1. Literature review

The scholars worldwide investigated the university-industry collaboration in general and in R&D in particular. Firstly, collaboration is closely studied in relation to the problem of chain capabilities and resilience for sustainability (Alzate et al., 2022; Małys, 2023). Samusevych et al. (2021) emphasised the role of education in the chain, Cortes et al. (2021) – the role of entrepreneurship, Abdimomynova et al. (2021) – the role of public-private partnership, Świadek & Gorączkowska (2020) and Bareith & Csonka (2022) – the importance of institutional support for innovation cooperation in industry.

Secondly, great attention is paid to cooperation between universities and enterprises. Generally, the interaction of higher education with business, including through the creation of innovation and business incubators, entrepreneurship ecosystem, is very perspective nowadays (Suroso et al., 2020; Kobylińska & Lavios, 2020). Based on a systematic literature review, João et al. (2021) investigated 94 studies of the socio-economic impact of collaboration between universities and industry according to the “context – intervention – mechanism – outcome” algorithm and identified them as social, economic, and financial. Cohen et al. (2023) analysed social dimension of investments in research and development, and societal impact of university and industry collaborations in R&D, mostly the theoretical understanding of this subject.

---

**INTERDISCIPLINARY APPROACH TO ECONOMICS AND SOCIOLOGY**

---

Xiaodi et al. (2021) proved that cooperation between industry and universities positively influences China's economic development through technological innovation based on a spatial autocorrelation and a spatial measurement model. Medda et al. (2005) and Mark et al. (2014) estimated the economic impact of university-industry collaboration on a business level, and companies' productivity growth. Samoilikova et al. (2023) studied collaboration in R&D investment of business and education determining gaps and critical points based on the MAR-splines method. Dalampira et al. (2022) also investigated technology transfer gaps in the education field.

Cecilia et al. (2019) studied the effect of university-enterprises cooperation on innovative business performance. Gerard et al. (2002) analysed the effects of business-university cooperation on financial performance and innovation output. Costa et al. (2021) also paid attention to open innovation and firm performance due to university-industry R&D collaboration based on the survey encompassing 908 firms. Koibichuk et al. (2023) investigated the cooperation of business, science, and education systems in the context of innovation development based on cluster analysis. Artyukhov et al. (2023) developed the innovation transfer model "Science – Business", Nahla (2023) proposed a case of university-company collaboration of Algeria, Ahamed et al. (2023) – an experience of Oman-UAE, etc.

The role of the universities in achieving some SDGs (4<sup>th</sup> and 7<sup>th</sup>) was investigated by Artyukhov et al. (2021). The significance of science and education in the context of knowledge economy, digitalization and other global challenges, taking into account Covid-19 pandemic, a wartime, etc. were studied by Skrynnyk & Vasilyeva (2020), Starčič & Lebeničnik (2020), Gad & Yousif (2021), Bauters et al. (2021), Chernogorova et al. (2021), Khushk et al. (2022), Didenko et al. (2022), Barvinok & Pudło (2023), Benrouina & Malki (2023), Ogunleye et al. (2023), Kaya et al., (2023) and Hammood et al. (2023).

However, the above studies do not cover the issue of influence of university-industry R&D collaboration on the general level of sustainable development of the country, the relationships of this indicator with the level of the shadow economy, etc.

The following scientists studied individual aspects of the informal (shadow) economy and its influence on various spheres. Bilan et al. (2019, 2020) investigated causality and panel cointegration of the shadow economy, economic development and the investment market indicators. Tiutiunyk et al. (2022) also studied the impact of shadow economy on foreign direct investment, using causality research methods for its grounding. Tiutiunyk & Kozhushko (2022) focused on the relationships between the shadow economy and the country's financial performance. Gamal et al. (2022), Surovičová et al. (2022), Bozhenko (2022) characterised the shadow economy impact on different macroeconomic indicators, especially economic growth. Some aspects of public management, economic and financial security related to the shadow economy were described by Shpak et al. (2020). Fedajev et al. (2022) determined different factors and links of the shadow economy separately for market and transition economies. The important issue of financial risks, intellectual property and copyright protection and other risks that accompany the cooperation of educational institutions and business in R&D is investigated by Kuzmenko et al. (2020), Soumadi (2023).

So, the issue of the influence of university-industry collaboration in research and development on reducing the informal economy level and strengthening sustainable development has been investigated rather fragmentarily. The impact of this indicator on sustainable development is highlighted mainly in the theoretical aspect. Cause-and-effect relationships between the indicators studied in the article have not been established before, which determines the novelty of this study.

## 2. Methodological approach

This research aims to confirm or reject the following hypotheses:

H1: university-industry R&D collaboration has a positive impact on sustainable development.

H2: university-industry R&D collaboration causes a reduction in the informal economy level.

H3: the informal economy negatively impacts the sustainable development.

The achievement of the set goal determined the use of such research methods as correlation and cause-and-effect analysis. Correlation analysis relates to the determination of the relationships between university-industry collaboration in R&D, the informal economy level and sustainable development, their character and strength. Based on the obtained results of Shapiro-Wilk test for data normal distribution (Shapiro & Wilk, 1965; Shapiro & Francia, 1972), correlation coefficients are calculated using Spearman's method (data do not subject to normal distribution) or Pearson's method (normal data distribution), also considering time lags (Spearman, 1904; Pearson, 1896). Regression and causality analysis helps to prove the causality of university-industry collaboration in R&D, the informal economy level and sustainable development, and the direction of their influence within grounded relationships between them. Granger test is performed based on the results of vector autoregression (Granger, 1969; Stata, n.d.).

For the cross-country analysis, a sample of 10 top countries in the Sustainable Development Index was formed (UNDESA, 2021). The statistical base has covered the data of the World Intellectual Property Organization (WIPO), the Department of Economic and Social Affairs of the United Nations (UNDESA) and the World Bank for 2011-2018 (final period is explained by the data for the informal economy indicator), in particular the following indicators: – University-Industry R&D Collaboration Indicator within the Global Innovation Index, score (WIPO, n.d.); – Sustainable Development Index, the overall score (UNDESA, 2021; UNDESA, n.d.); – the informal economy indicator (dynamic general equilibrium model-based estimate of informal output), % of official GDP (World Bank, n.d.; Elgin et al., 2021).

All calculations are made in STATA software.

## 3. Conducting research and results

### 3.1. Application of correlation analysis

A correlation analysis was conducted using the following algorithm to confirm the relationships between the studied indicators of university-industry collaboration in R&D, the informal economy level and sustainable development.

1. The Shapiro-Wilk test was applied to check the normal distribution of the data (Shapiro & Wilk, 1965; Shapiro & Francia, 1972). The test results are shown in *Table 1*.

## INTERDISCIPLINARY APPROACH TO ECONOMICS AND SOCIOLOGY

Table 1. Results of confirming / rejecting the data normal distribution (Shapiro-Wilk test)

Country	UI_RD	IE	SDG
Austria	0.60877	0.65396	0.60274
Denmark	0.09992	0.78048	0.67001
Estonia	0.07206	0.98301	0.63581
Finland	0.51528	0.98339	0.64815
France	0.54246	0.90650	0.82835
Germany	0.28361	0.15699	0.06931
Ireland	0.97684	0.07966	0.23902
Norway	0.28097	0.61275	0.98149
Sweden	0.79633	0.32466	0.26314
Switzerland	0.30130	0.19911	0.16227

Note: UI\_RD – University-Industry R&D Collaboration Indicator; SDG – Sustainable Development Index; IE – the informal economy indicator.

Source: *own compilation*

Normal data distribution was identified (Prob>z is more than 0.05).

2. Based on the results of the Shapiro-Wilk test, the correlation coefficients were calculated using Pearson's method because of normal data distribution, also considering time lags (Pearson, 1896). The correlation analysis results are shown in *Table 2*.

Table 2. The results of correlation analysis of the relationships between investigated indicators (coefficient / lag / nature: ↑ – direct; ↓ – inverse; strength of the relationship: h – high, m – medium, l – low)

Country	Relationship between UI_RD and SDG	Relationship between UI_RD and IE	Relationship between IE and SDG
Austria	-0.91 / 2 / ↓ / h	0.98 / 2 / ↑ / h	-0.96 / 1 / ↓ / h
Denmark	-0.93 / 2 / ↓ / h	0.76 / 0 / ↑ / h	-0.65 / 0 / ↓ / m
Estonia	0.55 / 2 / ↑ / m	-0.53 / 0 / ↓ / m	-0.96 / 0 / ↓ / h
Finland	0.23 / 0 / ↑ / h	-0.90 / 2 / ↓ / h	-0.39 / 0 / ↓ / m
France	0.85 / 2 / ↑ / h	-0.94 / 2 / ↓ / h	-0.96 / 0 / ↓ / h
Germany	0.87 / 1 / ↑ / h	-0.80 / 2 / ↓ / h	-0.90 / 0 / ↓ / h
Ireland	0.06 / 2 / ↑ / *	-0.97 / 2 / ↓ / h	-0.51 / 2 / ↓ / m
Norway	0.60 / 2 / ↑ / m	-0.84 / 2 / ↓ / h	-0.91 / 0 / ↓ / h
Sweden	0.57 / 1 / ↑ / m	0.91 / 1 / ↑ / h	0.69 / 1 / ↑ / m
Switzerland	0.75 / 2 / ↑ / h	0.14 / 0 / ↑ / *	-0.73 / 0 / ↓ / h

Note: \* – the relationship is not statistically significant; UI\_RD – University-Industry R&D Collaboration Indicator; SDG – Sustainable Development Index; IE – the informal economy indicator.

Source: *own compilation*

3. The obtained values of correlation coefficients made it possible to assess the statistical significance, nature, and strength of the relationships between the investigated indicators. Their analysis shows that:

– the relationship between university-industry R&D collaboration and sustainable development is statistically significant in 9 out of 10 sample countries and direct – in 7 out of 9 sample countries (with a time lag of 1-2 years), including a high strength – in 3 out of 7 countries and a medium strength – in 3 out of 7 countries with a direct nature of connection.

That is why a direct connection has been established in most of the studied countries with medium or high impact;

- the relationship between university-industry R&D collaboration and the informal economy level is statistically significant in 9 out of 10 countries of the sample and inverse – in 6 out of 9 countries (with a time lag of 0-2 years), including a high influence – in 5 out of 6 countries and a medium power – in 1 out of 6 countries with the inverse nature of the relationship. So, in most of the investigated countries, an inverse relationship with a high impact has been identified;

- the relationship between the informal economy level and sustainable development of the country is statistically significant in 10 out of 10 sample countries, and inverse – in 9 out of 10 countries of the sample (with a time lag of 0-2 years), including with a high strength of influence – in 6 out of 9 countries and with a medium strength of influence – in 3 out of 9 countries with the inverse nature of the relationship. Therefore, in most sample countries, an inverse relationship with a high impact has been grounded.

### 3.2. Application of cause-and-effect analysis

At the next stage, to establish the causality and direction of university-industry collaboration in R&D, the informal economy and sustainable development, an investigation was conducted, according to the following algorithm for each country from the sample:

1) multivariate time series were positioned using the following command in the STATA software:

```
. tsset CODE YEAR, annually
panel variable: CODE (strongly balanced)
time variable: YEAR, 2011 to 2018
delta: 1 year
```

2) a vector autoregression was built using the Multivariate Time Series – Vector Autoregression (VAR) tool in the STATA software, or by the command:

```
. var SDG UI_RD IE, lags(1/1)
```

3) based on the results of vector autoregression, Granger test is performed (Granger, 1969; Stata, n.d.) using Multivariate time series – VAR diagnostics and tests – Granger causality tests – Use active or svar results, or by the command:

```
. vargranger
```

The results of Granger testing on the example of the first country of the sample – Austria are presented in *Table 3*.

The results obtained in the first block indicate that the lag values of the UI\_RD indicator do not cause the value of the SDG indicator, as  $\text{Prob} > \chi^2 = 0.639$ , which is greater than 0.05. In turn, the lag values of the IE indicator cause the values of the SDG indicator, given the value of  $\text{Prob} > \chi^2 = 0.001$ , which does not exceed 0.05. The results of the second block of the Granger test show that the lag values of the SDG indicator are the cause of the value of the UI\_RD indicator, as  $\text{Prob} > \chi^2$  is less than 0.05. Similarly, the lag values of IE cause the value of UI\_RD, given  $\text{Prob} > \chi^2$ , which does not exceed 0.05. In turn, the analysis of the results of the third block of the test shows that the lag values of the SDG and UI\_RD indicators do not cause the value of the IE indicator, since the  $\text{Prob} > \chi^2$  value in both cases exceeds 0.05.

## INTERDISCIPLINARY APPROACH TO ECONOMICS AND SOCIOLOGY

Table 3. The results of Granger causality test for Austria

Equation	Excluded	chi2	df	Prob > chi2
SDG	UI_RD	.21971	1	0.639
SDG	IE	11.69	1	0.001
SDG	ALL	12.595	2	0.002
UI_RD	SDG	31.158	1	0.000
UI_RD	IE	25.931	1	0.000
UI_RD	ALL	31.273	2	0.000
IE	SDG	.04198	1	0.838
IE	UI_RD	1.996	1	0.158
IE	ALL	2.0006	2	0.368

Note: UI\_RD – University-Industry R&D Collaboration Indicator; SDG – Sustainable Development Index; IE – the informal economy indicator.

Source: *own compilation*

The generalized results of Granger causality testing for all sample countries are presented in *Table 4*.

Table 4. Establishing the causality and direction of influence of university-industry collaboration in R&amp;D, the informal economy level and sustainable development

Country	Causality and directions of indicators' influence		
Austria	UI_RD ← SDG	IE → SDG	UI_RD ← IE
Denmark	UI_RD ↔ SDG	IE → SDG	UI_RD ← IE
Estonia	UI_RD ↔ SDG	IE ↔ SDG	UI_RD ← IE
Finland	UI_RD ← SDG	-	-
France	UI_RD ↔ SDG	IE ↔ SDG	-
Germany	UI_RD → SDG	IE → SDG	UI_RD → IE
Ireland	UI_RD ← SDG	IE → SDG	UI_RD ↔ IE
Norway	UI_RD → SDG	IE ↔ SDG	UI_RD ↔ IE
Sweden	-	IE ← SDG	UI_RD → IE
Switzerland	UI_RD → SDG	IE ← SDG	-

Note: UI\_RD – University-Industry R&D Collaboration Indicator; SDG – Sustainable Development Index; IE – the informal economy indicator.

Source: *own compilation*

The results of the Granger test confirm the following causal relationships:

- university-industry R&D collaboration affects (is the cause of) sustainable development in Denmark, Estonia, France, Germany, Norway, and Switzerland, i.e., in 6 out of 10 sample countries. In turn, the country's sustainable development affects the university-industry R&D collaboration in Austria, Denmark, Estonia, Finland, France, and Sweden – in 6 out of 10 sample countries. At the same time, bidirectional causality between these indicators was determined in Denmark, Estonia, and France – in 3 out of 10 sample countries;

- university-industry R&D collaboration affects the informal (shadow) economy in Germany, Ireland, Norway, and Sweden – in 4 out of 10 sample countries. In turn, the informal economy affects the university-industry R&D collaboration in Austria, Denmark, Estonia, Ireland, and Norway – in 5 out of 10 sample countries. A bidirectional influence was established in Ireland and Norway - in 2 of the 10 sample countries;

- the informal (shadow) economy affects the country's sustainable development in Austria, Denmark, Estonia, France, Germany, Ireland, and Norway – in 7 out of 10 sample countries. In turn, the country's sustainable development affects the informal economy in Estonia, France, Norway, Sweden, and Switzerland – in 5 out of 10 sample countries. Besides, a bidirectional causality was established in Estonia, France, and Norway - in 3 out of 10 sample countries.

### **3.2. Results, limitations, and discussion**

This study has certain limitations due to the world countries sample and the investigated period. Therefore, in further research, it is advisable to expand the sample of countries, which should cover the top ten leaders in the ranking of sustainable development, and countries with significantly low positions. Also, we consider it possible to expand the time interval to improve the quality of the obtained results.

Nevertheless, a generalization of the correlation and causal analysis results confirms the following hypotheses:

H1: university-industry R&D collaboration positively affects sustainable development. In particular, strengthening university-industry R&D collaboration contributes to increasing the level of sustainable development, just as increasing the level of sustainable development contributes to strengthening university-industry R&D collaboration.

H3: the informal economy hurts sustainable development. In particular, an increase in the informal economy level causes a decrease in the level of the country's sustainable development, just as an increase in the sustainable development of the country leads to a decrease in the informal economy.

The second hypothesis (H2) about the positive impact of university-industry R&D collaboration on reducing the informal economy level was partly proved. It occurs because strengthening of university-industry R&D collaboration contributes to reducing of the informal economy only in 4 from 10 countries from study sample. At the same time, it was confirmed that the growth of the informal (shadow) economy leads to a decrease in the university-industry R&D collaboration. The above causes a decrease in the level of countries' sustainable development.

Vásquez et al. (2022) also emphasised the strategic role of links between business companies and universities for competitiveness and sustainable development, but this statement was not proved empirically. Mascarenhas et al. (2022) promoted the sustainable development goals through university cooperation with industry and government based on case study method of a Brazilian research centre. Sart & Kibritci (2021) analysed the impact of university-industry R&D collaboration on the countries' competitiveness based on statistical techniques and concluded that competitiveness increases in proportion to increased university-industry R&D collaboration. However, this investigation examines the influence on sustainable development in the indirect way through competitiveness and growth indicators

Dörgő et al. (2018) presented the interconnectedness of SDG measured using the Granger test and also concluded that there is a drastic deficiency of analysed datasets. The indicator of university-industry collaboration was not studied. Abdullah, L. (2020) established the causal relationship between fifteen criteria of sustainable development and found economic growth as the most important for sustainable development. But the university-industry collaboration indicator was not covered too. Prasetyo et al. (2021) set the hypothesis that sustainability is caused by collaboration, applied quantitative and qualitative methods aimed to collaboration between social entrepreneurship and institutions and the value chain. However, authors paid attention only to the regional economic development. Johnson, M.P. &



---

**INTERDISCIPLINARY APPROACH TO ECONOMICS AND SOCIOLOGY**

---

Schaltegger, S. (2020) investigated entrepreneurship for sustainable development and causal mechanisms in this context, but studied indicators in this research were not characterised.

Therefore, the obtained results connected with proving the causality and impact character of university-industry R&D collaboration on sustainable development and informal economy are relevant.

### **Conclusion**

This research aimed to confirm that university-industry collaboration in research and development contributes to reducing the informal economy level and strengthening sustainable development. As a result of correlation and causal analysis, based on cross-country approach, two from three proposed hypothesis were confirmed. It allowed to make the following conclusions.

The growth of the informal (shadow) economy leads to a decrease in the university-industry R&D collaboration. Strengthening of the university-industry R&D collaboration contributes to reducing of the informal economy, but only in 4 from 10 countries from study sample. So, in further research, it is advisable to expand the sample of countries, which should cover the top ten leaders in the ranking of sustainable development, and countries with significantly lower positions.

An increase in the informal economy level causes a decrease in the level of sustainable development of the country, just as an increase in the level of sustainable development of the country leads to a decrease in the informal economy level.

Strengthening of university-industry R&D collaboration contributes to increasing the level of sustainable development, just as increasing the level of sustainable development contributes to strengthening university-industry R&D collaboration too.

Therefore, it is expedient for business structures, educational and scientific institutions to establish and strengthen research and development cooperation to ensure the sustainable development of the country which will led to reducing the informal economy level. In turn, it is crucial to have the government help in this sphere due to policy and national strategy transformation with the accent on the university-industry R&D cooperation. The obtained results can be useful for further scientific research and during strategic public management in areas related to the researched issues.

### **Acknowledgement**

This research was funded by the grant from the Ministry of Education and Science of Ukraine (No. s/r 0122U000772, 0122U000780, 0121U109553 and 0123U101945).

### **References**

- Abdimomynova, A., Duzelbayeva, G., Berikbolova, U. Kim, V., Baimakhanova, A. (2021). Entrepreneurship Education Prospects in The Public-Private Partnership System. *Montenegrin Journal of Economics*, 17(2), 83-92. <https://doi.org/10.14254/1800-5845/2021.17-2.7>
- Abdullah, L. (2020). Causal Relationships Among Multiple Criteria of Sustainable Development. *International Journal of Social Ecology and Sustainable Development (IJSESD)*, 11(3). <https://doi.org/10.4018/IJSESD.2020070104>

---

**INTERDISCIPLINARY APPROACH TO ECONOMICS AND SOCIOLOGY**

---

- Abramo G., D'Angelo, C. A., Di Costa, F., and Solazzi, M. (2009). University– industry collaboration in Italy: A bibliometric examination. *Technovation*, 29(6–7), 498–507. <https://doi.org/10.1016/j.technovation.2008.11.003>
- Ahamed, F., Manakkancheri, A.N., and Kadooran, A. (2023). A new era of collaboration and growth on the Oman-UAE rail project. *Business, Management and Economics Engineering*, 21(1), 1038-1050. Retrieved from: <https://businessmanagementeconomics.org/article/view-2023/1038.html>
- Alzate, I. C., Manotas, E. C., Manotas, E. M., Boada, A. (2022). Impact of supply chain dynamic capabilities (SCDC) and horizontal collaboration over supply chain resilience for SME's sustainability in emerging economies. *Polish Journal of Management Studies*, 25 (2), 72-92. <https://doi.org/10.17512/pjms.2022.25.2.05>
- Ankrah, S., and AL-Tabbaa, O. (2015). Universities-industry collaboration: A systematic review. *Scandinavian Journal of Management*, 31 (3), 387-408. <https://doi.org/10.1016/j.scaman.2015.02.003>
- Artyukhov, A., Bilan, S., Volk, I., Lyeonov, S., Serafimova, D. (2023). SPACE-RL Innovation Transfer Model “Science – Business”. *European Journal of Interdisciplinary Studies*, 15(1), 1-15. <http://doi.org/10.24818/ejis.2023.01>
- Artyukhov, A., Volk, I., Vasylieva, T., & Lyeonov, S. (2021). The role of the university in achieving SDGs 4 and 7: A Ukrainian case. Paper presented at the *E3S Web of Conferences*, 250. <https://doi.org/10.1051/e3sconf/202125004006>
- Barbosa, J., Fernandes, G., and Tereso, A. (2023). Benefits of University-Industry R&D Collaborations: A Systematic Literature Review”, in: et al. *Innovations in Industrial Engineering II. Lecture Notes in Mechanical Engineering*. Springer, Cham.
- Bareith, T. and Csonka, A. (2022). Dynamics of Competition in the Hungarian Poultry Industry. *AGRIS on-line Papers in Economics and Informatics*, 14(2), 15-29. <https://doi.org/10.7160/aol.2022.140202>
- Barvinok, V., & Pudło, T. (2023). Formation of Online Content Patterns of Higher Education Based on Trends to Preserve Intellectual Capital Quality Decreasing in Ukraine During Wartime. *Business Ethics and Leadership*, 7(2), 109-127. [https://doi.org/10.21272/bel.7\(2\).109-127.2023](https://doi.org/10.21272/bel.7(2).109-127.2023)
- Bauters, M., Pejoska, J., Durall, E., Saarikivi, K., Wikström, V., Falcon, M., & Martikainen, S. (2021). Are you there? Presence in collaborative distance work. *Human Technology*, 17(3), 261–293. <https://doi.org/10.14254/1795-6889.2021.17-3.5>
- Benrouina, M., & Malki, O. (2023). Assessing the impact of quality of education on the knowledge economy: evidence from Algeria. *SocioEconomic Challenges*, 7(2), 94-104. [https://doi.org/10.21272/sec.7\(2\).94-104.2023](https://doi.org/10.21272/sec.7(2).94-104.2023)
- Bilan, Y., Tiutiunyk, I., Lyeonov, S., & Vasylieva, T. (2020). Shadow economy and economic development: A panel cointegration and causality analysis. *International Journal of Economic Policy in Emerging Economies*, 13(2), 173-193. <https://doi.org/10.1504/IJEPEE.2020.107929>
- Bilan, Y., Vasylieva, T., Lyeonov, S., & Tiutiunyk, I. (2019). Shadow economy and its impact on demand at the investment market of the country. *Entrepreneurial Business and Economics Review*, 7(2), 27-43. <https://doi.org/10.15678/EBER.2019.070202>
- Bozhenko, V. (2022). Tackling corruption in the health sector. *Health Economics and Management Review*, 3(3), 32-39. <https://doi.org/10.21272/hem.2022.3-03>
- Cecilia, V., Afcha, S.M., and Bustamante, M.A. (2019). Cooperation between university-enterprises and its effect on innovative business performance. *Informacion Tecnologica*, 30 (1), 159-168. <https://doi.org/10.4067/s0718-07642019000100159>

## INTERDISCIPLINARY APPROACH TO ECONOMICS AND SOCIOLOGY

- Chernogorova, Y. , Bliznakov, Z., and Bliznakova K. (2021). Management challenges in implementing scientific projects during covid-19 pandemic. *Polish Journal of Management Studies*, 23 (1), 136-150. <http://doi.org/10.17512/pjms.2021.23.1.09>
- Chien F.C. (2023). The Impact of Green Investment, Eco-Innovation, and Financial Inclusion on Sustainable Development: Evidence from China. *Inzinerine Ekonomika-Engineering Economics*, 34(1), 17-31. <https://doi.org/10.5755/j01.ee.34.1.32159>
- Cohen, M., Fernandes, G., and Godinho, P. (2023). Measuring the societal impacts of university-industry R&D collaborations. *Procedia Computer Science*, 219, 1574-1582. <https://doi.org/10.1016/j.procs.2023.01.449>
- Cortes, A. F., Lee, Y., Cortes, J. D., & Liñan, I. (2021). Entrepreneurial orientation in supply chain management: a systematic review. *International Journal of Entrepreneurial Knowledge*, 9(1), 127–143. <https://doi.org/10.37335/ijek.v9i1.127>
- Costa, J., Neves, A.R., and Reis, J. (2021). Two sides of the same coin. “University-industry collaboration and open innovation as enhancers of firm performance.” *Sustainability* 13(7), 2-18. <https://doi.org/10.3390/su13073866>
- Dalampira, E.S., Tsoukalidis, I., Lazaridou, D., Nikouli, S., Livadiotis, A. and Michailidis, A. (2022). Investigating Technology Transfer Gaps Through Farmers Field School. *European Journal of Interdisciplinary Studies*, 14(2), 193-206. <http://doi.org/10.24818/ejis.2022.29>
- Didenko, I., Valaskova, K., Artyukhov, A., Lyeonov, S., & Vasa, L. (2022). Quality of scientific activity as a determinant of socio-economic development. *Economics and Sociology*, 15(3), 301-318. <https://doi.org/10.14254/2071-789X.2022/15-3/17>
- Dörgö, G.; Sebestyén, V.; Abonyi, J. (2018). Evaluating the Interconnectedness of the Sustainable Development Goals Based on the Causality Analysis of Sustainability Indicators. *Sustainability*, 10, 3766. <https://doi.org/10.3390/su10103766>
- Dou, Z., Xie, M., Wang, X. (2022). Effects of multiple monetary policy tools on enterprises' R&D investment: differences among industry categories. *Transformations in Business & Economics*, 21, 1(55), 83-100. <http://www.transformations.knf.vu.lt/55/article/effe>
- Elgin, C., Kose, M. A., Ohnsorge, F. and Yu, S. (2021). Understanding Informality. *CERP Discussion Paper*, 16497. <http://dx.doi.org/10.2139/ssrn.3914265>
- Fedajev, A., Velickovic, M., Nikolic, R., Cogoljevic, M., and Remeikiene, R. (2022). Factors of the Shadow Economy in Market and Transition Economies during the Post-Crisis Period: is there a Difference? *Inzinerine Ekonomika-Engineering Economics*, 33(3), 246–263. <https://doi.org/10.5755/j01.ee.33.3.28417>
- Gad, S., Yousif, N. B. A. (2021). Public management in the education sphere: Prospects for realizing human capital in the development of knowledge management technologies. *Administratie si Management Public*, 37, 151-172. <https://doi.org/10.24818/amp/2021.37-10>
- Gamal, A.A.M. Pyng, C.H., Hussin, M.Y.M., Gan Pei Tha, G.P., Viswanathan, K.K. (2022). Shadow Economy and Selected Macroeconomic Variables Affecting Economic Growth in Malaysia. *Montenegrin Journal of Economics*, 18(2), 19-28. <https://doi.org/10.14254/1800-5845/2022.18-2.2>
- Gerard, G., Zahra, S., and Wood, R. (2002). The effects of business-university alliances on innovative output and financial performance: a study of publicly traded biotechnology companies. *Journal of Business Venturing*, 17 (6), 577-609. [https://doi.org/10.1016/S0883-9026\(01\)00069-6](https://doi.org/10.1016/S0883-9026(01)00069-6)
- Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica: journal of the Econometric Society*, 424-438. <https://doi.org/10.2307/1912791>

INTERDISCIPLINARY APPROACH TO ECONOMICS AND SOCIOLOGY

---

- Hammood, H.A., Bunyan, M.K., and Tahan, A.A. (2023). The impact of digitization on improving the quality of higher Education: an applied study in the universities of Iraq and Lebanon 2022. *Business, Management and Economics Engineering*, 21(1), 252-272. Retrieved from: <https://businessmanagementeconomics.org/pdf/2023/252.pdf>
- João, L., Torkomian, A., Pereira, S., Oprime, P. and Hashiba L. (2021) Socioeconomic impacts of university industry collaborations a systematic review and conceptual model. *Journal of Open Innovation: Technology, Market, and Complexity*, 7 (2), 2-23. <https://doi.org/10.3390/joitmc7020137>
- Johnson, M.P. & Schaltegger, S. (2020). Entrepreneurship for Sustainable Development: A Review and Multilevel Causal Mechanism Framework. *Entrepreneurship Theory and Practice*, 44(6), 1141-1173. <https://doi.org/10.1177/1042258719885368>
- Kaya, H., Kwok, J. S., LaTurner, J. (2023). Experiential Learning Through the Creation of an Investment Lab. *Financial Markets, Institutions and Risks*, 7(1), 16-25. [https://doi.org/10.21272/fmir.7\(1\).16-25.2023](https://doi.org/10.21272/fmir.7(1).16-25.2023)
- Kharchenko, D. (2023). Content and Bibliometric Analysis of Education as a Competitive Advantage of Business. *Business Ethics and Leadership*, 7(2), 99-108. [https://doi.org/10.21272/bel.7\(2\).99-108.2023](https://doi.org/10.21272/bel.7(2).99-108.2023)
- Khushk, A., Ihsan Dacholfany, M., Abdurohim, D., & Aman, N. (2022). Social Learning Theory in Clinical Setting: Connectivism, Constructivism, and Role Modelling Approach. *Health Economics and Management Review*, 3(3), 40-50. <https://doi.org/10.21272/hem.2022.3-04>
- Kobylińska, U., & Lavios, J. J. (2020). Development of research on the university entrepreneurship ecosystem: trends and areas of interest of researchers based on a systematic review of literature. *Oeconomia Copernicana*, 11(1),117–133. <https://doi.org/10.24136/oc.2020.005>
- Koibichuk, V., Samoilikova, A., Kharchenko, D. & Fritsak, M. (2023). Challenges and opportunities in the ‘business-education-science’ system in the context of innovation development: cluster analysis. *SocioEconomic Challenges*, 7(2), 142-151. [https://doi.org/10.21272/sec.7\(2\).142-151.2023](https://doi.org/10.21272/sec.7(2).142-151.2023)
- Kozubikova, L., Kubalek, J., Rowland, Z., and Palcak, L. (2023). The significant factors of sustainability of SME in the V4 countries. 22(1), *Transformations in Business & Economics*, 98-114. Retrieved from: <http://www.transformations.knf.vu.lt/58>
- Kuzmenko, O., Šuleř, P., Lyeonov, S., Judrupa, I., & Boiko, A. (2020). Data mining and bifurcation analysis of the risk of money laundering with the involvement of financial institutions. *Journal of International Studies*, 13(3), 332-339. <https://doi.org/10.14254/2071-8330.2020/13-3/22>
- Liu, K. (2023). Shanghai Stock Exchange’s Science and Technology Innovation Board: A Review. *Financial Markets, Institutions and Risks*, 7(1), 1-15. [https://doi.org/10.21272/fmir.7\(1\).1-15.2023](https://doi.org/10.21272/fmir.7(1).1-15.2023)
- Małys, Ł. (2023). The approach to supply chain cooperation in the implementation of sustainable development initiatives and company’s economic performance. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 18(1), 255–286. <https://doi.org/10.24136/eq.2023.008>
- Mark, M., Jensen, R., and Norn, M.T. (2014). Estimating the economic effects of university-industry collaboration *International Journal of Technology Transfer and Commercialisation*, 13 (1-2), 80-106. <https://doi.org/10.1504/IJTTC.2014.072687>
- Mascarenhas, K., Malvezzi, S., Hawkes, A., and Meneghini, J.R. (2022). University-industry-government partnership working on sustainable development goals in Brazil.

## INTERDISCIPLINARY APPROACH TO ECONOMICS AND SOCIOLOGY

- International Journal of Intellectual Property Management*, 12(1), 42.  
<https://doi.org/10.1504/IJIPM.2022.121005>
- Medda, G., Piga, C., and Siegel, D.C. (2005). University R&D and Firm Productivity: Evidence from Italy. *Journal of Technology Transfer*, 30 (2-2), 199-205.  
<https://doi.org/10.1007/s10961-004-4366-7>
- Nahla, N. (2023). University-company collaboration: what are the obstacles in Algeria? *SocioEconomic Challenges*, 7(1), 59-64. [https://doi.org/10.21272/sec.7\(1\).59-64.2023](https://doi.org/10.21272/sec.7(1).59-64.2023)
- Naomi, P., & Akbar, I. (2021). Beyond sustainability: Empirical evidence from OECD countries on the connection among natural resources, ESG performances, and economic development. *Economics and Sociology*, 14(4), 89-106. <https://doi.org/10.14254/2071-789X.2021/14-4/5>
- Novikova, I., Stepanova, A., Zhylinska, O., & Samoilikova, A. (2022). Technology transfer risk management in the conditions of scientific internationalisation. *Financial and Credit Activity Problems of Theory and Practice*, 4(45), 308–321.  
<https://doi.org/10.55643/fcaptp.4.45.2022.3808>
- Ogunleye, J. K., Afolabi, C. S., Ajayi, S. O., & Omotayo, V. A. (2023). Virtual Learning as an Impetus for Business Education Programme in the Midst of COVID-19 in Nigeria. *Health Economics and Management Review*, 4(2), 83-89. <https://doi.org/10.21272/hem.2023.2-08>
- Pearson, K. (1896). Mathematical contributions to the theory of evolution – III. Regression, heredity, and panmixia. *Philosophical Transactions of the Royal Society of London, Series A*, 187, 253-318. <https://doi.org/10.1098/rsta.1896.0007>
- Prasetyo, P., Setyadharma, A. and Kistanti, N. (2021) The Collaboration of Social Entrepreneurship and Institution for Sustainable Regional Development Security. *Open Journal of Business and Management*, 9, 2566-2590.  
<https://doi.org/10.4236/ojbm.2021.95141>
- Rigelsky, M., Gavurova, B., & Nastisin, L. (2022). Knowledge and Technological Innovations in the Context of Tourists' Spending in OECD Countries. *Journal of Tourism and Services*, 13(25), 176–188. <https://doi.org/10.29036/jots.v13i25.460>
- Samoilikova, A., Korpysa, J., Vasylieva, T., & Filep, B. (2023). Business – education collaboration in R&D investment: Analysis of development gaps and critical points using MAR-splines. *Journal of International Studies*, 16(2), 57-71.  
<https://doi.org/10.14254/2071-8330.2023/16-2/3>
- Samusevych, Y. V., Novikov, V. V., Artyukhov, A. Y., & Vasylieva, T. A. (2021). Convergence trends in the “economy - education - digitalization - national security” chain. *Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu*, (6), 177-183.  
<https://doi.org/10.33271/NVNGU/2021-6/177>
- Sart, G. & Kibritci Artar, O. (2021). The Effects of University-Industry Collaboration in R&D on the Global Competitiveness of the Countries. In: D. Günay, T. Asunakutlu, & O. Yildiz (Eds.). *University-Industry Collaboration Strategies in the Digital Era*, IGI Global, 265-282. <https://doi.org/10.4018/978-1-7998-3901-9.ch013>
- Sart, G., Artar, O.K. (2021). The Effects of University-Industry Collaboration in R&D on the Global Competitiveness of the Countries. In book: *University-Industry Collaboration Strategies in the Digital Era*. <https://doi.org/10.4018/978-1-7998-3901-9.ch013>
- Šeligová, M. and Košťuríková, I. (2022). The Relationship between Working Capital and Profitability of Companies Operating in the Food Industry in the Czech Republic. *AGRIS on-line Papers in Economics and Informatics*, 14(3), 97-110.  
<https://doi.org/10.7160/aol.2022.140308>

## INTERDISCIPLINARY APPROACH TO ECONOMICS AND SOCIOLOGY

- Shapiro, S. S., & Francia, R. S. (1972). An approximate analysis of variance test for normality. *Journal of the American Statistical Association*, 67(337), 215-216. <https://doi.org/10.1080/01621459.1972.10481232>
- Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika*, 52(3/4), 591-611. <https://doi.org/10.2307/2333709>
- Shpak, N., Kulyniak, I., Gvozd, M., Pyrog, O., Sroka, W. (2020). Shadow economy and its impact on the public administration: aspects of financial and economic security of the country's industry. *Administratie si Management Public*, 36, 81-101. <https://doi.org/10.24818/amp/2021.36-05>
- Skrynnyk, O., & Vasilyeva, T. (2020). Comparison of open learning forms in organizational education. Paper presented at the CEUR Workshop Proceedings, 2732, 1314-1328. Retrieved from: <http://ceur-ws.org/>
- Skvarciany, V., Lapinskaite, I., and Volskyte, G. (2021). Circular economy as assistance for sustainable development in OECD countries. *Oeconomia Copernicana*, 12(1). Retrieved from: <https://oekonomiacopernicana.com/2021-volume-12-issue-1/>
- Soumadi, M. M. (2023). Intellectual Property and Patent Rights Protection for Innovators in Jordan. *Business Ethics and Leadership*, 7(1), 12-24. [https://doi.org/10.21272/bel.7\(1\).12-24.2023](https://doi.org/10.21272/bel.7(1).12-24.2023)
- Spearman, C. E. (1904). The proof and measurement of association between two things. *The American Journal of Psychology*, 15(1), 72-101. <https://doi.org/10.2307/1412159>
- Starčič, A. I., & Lebeničnik, M. (2020). Investigation of university students' perceptions of their educators as role models and designers of digitalized curricula. *Human Technology*, 16(1), 55–91. <https://doi.org/10.17011/ht/urn.202002242163>
- Stata (n.d.). Pairwise Granger causality tests after var or svar. Manuals. Retrieved from: <https://www.stata.com/manuals/tsvargranger.pdf>
- Suroso, A., Rafinda, A., & Gal, T. (2020). The evaluation of entrepreneur incubation program at higher education. *International Journal of Entrepreneurial Knowledge*, 8(2), 14–26. <https://doi.org/10.37335/ijek.v8i2.113>
- Surovičová, A., Bozhenko, V., Boyko, A., & Petrenko, K. (2022). Assessment of transmission effects between “corruption-digitization-economic growth”. *Financial and Credit Activity Problems of Theory and Practice*, 3(44), 132–140. <https://doi.org/10.55643/fcaptp.3.44.2022.3797>
- Świadek, A., & Gorączkowska, J. (2020). The institutional support for an innovation cooperation in industry: the case of Poland. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 15(4), 811–831. <https://doi.org/10.24136/eq.2020.035>
- Tiutiunyk, I. & Kozhushko, I. (2022). Modeling the Impact of Shadow Financial Transactions on the Country's Financial Potential. *Financial Markets, Institutions and Risks*, 6(4), 134-143. [https://doi.org/10.21272/fmir.6\(4\).134-143.2022](https://doi.org/10.21272/fmir.6(4).134-143.2022)
- Tiutiunyk, I., Cieśliński, W., Zolkover, A., & Vasa, L. (2022). Foreign direct investment and shadow economy: One-way effect or multiple-way causality? *Journal of International Studies*, 15(4), 196-212. <https://doi.org/10.14254/2071-8330.2022/15-4/12>
- UNDESA (2021). The Sustainable Development Goals Report 2021. New York, United Nations Publications.
- UNDESA (n.d.). The SDG Database. Retrieved from: <https://dashboards.sdgindex.org/explorer>
- Vasanicova, P., Jencova, S., Gavurova, B., & Bacik, R. (2022). Coopetition of European Union Countries within Destination Management. *Journal of Tourism and Services*, 13(24), 71–89. <https://doi.org/10.29036/jots.v13i24.368>
- Vásquez, T., Rodríguez-Gulías, A., Jesús, M., González-López, M. and Rodeiro-Pazos, D. (2022). University–industry collaboration to support sustainability: An analysis of the

---

**INTERDISCIPLINARY APPROACH TO ECONOMICS AND SOCIOLOGY**

---

- determining factors for European Union countries. In: Fernandes, C., Ramírez-Pasillas, M. and Ferreira, J.J. Universities, Entrepreneurial Ecosystems, and Sustainability, Berlin, Boston: De Gruyter, 133-160. <https://doi.org/10.1515/9783110670219-008>
- WIPO (n.d.). The interactive database of the GII indicators. Retrieved from: <https://www.globalinnovationindex.org/analysis-indicator>
- World bank (n.d.). Informal Economy Database. World Bank. Retrieved from: <https://www.worldbank.org/en/research/brief/informal-economy-database>
- Xiaodi, X., Zhu, Y., Xu, L., & Wang, Z. (2021). Influence of Industry-University Cooperation on Economic Development: A Mathematical Statistical Analysis. *Mathematical Problems in Engineering*, 2-11, 4661933. <https://doi.org/10.1155/2021/4661933>