Samoilikova, Anastasiia; Herasymenko, Valeriia; Kuznyetsova, Anzhela et al.

Article

Effect of education on ease of doing business in conditions of innovation development : factor analysis and multiple regression

Reference: Samoilikova, Anastasiia/Herasymenko, Valeriia et. al. (2023). Effect of education on ease of doing business in conditions of innovation development : factor analysis and multiple regression. In: Marketing i menedžment innovacij 14 (2), S. 208 - 217. https://mmi.sumdu.edu.ua/wp-content/uploads/2023/06/A707-2023_19_Samoilikova-et-al.pdf. doi:10.21272/mmi.2023.2-019.

Marketing and Management of Innovations, 2, 2023
ISSN 2218-4511 (print) ISSN 2227-6718 (online)

EFFECT OF EDUCATION ON EASE OF DOING BUSINESS IN CONDITIONS OF INNOVATION DEVELOPMENT: FACTOR ANALYSIS AND MULTIPLE REGRESSION

Anastasiia Samoilikova, ORCID ID: https://orcid.org/0000-0001-8639-5282
Ph.D., Sumy State University, Ukraine
Valeriia Herasymenko, ORCID ID: http://orcid.org/0000-0003-1772-8017
Sumy State University, Ukraine
Anzhela Kuznyetsova, ORCID ID: https://orcid.org/0000-0003-3590-7625
D.Sc., Professor, Sumy State University, Ukraine
Milos Tumpach, ORCID ID: https://orcid.org/0000-0003-3389-6803
Ph.D., Professor, Brno University of Technology, Czech Republic
Martina Ballova, ORCID ID: https://orcid.org/0000-0002-9903-0749
Ph.D., University of Economics in Bratislava, Slovakia
Larisa Savga, ORCID ID: https://orcid.org/0000-0002-9691-7475
Ph.D, Professor, Trade Co-operative University of Moldova, Republic of Moldova
Dunarea de Jos University of Galati, Romania
Corresponding author: Anastasiia Samoilikova, a.samoilikova@biem.sumdu.edu.ua
Type of manuscript: research paper

Abstract: *Education accelerates changes and transformations in social life, as well as one of the main factors of progress and development in general and business. The article substantiates and formalises the relationships between indicators of the level of education (taking into account its innovative development) and the ease of doing business based on evidence from 28 world countries and the data from the World Bank, the United Nations, Tufts University and Standard & Poor's Ratings Services. The article aims to find indicators of innovative education that most significantly contribute to the ease of doing business. For this, cognitive analysis of statistical data is carried out, and with the help of descriptive analysis tools, a statistically significant characteristic space of indicators is formed. Checking the density and direction of the relationship is carried out by calculating the values of the Pearson correlation coefficients. The multidimensionality of input feature space is reduced to the four most significant indicators from nine investigated ones (digital development indicator; human development index; digital trust, financial literacy index) using the procedure of principal component analysis and orthogonal transformation using the Varimax method in the Statgraphics Centurion 19 software. The quality of the factorisation is confirmed by Kaiser-Meier-Olkin testing and Bartlett's sphericity testing. As a result of the developed multiple econometric models, which describe the dependence of ease of doing business and the above indicators, and the Backward Stepwise Selection hard screening procedure in Statgraphics 19, a statistically significant model of the effect of digital development on ease of doing business is built. It shows that with the value increase of digital development by 1%, ease of doing business will also increase by 0.79%. The obtained results can be useful to scientists for further research, as well as to change-makers in education and business and all stakeholders in the direction of «business–education» competition.*
Keywords: academic staff, business, digital evolution, digital trust, expenditure, financial literacy, human development, school, tertiary education.
JEL Classification: I23, M21, O32.

Received: 10 January 2023 **Accepted:** 05 June 2023 **Published:** 30 June 2023

Funding: This research was funded by the Ministry of Education and Science of Ukraine (projects No. 0122U000772 and No. 0122U000780) and by the Vega Agency (No. 1/0638/23).
Publisher: Academic Research and Publishing UG, Germany.
Founder: Sumy State University and Academic Research and Publishing UG (i.G.), Germany

Cite as: Samoilikova, A., Herasymenko, V., Kuznyetsova, A., Tumpach, M., Ballova, M., & Savga, L. (2023). Effect of Education on Ease of Doing Business in Conditions of Innovation Development: Factor Analysis and Multiple Regression. *Marketing and Management of Innovations*, 2, 208–217. https://doi.org/10.21272/mmi.2023.2-19

Introduction. Today education is an important precondition for the future in which we will live. Education and experience are catalysts for all scientific and technical discoveries, innovations, and the progress of humanity in general. Everything around them changes quickly, and any innovative solution can radically affect an entire industry, the economic direction, or the sphere of people's lives (Bilas, 2020). The influence of education on economic growth is a widespread issue (Hanushek and Woßmann, 2007, Barro, 2013, Canals, 2017).

In turn, education affects business in at least two ways: it creates a basis for the development of human potential (critical thinking, project thinking, creativity, openness to innovation, ability to lifelong learning, etc.) and forms the future class of consumers, and provides new knowledge through research and observation, which leads to innovation development, the emergence of innovative solutions, opening a new business, economic growth, national and business competitiveness (Bilas, 2020).

All the above potential benefits of education, both for country and business levels, are especially important in modern conditions of countries' transition and integration processes, urbanisation, industrialisation, economic recession, labour migration, etc. (Stojanov et al., 2011; Jiroudkova et al., 2015; Li et al., 2019). Special challenges arise for education and business during war, pandemics, and other emergencies.

However, despite the seemingly logical conclusion about the value of education when creating a business, entrepreneurs have a diametrically opposite attitude to education: some of them say that a good education is a good foundation for a successful business, while others follow Mark Zuckerberg, saying that education is not the most important thing without which business cannot be built (Shveda, n.d.).

That is why the issue of the effect of education on ease of doing business in conditions of innovation development is timely and relevant. The article aims to find indicators of innovative education that most significantly contribute to the ease of doing business.

Achieving the goal involves carrying out research in the following stages:

1. Literature review and bibliometric analysis based on VosViewer soft.
2. Formation of indicators sample.
3. Description of statistical significance and feature space quality (descriptive statistics).
4. Data standardisation.
5. Analysis of the main components and factor analysis (building a regression model).

Literature Review. When searching for scientific papers in the scientometric database Scopus using the words «business» and «education», 63,618 scientific papers were found from 1965 to 2022. Only in the last seven years (from 2016 to 2022) 21,648 scientific works dedicated to studying the relationship between education and business were indexed, emphasising the extreme importance and relevance of the research topic.

From the keyword relationship map (Figure 1), it is possible to clearly distinguish the 80 most used keywords: human, education, students, adults, experiment, men, women, engineering, cross-sectional study, psychology, decision-making, online learning, covid, university, commerce, awareness, leadership, economics, learning systems, knowledge, organisation and management, employment, social media, business, motivation, financial management, innovation, etc.

All these keywords are connected by different links, forming four clusters of multidisciplinary research, as the following:

1) «red» cluster – education, e-learning, personal training, decision-making, entrepreneurship, business, employment, sustainable development, innovation, artificial intelligence, big data, etc.

2) «green» cluster – knowledge, university, cross-sectional studies, students, men, females, psychology, etc.

3) «blue» cluster – human, health, workplace, organisation and management, pandemic, covid-19, etc.

4) «yellow» cluster – leadership, skill, perception, human experiment, etc.

The formed clusters reflect the most common areas of interdisciplinary research on education and business, which are of the greatest scientific interest.

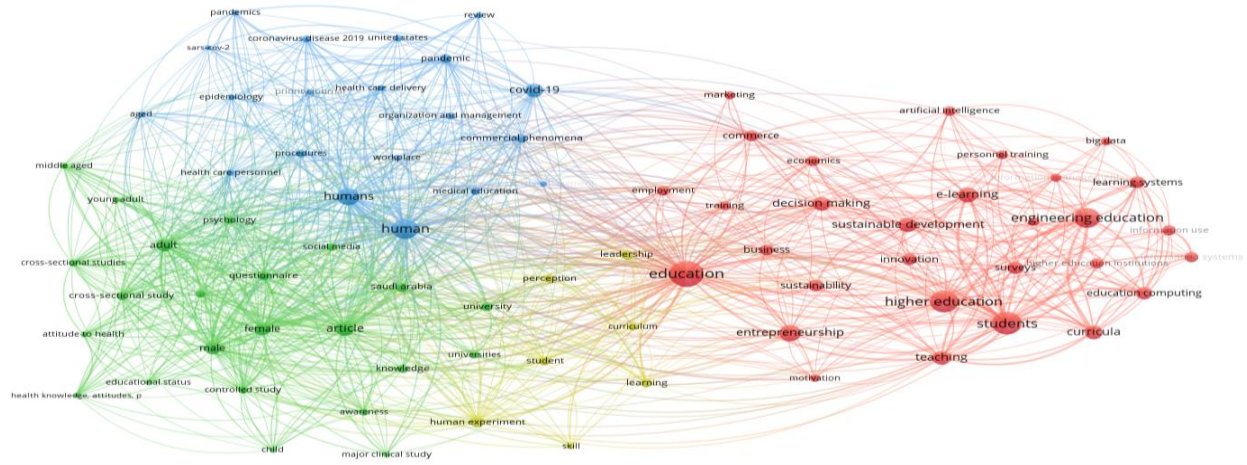

Figure 1. Keyword Link Map

Sources: developed by the authors using the VOSviewer software toolkit.

In addition, separate publications are worth highlighting when reviewing the literature related to business and education. The Business Continuity Guide by Hayes and Kotwica (2013) provides the basics and tools for creating, managing, and executing all aspects of an organisation's business continuity program. The book «Emergency Preparedness for Business Professionals» by Wayland (2015) explores how to respond to a genuine emergency and renovate a business afterwards.

Manley (1903) grounded the distant relationship between education and business. Cranson (2018) raised an important question of whether education affects business. Bosire and Etyang (2003) explored education's impact on entrepreneurial skills. Kambayashi et al. (2008), in the book «Management Education in Japan», investigate whether are MBA system useful in Japanese education and especially business schools for the development of H.R. in Japanese companies. Moreover, the authors discuss the significance of development management training methods specific to Japan based on the contextual model. Sakitri, G. (2020) proved that student stress negatively influences academic performance after studying. The article also gave recommendations for the university to create a positive competitive atmosphere, introduce stress management practices, etc.

Greene (2015) paid attention to the influence of education on business and its growth. Raposo and Paco (2011), Mahmood et al. (2021) and Kanaan-Jebna et al. (2022) investigated business education's effect on entrepreneurship, in particular, SMEs functioning. Peters and Bridjlal (2011) investigated links between business success and the education level of entrepreneurs using questionnaire surveys and face-to-face interviews. Jimenez et al. (2015) studied education's influence on formal and informal entrepreneurship. In particular, the authors found that higher education can negatively impact shadow business because it promotes an understanding of probable negative consequences. Limited administrative skills neutralise this influence at the secondary education level. Lu et al. (2019) also described the problem of informal business and corruption.

At the same time, the issue of the effect of education on ease of doing business in conditions of innovation development is investigated fragmentally and requires further research. That is why the chosen topic is present, and it is necessary to study and formalise indicators of innovative education that most significantly contribute to the ease of doing business.

Methodology and research methods. To substantiate and formalise the relationships between indicators of the level of education (taking into account its innovative development) and the ease of doing business and to determine indicators that mostly contribute to the ease of doing business, research methods' complex was applied.

A cognitive analysis of statistical data was carried out, and with the help of descriptive analysis tools, a statistically significant characteristic space of indicators was formed. Checking the density and direction of the relationship was carried out by calculating the values of the Pearson correlation coefficients. The multidimensionality of input feature space was reduced to the clearest indicators from all investigated ones using principal component analysis and orthogonal transformation based on the Varimax method in the Statgraphics Centurion 19 software. The quality of the factorisation was confirmed by the Kaiser-Meier-Olkin test (Kaiser, 1974; Cattell, 1966) and Bartlett's sphericity test (Bartlett, 1955).

Multiple econometric models were developed, which describe the dependence on ease of doing business and determined indicators (digital development indicator; human development index; digital trust, financial literacy index). Due to the Backward Stepwise Selection hard screening procedure in Statgraphics 19, a statistically significant model of the effect of digital development on ease of doing business was built.

The information base involved data from the World Bank, Eurostat, and Index Mundi for the sample from 28 countries of the world in 2020 according to the following indicators: ease of doing business; school enrolment, primary; enrolment in tertiary education, all programs; higher education, teachers; digital evolution score; human development index; the number of registered businesses; digital trust; financial literacy index; government expenditure on education, % of GDP.

Results. Research is conducted in the four stages to determine indicators of innovative education that most significantly contribute to the ease of doing business.

1. Formation of a sample of indicators.

For evaluation, a sample of statistical data from the World Bank, Human Development Report Office of the United Nations, Tufts University (Digital Planet project) and Standard and Poor's Ratings Services for 28 countries for 2020 was formed, in particular, the input sample of the study consisted of the following indicators:

– k1 – ease of doing business (overall score) (World Bank, n.d.d);
– k2 – school enrolment, primary (World Bank, n.d.e);
– k3 – enrolment in higher education (enrolment in tertiary education, all programs) (World Bank, n.d.a);
– k4 – tertiary education, academic staff (World Bank, n.d.f);
– k5 – an indicator of digital development (digital evolution score) (Tufts University, n.d.a);
– k6 – human development index (UNDP, n.d.);
– k7 – number of new businesses registered (World Bank, n.d.c);
– k8 – digital trust (Tufts University, n.d.b.);
– k9 – financial literacy index (S&P Ratings Services, n.d.; Klapper et al., 2020);
– k10 – government costs on education as % of GDP (World bank, n.d.b).

The countries of the study were: Switzerland, Sweden, Germany, Denmark, the Netherlands, Austria, Spain, the United Kingdom, Singapore, France, Italy, Turkey, Poland, Portugal, Romania, Brazil, Colombia, Egypt, Israel, Malaysia, Indonesia, New Zealand, Ukraine, Saudi Arabia, Thailand, Vietnam, the United Arab Emirates, the Philippines.

2. Description of statistical significance and quality of feature space.

Table 1 presents the obtained results of the descriptive statistics analysis.

Table 1. The obtained results of the descriptive statistics analysis

Indicator	Coefficient of variation	Coefficient of kurtosis (Stnd. kurtosis)	Asymmetry coefficient (Stnd. skewness)
k1	9,36595%	0,605458	-1,79414
k2	30,7039%	-0,984239	-1,09999
k3	24,4477%	-1,13488	0,1508
k4	152,413%	*14,5156*	*7,49225*
k5	8,49774%	*4,80746*	*2,29197*
k6	31,1825%	-0,121725	0,652495
k7	13,1771%	0,717654	0,875067
k8	9,90225%	-0,947547	-1,47752
k9	38,1504%	-1,56122	0,692392
k10	30,2502%	-0,0852232	0,988791

Sources: developed by the authors based on Statgraphics.

The variation coefficient informs about the relative dispersion of the data set. The indicator is significant if the coefficient of variation is more than 5%, so from the obtained results, all indicators are statistically significant, and it is possible to conduct research with them. The asymmetry coefficient is a numeral indicator of the probability distribution of a valid random variable. The kurtosis coefficient shows the steepness of the distribution curve's rise compared to the normal one.

Kurtosis and asymmetry coefficients should range from -2 to 2, so attention should be paid to indices for which standardised coefficients' values go beyond this interval. Depending on the aim of model development

and applying certain multivariate statistical analysis methods to interpret obtained results, there may be more than these coefficients to satisfy the corresponding testing. In this case, these are k4 (higher education, teachers) and k5 (development indicator).

Figure 2 shows a means of visualising groups of numerical data in descriptive statistics through their quantiles – a swing chart, boxplot, or «box with whiskers». Quantiles cut off within a series a certain part of its members. A boxplot may also have lines that extend vertically out of the box («whiskers»), indicating the amount of variability outside the upper and lower quantile limits. Emissions can be plotted as points.

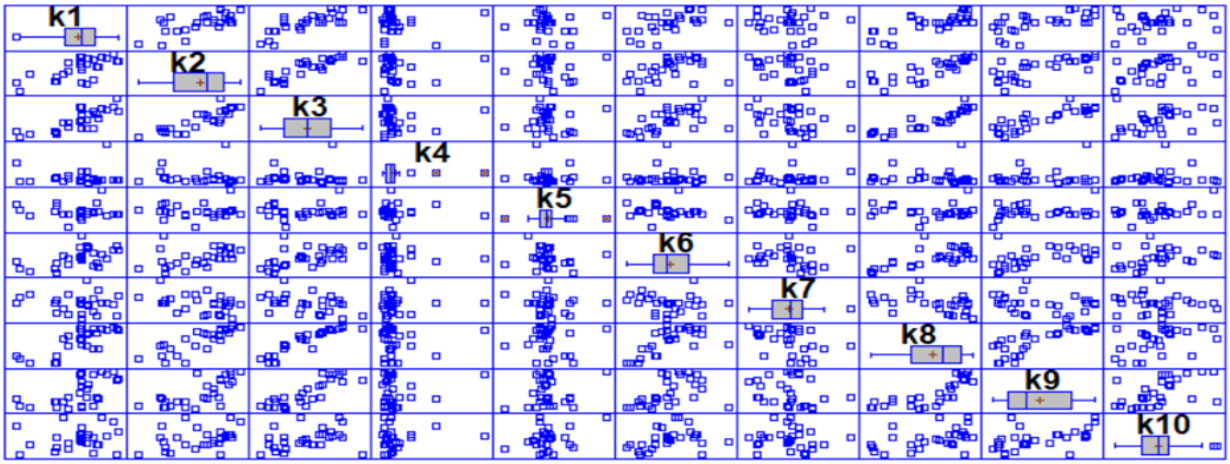

Figure 2. Box graph («box with whiskers»)

Sources: developed by the authors using the Statgraphics program.

Some indicators have anomalous values (shown by squares outside the line corresponding to the input range of values); for example: for k1 (ease of doing business), the value for the country Brazil (59.10) is anomalous, as this value is the smallest among of all countries; for k5 (digital development indicator), there are three outliers for countries such as Sweden (133.86) and Romania (82.85), which are the highest and lowest of all countries, respectively; for the indicator k10 (state spending on education as a % of GDP), the value for the country of Saudi Arabia is abnormal, since this indicator is the largest for this country, etc.

The next indicator of descriptive statistics that must be considered is the Pearson correlation coefficient (Figure 3).

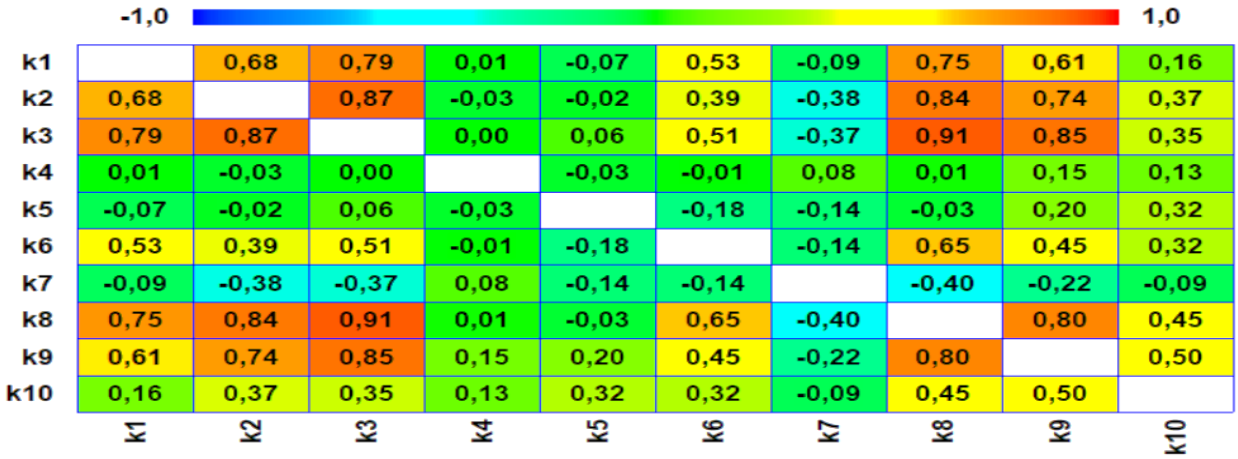

Figure 3. Pearson correlation results

Sources: developed by the authors based on Statgraphics.

Based on Figure 3, the following conclusions can be made. A high level of positive correlation, direct influence (from 0.5 to 1.0) exists between indicators of ease of conducting business and school enrolment, ease of conducting business and enrolment in higher education, ease of conducting business and human development, ease of conducting business and digital trust, ease of conducting business and financial literacy; school enrolment and enrolment in tertiary education, school enrolment and digital trust, school enrolment

and financial literacy; enrolment in tertiary education and human development, enrolment in tertiary education and digital trust, enrolment in higher education and financial literacy; human development and digital trust; digital trust and financial literacy; financial literacy and government expenditure on education.

A high level of negative correlation and inverse influence (from -1.0 to -0.5) does not exist between any indicators.

Medium level of positive correlation, direct influence (from 0.3 to 0.5) exists between school enrolment and human development, school enrolment and government costs on education; enrolment in higher education and government costs on education; an indicator of digital development and government costs on education; human development and financial literacy, human development and government costs on education; digital trust and government costs on education.

The average level of negative correlation, reverse influence (from -0.5 to -0.3), takes place between school enrolment and the number of new businesses registered, enrolment in higher education and number of new businesses registered, number of new businesses registered and digital trust.

Low level of positive correlation, direct influence (from 0.1 to 0.3) there is between ease of doing business and government costs on education, higher education (academic staff) and financial literacy, tertiary education (academic staff) and government costs on education, an indicator of digital development and financial literacy.

A low level of negative correlation, reverse influence (from -0.3 to -0.1) exists between the indicator of digital development and human development, an indicator of digital development and new businesses number, human development and some new businesses registered, new businesses number and financial literacy.

There is no correlation at all (from -0.09 to 0; from 0 to 0.09) between indicators of ease of doing business and tertiary education (academic staff), ease of doing business and indicator of digital development, ease of doing business and number of new businesses registered, school enrolment and tertiary education (academic staff), school enrolment and indicator of digital development, enrolment in higher education and tertiary education (academic staff), enrolment in higher education and indicator of digital development, tertiary education (academic staff) and indicator of digital development, tertiary education (academic staff) and human development, tertiary education (academic staff) and number of new businesses registered, tertiary education (academic staff) and digital trust, an indicator of digital development and digital trust, number of new businesses registered and government expenditure on education.

3. Data standardisation.

Since the input data are measured in different scales, reflecting both absolute and relative values of the characteristics, for accuracy and adequacy of the further development of regression models, it was necessary to carry out their normalisation procedure using the data standardisation procedure in the Statistica software.

4. Factor analysis. Analysis of the main components.

Factor analysis aims to receive a small sample of variables that mostly explain the variability in 10 investigated factors. Using principal component analysis, the most influential factors were identified. A factor is significant if the Kaiser statistic (Eigenvalue) is greater than 1. The first three factors give the result of the entire sample (Table 2).

Table 2. Factor analysis results

Factor Number	Eigenvalue	Per cent of Variance	Cumulative Percentage
1	4,84551	48,455	48,455
2	1,36566	13,657	62,112
3	1,14785	11,479	*73,590*
4	0,861498	8,615	82,205
5	0,736635	7,366	89,571
6	0,505188	5,052	94,623
7	0,257941	2,579	97,203
8	0,147966	1,480	98,682
9	0,078399	0,784	99,466
10	0,0533573	0,534	100,000

Sources: developed by the authors based on Statgraphics.

So, three factors were determined because they were equal to or more than 1.0. They cover 73.59% of data variability. Because the method of principal components was chosen, initial estimations were adjusted to suppose that widespread factors caused all data variability.

Table 3 shows the factor loading matrix after Varimax rotations.

Table 3. Factor capacity matrix after rotations

	Factor 1	Factor 2	Factor 3	Estimated Communality	Specific Variance
k1	0,84669	-0,118381	-0,00703817	0,730948	0,269052
k2	-0,151642	0,860307	-0,151296	0,786013	0,213987
k3	0,70641	-0,154746	0,0928117	0,531576	0,468424
k4	-0,278346	-0,276233	0,629398	0,549924	0,450076
k5	0,927061	0,182366	-0,155342	*0,91683*	0,0831702
k6	0,95214	0,134842	-0,111442	*0,937172*	0,0628275
k7	0,067033	0,169059	0,774814	0,633411	0,366589
k8	0,859829	0,157759	-0,196094	*0,802647*	0,197353
k9	0,818927	0,388939	0,0782907	*0,828045*	0,171955
k10	0,387844	0,654283	0,252867	0,642451	0,357549

Sources: developed by the authors based on Statgraphics.

Factor 1, which characterises the quality of business and its development from indicators, is considered in more detail, and three significant models can be used. Table 3 gives the equation's estimated total coefficients after rotation performed to simplify the factors explanation. The first returned factor has the equation:

$$Factor\ 1 = 0{,}84669 * k1 - 0{,}151642 * k2 + 0{,}70641 * k3 - - 0{,}278346 * k4 + 0{,}927061 * k5 + 0{,}95214 * k6 + 0{,}067033 * k7 + + 0{,}859829 * k8 + 0{,}818927 * k9 + 0{,}387844 * k10 \quad (1)$$

The variables' values are standardised by subtracting their averages and dividing them by standard deviations. In addition, the obtained results were confirmed by the following tests: the Kaiser-Meier-Olkin sampling adequacy measure and Bartlett's sphericity test. The Kaiser-Meyer-Olkin testing allows us to determine how well data fit for factor analysis and measures sampling adequacy for each model variable and the entire model. The obtained values, according to Kaiser-Meyer-Olkin testing from 0.5 to 1, indicate the adequacy of the factor analysis; values up to 0.5 mean that factor analysis cannot be used for these input samples. Bartlett's sphericity test is used to check whether the correlations of the studied indicators are different from 0. If the value of the correlation coefficient is close to zero, then the selected variable is not interconnected with others. A significance of less than 0.05 indicates that the factor analysis is acceptable.

The test results (KMO = 0.768882; Chi-square = 179,298; DF = 45; P-value = 0.0) confirmed the quality of the factor analysis.

The next step is to build a multiple regression that describes independent indicators' impact on the performance indicator – ease of doing business. In order to determine which indicators are the most influential, the accumulated variance (Estimated Communality) was analysed. Accordingly, four indicators with the largest variance were selected: k5 (digital development indicator) – 0.91683, k6 (human development index) – 0.937172, k8 (digital trust) – 0.802647, k9 (financial literacy index) – 0.828045.

The multiple regression was built with dependent variables – k1 (ease of doing business) and independent variables – k5 (digital development index), k6 (human development index), k8 (digital trust), and k9 (financial literacy index). As a result of constructing the regression model, the following equation was obtained:

$$k1 = 4{,}60422E - 11 + 0{,}821542 * k5 + 0{,}271888 * k6 - - 0{,}0761361 * k8 - 0{,}252757 * k9 \quad (2)$$

Indicators k8 (digital trust) and k9 (index of financial literacy) have an inversely proportional (inverse) relationship with the resulting indicator k1 (ease of doing business). However, based on the logical content of indicators k8 (digital trust) and k9 (index of financial literacy), it is obvious that the dependence should be directly proportional, so let us check for multicollinearity in the regression model using the Backward Stepwise Selection hard screening procedure in the Statgraphics 19 software.

Multicollinearity was found between indicators k8 (digital trust) and k9 (index of financial literacy), so the regression equation for indicator k1 (ease of doing business) takes the following form (Tables 4-5):

$$k1 = 2{,}8077E - 11 + 0{,}786154 * k5 \quad (3)$$

Table 4 presents multiple regression results.

Table 4. Multiple regression results

Variable	Estimation	Standard Error	t-statistic	p-value	95.0% confidence interval	
Const.	2,8077E-11	0,119022	2,35898E-10	1,0000	-0,244653	0,244653
k5	0,786154	0,121206	6,48611	*0,0000*	0,537012	1,0353

Sources: developed by the authors based on Statgraphics.

Table 5 shows an analysis of variance results.

Table 5. Analysis of variance results (ANOVA)

Sources	Squares sum	Df	Square mean	f-ratio	p-value
Model	16,687	1	16,687	42,07	*0,0000*
Residual	10,313	26	0,396653		
Total (Corr.)	27,0	27			

Sources: developed by the authors based on Statgraphics.

Therefore, when the value of the k5 indicator increases by 1% (digital development indicator), the result indicator of k1 (ease of doing business) will also increase by 0.79% on average.

The coefficient of determination for the model has a value of 61.8038; that is, it covers 61.80% of the dependent indicator variability (ease of doing business). The built model accepts well with original data. Also, the p-value is less than 0.05. Accordingly, there is a significant dependence on the 95.0% confidence interval.

Thus, digital development is the most important of the considered triggers for improving the business process.

Conclusions. Indicators of innovative education that most significantly contribute to the ease of doing business were identified based on data samples from 28 world countries and applying the complex research methods including descriptive, correlation, factor, and regression analysis, special tests for quality and significance confirmation and specific program software.

Firstly, the four most influential factors from the nine investigated were singled out: digital development indicator, human development index, digital trust, and financial literacy index. At the same time, the analysis of the developed multiple econometric models describing the dependence of the above indices and the performance indicator of ease of doing business revealed signs of multicollinearity between independent variables. So secondly, due to the hard screening procedure, a statistically significant model of the effect of digital development indicators on the ease of doing business was built. It was grounding that ease of doing business will increase by 0.79% with an increase in the value of digital development by 1%.

However, the obtained results have certain limitations because of the number of sample countries and the period, which should be expanded in the future, as well as the number and list of factors selected for analysis, to which other variables can also be added in the future.

Nevertheless, the obtained results can be useful to scientists for further research, as well as to change-makers in the field of education and business and to all stakeholders in the direction of 'business–education' coopetition.

Author Contributions: conceptualisation, A. S. and A. K.; methodology, A. S., V. H., M. T., M. B. and L. S.; software, V. H.; validation, A. S. and V. H.; formal analysis, V. H.; investigation, A. S., V. H., A. K., M. T., M. B. and L. S.; data curation, V. H.; resources, V. H.; writing-original draft preparation, A. S., V. H., M. T. and M. B.; writing-review and editing, A. S., A. K. and L. S.; visualisation, V. H.; project administration, A. S.; supervision, A. S.; funding acquisition, A. S. and M. T.

Conflicts of Interest: Authors declare no conflict of interest.

Data Availability Statement: Not applicable.

Informed Consent Statement: Not applicable.

References

Barro, R. J. (2013). Education and economic growth. *Annals of economics and finance*, *14*(2), 301-328. [Google Scholar]

Bartlett, M. S. (1978). *An introduction to stochastic processes: with special reference to methods and applications*. CUP Archive. [Google Scholar]

Bilas, L. (2020). How education affects business, society and the country. Retrieved from: [Link]

Bosire, J., & Etyang, M. (2003). The Effect of Education on Business Skills Cognition: the case of indigenous microscale enterprise owners in Kenya. *Journal of vocational education and training*, *55*(1), 5-20. [Google Scholar] [CrossRef]

Canals, C. (2017). Education: More Crucial Than Ever. Education and economic growth. CaixaBank Research Monthly Report – Economic and Financial Market Outlook no. 412 (May 2017), 32-34. Retrieved from: [Link]

Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate behavioral research*, *1*(2), 245-276. [Google Scholar] [CrossRef]

Cranson, A. (2018). Does Education Really Drive Success in Business? Harvard Business Review. Retrieved from: [Link]

Greene, P. (2015). Impact Of Education On Business Growth. *Forbes*. Retrieved from: [Link]

Hanushek, E. A., & Woßmann, L. (2007). The role of education quality for economic growth. *World Bank policy research working paper*, (4122). [Google Scholar] [CrossRef]

Hayes, B., & Kotwica, K. (2013). Business Continuity. 2nd Edition, Elsevier. Retrieved from: [Link]

Jimenez, A., Palmero-Camara, C., Gonzalez-Santos, M. J., Gonzalez-Bernal, J., & Jimenez-Eguizabal, J. A. (2015). The impact of educational levels on formal and informal entrepreneurship. *BRQ Business Research Quarterly*, *18*(3), 204-212. [Google Scholar] [CrossRef]

Jiroudkova, A., Anna, L., Strielkowski, W., & Slosarcík, I. (2015). EU accession, transition and further integration for the countries of Central and Eastern Europe. *Economics & Sociology*, *8*(2), 11. [Google Scholar] [CrossRef]

Kaiser, H. F. (1974). An index of factorial simplicity. *psychometrika*, *39*(1), 31-36. [Google Scholar] [CrossRef]

Kambayashi, N., Morita, M., & Okabe, Y. (2008). *Management education in Japan*. Elsevier. [Google Scholar] [CrossRef]

Kanaan-Jebna, J. M. A., Alabdullah, T. T. Y., Ahmed, E. R., & Ayyasamy, R. K. (2022). Firm Performance and the Impact of Entrepreneurial Education and Entrepreneurial Competencies. [Google Scholar] [CrossRef]

Klapper, L., Lusardi, A., and Oudheusden, P.V. (2020). Financial Literacy Around the World: Insights from the Standard & Poor's Ratings Services Global Financial Literacy Survey. Retrieved from: [Link]

Li, M., Li, L., & Strielkowski, W. (2019). The impact of urbanization and industrialization on energy security: A case study of China. *Energies*, *12*(11), 2194. [Google Scholar] [CrossRef]

Lu, J., Ren, L., Qiao, J., Yao, S., Strielkowski, W., & Streimikis, J. (2019). Corporate social responsibility and corruption: Implications for the sustainable energy sector. *Sustainability*, *11*(15), 4128. [Google Scholar] [CrossRef]

Mahmood, R., Zahari, A. S. M., Ibrahim, N., Jaafar, N. F. H. N., & Yaacob, N. M. (2021). The impact of entrepreneur education on business performance. *Asian Journal of University Education*, *16*(4), 171-180. [Google Scholar] [CrossRef]

Manley, E. (1903). The Remote Relation between Education and Business. *The School Review*, 11, no. 7 (Sep., 1903), 563-571. [CrossRef]

Peters, R. M., & Brijlal, P. (2011). The relationship between levels of education of entrepreneurs and their business success: a study of the province of KwaZulu-Natal, South Africa. *Industry and higher education*, *25*(4), 265-275. [Google Scholar] [CrossRef]

Raposo, M. L. B., & Paco, A. M. F. D. (2011). Entrepreneurship education: Relationship between education and entrepreneurial activity. *Psicothema*. [Google Scholar] [CrossRef]

S&P Ratings Services (n.d.). Global FinLit Survey. Retrieved from: [Link]

Sakitri, G. (2020). The relationship among student stress, Type A personality, and academic performance in a business school in Indonesia. *Journal of Education for Business*, *95*(3), 169-179. [Google Scholar] [CrossRef]

Shveda, O. (n.d.). How business education affects the development of future entrepreneurs. Retrieved from: [Link]

Stojanov, R., Strielkowski, W., & Drbohlav, D. (2011). Labour migration and remittances: current trends in times of economic recession. Geografie, 116(4), 375-400. [Google Scholar] [CrossRef]

Tufts University (n.d.a). Digital Evolution Score. Retrieved from: [Link]

Tufts University (n.d.b). Digital Trust. Retrieved from: [Link]

UNDP (n.d.). Human Development Index. Retrieved from: [Link]

Wayland, B. A. (2015). *Emergency Preparedness for Business Professionals: How to Mitigate and Respond to Attacks Against Your Organization*. Butterworth-Heinemann. [Google Scholar] [CrossRef]
World Bank (n.d.a). Enrolment in tertiary education, all programmes. Retrieved from: [Link]
World Bank (n.d.b). Government expenditure on education as % of GDP. Retrieved from: [Link]
World Bank (n.d.c). New businesses registered. Retrieved from: [Link]
World Bank (n.d.d). Overall ease of doing business score as of current data. Retrieved from: [Link]
World Bank (n.d.e). School enrolment, primary. Retrieved from: [Link]
World Bank (n.d.f). Tertiary education, academic staff. Retrieved from: [Link]

Анастасія, Самойлікова, к.е.н., Сумський державний університет, Україна
Валерія, Герасименко, Сумський державний університет, Україна
Анжела Кузнєцова, д.е.н., Сумський державний університет, Україна
Мілош Тумпах, Ph.D., Технічний університет в Брно, Чеська Республіка
Мартіна Баллова, Ph.D., Економічний університет в Братиславі, Словаччина
Лариса Шавга, Ph.D., Кооперативно-торговий університет Молдови, Республіка Молдова
Галацький університет «Dunarea de Jos», Румунія

Вплив освіти на легкість ведення бізнесу в умовах інноваційного розвитку: факторний аналіз та множинна регресія

Освіта є вагомим прискорювачем змін і перетворень у суспільному житті, а також одним із головних факторів прогресу та розвитку як загалом, так і у сфері бізнесу, зокрема. У статті обґрунтовуються та формалізуються взаємозв'язки між показниками рівня освіти (з урахуванням її інноваційного розвитку) та легкості ведення бізнесу на основі вибірки з двадцяти восьми країн світу та даних Світового банку, Організації Об'єднаних Націй, Університету Тафтса та рейтингових служб Standard & Poor's. Метою статті є визначення показників інноваційної освіти, які найбільш суттєво сприяють полегшенню ведення бізнесу. Для цього здійснюється когнітивний аналіз статистичних даних і за допомогою засобів дескриптивного аналізу формується статистично значущий ознаковий простір показників. Перевірка щільності та спрямованості зв'язку здійснюється шляхом обчислення значень коефіцієнтів кореляції Пірсона. Багатовимірність простору вхідних ознак зводиться до чотирьох найвпливовіших показників із дев'яти досліджуваних факторів (індикатор цифрового розвитку; індекс людського розвитку; цифрова довіра, індекс фінансової грамотності) шляхом застосування процедури аналізу головних компонент та ортогонального перетворення за допомогою методу Varimax у пакеті програмного забезпечення Statgraphics Centurion 19. Якість факторизації підтверджується тестом Кайзера-Майєра-Олкіна та критерієм сферичності Бартлетта. У результаті розроблених декількох економетричних моделей, які описують залежність легкості ведення бізнесу від вищезазначених показників, і процедури жорсткого відбору Backward Stepwise Selection у Statgraphics 19, будується та описується статистично значуща модель впливу цифрового розвитку на легкість ведення бізнесу із перевіркою на її адекватність. Виявляється, що зі збільшенням показника оцінки цифрового розвитку на 1% легкість ведення бізнесу також збільшується в середньому на 0,79%. Отримані результати можуть бути корисними науковцям для подальших досліджень, а також законотворцям у сфері освіти та бізнесу, та всім стейкхолдерам у напрямку коопетиції «бізнес – освіта».

Ключові слова: бізнес, викладачі, витрати, вища освіта, людський розвиток, фінансова грамотність, цифрова довіра, цифрова еволюція, школа.