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INNOVATIONS AND INTERNATIONAL COMPETITIVENESS: COUNTRY-LEVEL EVIDENCE

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ABSTRACT. The paper studies the interaction between innovations and international competitiveness and the main objective is to determine the potential impact of innovations on competitiveness and assess the extent of that impact. Therefore, the paper questions (a) whether innovations cause competitiveness, and (b) to what extent the innovations influence competitiveness. Based on the literature review, the export of goods and the number of patent applications (both per million people) are taken as proxies and chosen as indicators for measuring innovations and international competitiveness. Cross-country panel data analysis is performed for a sample of 67 countries over the period of 1993-2020. The selection of countries was based on the availability of data on all variables. The autoregressive model whose dependent variable is the export of goods and the independent variables are the number of patent applications, foreign direct investments, and the real effective exchange rate is estimated using the Random effect model. The results show that patents have a positive impact on export, though its extent is not so significant. The Granger causality test also confirms that patents cause increased export. The research results hold practical value for policymakers.

JEL Classification: O31, F19

Keywords: export, competitiveness, innovation, patent, panel data.

Introduction

According to many schools of thought, innovations are regarded as a determining factor of productivity, which, in turn, enhances the international competitiveness of countries. Alekseeva et al. (2022) argue that innovative activity is the main driver of any economic unit's competitiveness. In particular, innovations are more likely to enhance productivity and more high added value production. More competitive countries are more capable of ensuring their population's well-being. Therefore, continuously studying and exploring all factors affecting competitiveness is always relevant.

So far, very few studies have used large-scale datasets to investigate the intersection of international competitiveness and innovations. Hence, this paper aims to assess the innovations' impact on international competitiveness and its questions are as follows:

a) Do innovations enhance international competitiveness? In other words, do patents cause export?

b) To what extent are patents influencing export?

In order to answer the research questions, a thorough analysis of existing literature on the topic was used as the basis for the choice of innovation and competitiveness measures. As both of them are multidimensional phenomena, there are no generally accepted indicators for either. Competitiveness is often measured through export market share, productivity, or revealed competitive advantage index; patent applications, research and development expenditures, and products and services innovations are used for measuring innovations. However, due to lack of data availability for most of the countries during the time, the export of goods has been chosen as a proxy for competitiveness, while the number of patent applications has been set as a proxy for innovations. The sample comprises 67 countries – those which have all data for 1993-2020 or only 3 missing data points across all variables. Cross-country panel data analysis has been chosen as the primary research method. Export of goods per million people is taken as a dependent variable; the independent variables include number of patent applications per million people, share of foreign direct investment in GDP, and real effective exchange rate. All diagnostic tests for checking heteroscedasticity and autocorrelation are applied before the model is estimated through the random effect model. After that, "remedy" measures are undertaken. The results are discussed in the penultimate part followed by the final conclusions.

1. Literature review

Innovation as a driver of economic growth has evolved over time, encompassing not only new technologies but also non-technological sectors. Still, at the outset of the 20th century, J. Schumpeter introduced innovation as a dynamic process in which new technologies replace old ones, giving rise to what he termed "creative destruction". According to Schumpeter (2010), development is caused by innovation (new combinations). The latter encompasses several aspects, including the introduction of a new product (one that consumers are not yet familiar with or an enhancement to an existing product), the adoption of a new production method (which may not necessarily be the result of scientific findings but could also involve a new approach to commercializing a product), the expansion into new markets (whether or not these markets existed previously), the procurement of new sources for raw materials and other resources (irrespective of their preexistence), and the implementation of new organizational strategies (such as attaining a monopoly position or losing one).

A comprehensive definition of innovation has also been given by the OECD (2018), which since 1992 has published and periodically revised the Oslo Manual of Innovation Statistics as internationally accepted guidelines for measuring innovation and innovative activity. A comprehensive definition of innovation has also been provided by the OECD (2018), which, since 1992, has published and periodically revised the Oslo Manual of Innovation Statistics. This manual serves as internationally accepted guidelines for measuring innovation and innovative activities. In accordance with the latest Oslo edition of October 2018, an innovation is defined as a new or improved product or process (or a combination thereof) that is significantly different from the unit's previous products or processes and that is available to its potential users (in the case of product innovation) or applied by the given unit (process innovation).

When it comes to empirical papers, long-standing studies primarily employ R&D expenditures or the number of patent applications as a measure of innovations. In a paper that examines firms' innovation performance, the degree of radical innovation, and challenges in measuring innovation, the author employs patents as a metric for innovation (Katila, 2000). The author concludes that patents and the successive patents that refer to them enable a valuable way to measure innovations. Patent data is also valuable for monitoring competitors' activities and identifying technological trends. In another study conducted by Burhan et al. (2017) on Indian Public Funded Research Organizations, patents are examined as a proxy for innovation. The study concludes that measuring innovations through granted patents, rather than filed patents, offers a more useful approach.

While patents can be a useful measure of innovation, it's important to note that there are drawbacks associated with this approach. This concern is addressed in a technical report by the European Commission (2021) that focuses on tracking the clean-energy innovation performance of EU member states. The report highlights two primary problems associated with using patents as a measure of innovation. First, there are practical problems concerning data quality and the risk of double counting. Second, there are fundamental issues, including time lags between policy implementation and patent issuance, variations in countries', sectors', and time periods' propensity to patent, disparities in the value of patents, and differences in R&D and innovation resources." However, considering that patenting an invention is a clear indicator of successful innovation, and given the widespread availability of patent statistics in all countries, patents are commonly utilized as a proxy to measure innovation. The aforementioned technical report also relies on patents as a measure of innovation in the development of its composite indicator.

Many studies also employ firm-level data on innovative activities collected through surveys. In a study by Bronwyn and Mairesse (2006), they analyzed ten papers that examined various aspects of innovation using firms' survey data and underscored the significance of this data source. Another study (Tadevosyan, 2021) discussing Armenian enterprises' innovative activity also uses survey-based data. However, in contrast with patent data, firms’ level survey data is not universally available for all countries, and when it is, it is often irregular, limited to only one year or a few years. This limitation makes it impossible to conduct research based on panel data.

When considering R&D expenditure as a proxy for innovation, it's worth noting that the available data is more limited, both in terms of temporal coverage and the number of countries included. In the case of most countries, data is available from 2000 onwards, with 47 countries having data from that year. However, there are still gaps in the data for some years.

In contrast, the number of patents, as an alternative measure, has been available since 1993 and is supported by data from 67 countries. Despite its limitations, the number of patents is a well-established indicator and proxy for innovation. Therefore, in this study, we adopt the number of patent applications per million people as a proxy for innovation.

In regard to international competitiveness as a complex and multifactorial concept has been repeatedly discussed by economists. It has continuously evolved with the inclusion of various additional phenomena and factors, yet a definitive, unified definition remains elusive. The challenge of measuring it remains unsolved and is a topic of ongoing debate. In essence, there exists neither a universally accepted definition nor a standardized method for measuring international competitiveness. Nevertheless, it is widely regarded as a critical indicator of a country's economic development.

The Organization for Economic Development and Cooperation (OECD) defines competitiveness as a country's ability to sell its products on the world market. It primarily assesses competitiveness based on sectoral productivity levels, as higher productivity is seen as a key driver of increased competitiveness. Simultaneously, drawing from a previous OECD study (OECD, 1998) that employed regression analysis to estimate the impact of manufacturing exports on competitiveness indicators during the period from 1975 to 1998, it acknowledges a positive relationship between competitiveness and export share. The study regards the export share as an indicative measure of competitiveness.

According to Harvard University professors Bruce and George (1985), competitiveness is the ability of a country to create, produce, ship goods, and/or provide services in international trade, ultimately leading to a sustained increase in income.

A widely accepted definition of competitiveness is provided by Laure Andrea Tyson (1992), the former head of the US Council of Economic Advisers. According to her, competitiveness is the ability to produce goods and services that meet international standards, thereby ensuring a high and stable standard of living for the population

According to economist Michael Porter (1990), one of the world's most influential thinkers in the field of management and competitiveness, national competitiveness hinges on a country's industry's ability to innovate and modernize. In his work, "The Competitive Advantage of Nations," he utilizes the presence of stable and substantial exports to other countries as an indicator of competitiveness, along with the investments made in other countries, leveraging the skills and assets developed within the given country.

The Global Competitiveness Index (GCI) published by the World Economic Forum (Schwab, 2019) provides a widely distributed assessment of competitiveness. The index consists of 12 pillars, which in turn include 98 indicators. Notably, one of these 12 pillars exclusively focuses on innovation capacity, while the remaining 11 encompasses institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, and business sophistication.

In the economic literature, Bela Balassa's index (Balassa, 1965) of revealed comparative advantage (RCA) is often employed to gauge international competitiveness. This index unveils a country's comparative advantage in a particular industry or product and is calculated as the ratio of that country's share of exports in a specific industry or product to the global or group-of-countries' share of exports in the same industry or product. This index measures relative rather than absolute advantage. It is possible for a particular product or sector to have a large weight in the export of a specific country, but an insignificant share in the global export of that same product, therefore that it may not be suitable to use it as an indicator of international competitiveness in this study.

Another indicator commonly used to measure international competitiveness is the Export Market Share (EMS), which is generally measured by relating a given country's exports to global or regional exports expressed as a percentage. The European Commission (2021) also calculates this indicator for EU countries, revealing the significance of a country's exports within the context of global or regional exports. This indicator is frequently employed to calculate the export share of various industrial sectors. However, the use of this indicator is also not suitable for this research because the study encompasses 67 countries with varying levels of development and significantly different economic sizes. It does not fit the context of integration union countries with similar development levels and comparable economic sizes. This is why it is deemed appropriate to use exports per million people, which, while not resolving the issue arising from developmental disparities, does consider the size of the economy.

Thus, the examination of the concept of international competitiveness and its measurement by various authors reveals that although competitiveness is a multidimensional concept, when assessed at the international level, the focus is primarily on competition among countries. Other measures, such as productivity and profitability, do not necessarily emphasize the international dimension. All these definitions assert that a country's competitiveness is manifested in its capacity to produce goods and services that meet international market demands, thereby generating income that contributes to the continuous improvement of the well-being of its population. Thus, guided by the literature review, this study employs the export of goods per million population as an indicator of international competitiveness.

2. Methodological approach

As mentioned earlier, this study uses the number of patent applications by residents per million people as a proxy for innovations, and the export of goods per million people is employed as a proxy for international competitiveness, based on the literature review. Initially, data on the export of goods is sourced from UNCTAD, while data on the Patent applications are taken from WIPO statistical database. Subsequently, to account for differences in country sizes, both sets of data are adjusted per million people. As other determinants of competitiveness (export) Real Effective Exchange Rate and inward FDI % in GDP are taken. All variables and their sources are depicted in table 1.

Table 1. Variables and sources

Variables	Source
Export of Goods	UNCTAD
Number of Patent Applications by Residents	WIPO statistical database (last updated 2021 November)
Inward Foreign Direct Investment (FDI) Flows % of GDP	UNCTAD
Real Effective Exchange Rate (REER)	Bruegel-European Think Thank
Population	UN Population Division, World Population Prospects (2021)

Sources: developed by the author

Effects related to FDI emerge as a result of multinational companies' presumed greater knowledge and advanced technologies. Some empirical results (Kutan & Vukšić, 2007) indicate that FDI increases domestic supply capacity, consequently boosting exports. Hakhverdyan and Shahinyan (2022) studying competitiveness, innovation and productivity issues, also used FDI as one of the primary factors influencing competitiveness. UNCTAD's empirical research also reveals FDI's positive influence on export performance. This is explained by the fact that FDI transforms the export structure by contributing to the increase of its technological component (UNCTAD, 2005). Another empirical analysis by the IMF (Jirasavetakul & Rahman, 2018) reveals that FDI has played a crucial role in export-led growth in the new EU member countries of Eastern Europe. The analysis also indicates a shift in export composition from low technology intensity to high technology intensity. Measures of capital intensity or investment activities have also been extensively used in empirical models of export propensity and intensity. Investing in physical assets is expected to be positively associated with a firm’s probability of joining international markets and maintaining its market power. According to Tovmasyan (2021), in a study focused on capital investments and tourism development issues, it was found that capital investments enhance international competitiveness. Therefore, as a factor affecting export, FDI is taken, but as a percentage of GDP, again to account for size differences of the economies.

Real Effective Exchange Rate (REER) has always been considered one of the main factors affecting export and, consequently, competitiveness. An increase in REER indicates that exports become more expensive; therefore, a rise in REER results in a decrease in trade competitiveness (IMF, 2022). Another study (Sato et al., 2020) that investigated export price competitiveness also employed REER as a determinant of export performance. In their discussion of competitiveness in the industry sector, Avagyan et al. (2022) utilized exports as an indicator of competitiveness and for independent variables, REER, total industrial production, and lagged GDP values were used.

To estimate the factors influencing international competitiveness, particularly the export of goods, we employ the Panel Data Autoregressive model. The model utilizes data spanning 27 years, covering 67 countries from 1993 to 2020. All countries with complete data or 1-3 missing values for all dependent variables have been included in the model. A description of the variables is provided in Table 2.

Table 2. Variable descriptions

Variable description	Variable name	Expected sign
Export of Goods per million population	ExpG	Dependent variable
Number of Patent Applications by Residents per million population	PatP	+
Real Effective Exchange Rate	REER	-
Inward Foreign Direct Investment Flows % of GDP	FDI	+
The lagged value of ExpG	ExpT	+

Sources: developed by the author

The model used to asses the effects of macroeconomic factors on international competitiveness is as follows

$$Y_{it}=b_0+b_1X_{1it}+ b_2X_{2it}+ b_3X_{3it}+ b_4Y_{(t-1)it}+ \alpha_i+ \varepsilon_{it}$$

$i = 1, 2, \ldots, 67$

$t = 1, 2, \ldots, 28$

Where Y_{it} represents the export of goods per million population, X_{1it} is the Number of Patent Applications by Residents per million population, X_{2it} is REER, X_{3it} is FDI % in GDP, $Y_{(t-1)it}$ is the lagged value of Y_{it}, αi is the unobserved country-specific effect and ε_{it} is the error term, *i* denotes countries, and *t* denotes time.

The model is estimated, and diagnostic tests are conducted using the R statistical program, as further detailed in the next section.

3. Conducting research and results

Do innovations affect a country’s international competitiveness and to what extent? To answer this question panel data autoregressive model is constructed. To address the issue of heteroscedasticity, which arises due to differences among countries, certain variables have been transformed logarithmically. Figure 1 depicts the logarithmic transformation of export and the number of patent applications per million people.

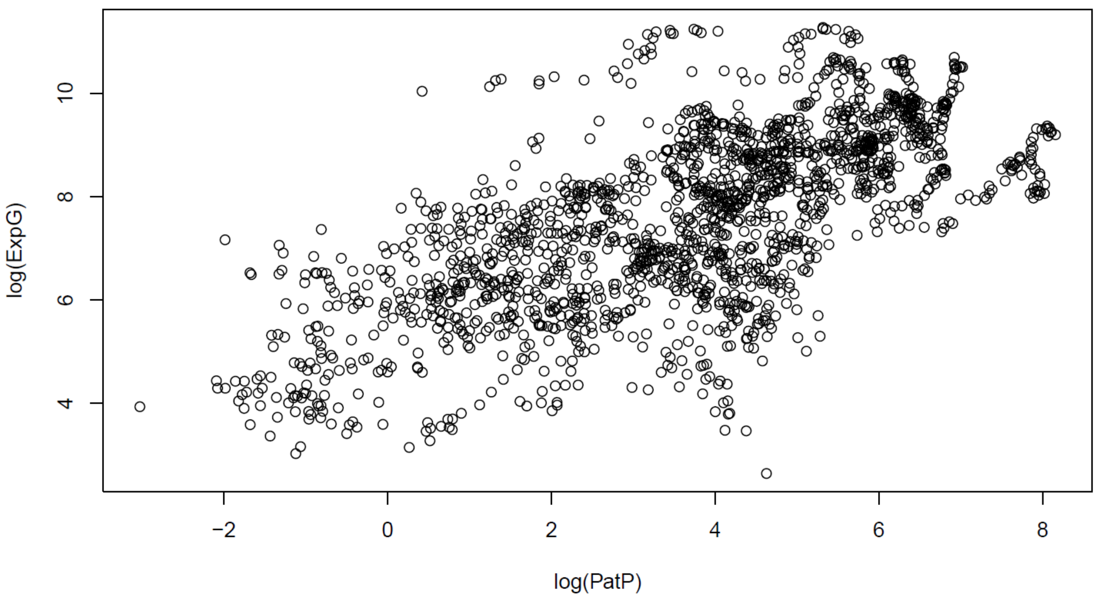

Figure 1. Logarithmic transformation of export and the number of patent applications per million people.
Sources: developed by the author using the R programming language

Figure 1 makes it evident that the logarithmic transformations of exports and the number of patent applications exhibit a linear relationship between them, which supports the use of the adopted panel data regression model. There are several techniques to estimate panel data regression models (Gujarati, 2003) with the most popular two models are Random Effects Model (REM) or Error Component Model (ECM) and Fixed Effects Model (FEM). There are certain guidelines to help choose between them, including a test called the Hausman test. One of these guidelines postulates that if the number of cross-sectional units, in this case, countries (67 countries) is greater than the number of time series (27 years), then REM estimators are more efficient than FEM estimators (Taylor, 1980). Therefore, REM is chosen for the model estimation. So, the specified model is the following;

$$Log(ExpG)_{it}=b_0+b_1 \log(PatP)_{1it}+ b_2 (REER)_{2it}+ b_3(FDI)_{3it}+ b_4\log(ExpT)_{it}+ \alpha_i+ \varepsilon_{it}$$
$i = 1, 2, \ldots,67$
$t = 1, 2, \ldots, 28$

The dependent variable is the logarithm of the export of goods per million population, b_0 is the intercept of the model, while the other b-s are coefficients indicating the change in the dependent variable (in our case log of export of goods per million people) for every unit change in the corresponding independent variable, with all other variables held constant. $(ExpT)_{it}$ is the lagged value of $ExpG_{it}$,, αi is the unobserved country-specific effect, ε_{it} is the error term, i denotes countries, and t denotes time.

Once the preferred estimation methodology is established, the next step involves checking the key diagnostics of the models. Heteroscedasticity is commonly present in panel data analysis when countries of different sizes and economic development levels are assessed. In the presence of heteroscedasticity, estimates are still consistent but not efficient and their standard errors are biased. To test for heteroscedasticity, the Breusch-Pagan test is applied. The null hypothesis of this test is homoscedasticity. The results of the Breusch-Pagan test are depicted in table 3.

Table 3. Results of the Breusch-Pagan test

Breusch-Pagan	Degrees of freedom	p-value
30.514	3	3.846e-06
Model data: log(ExpG) ~ log(PatP) + REER + FDI + log(ExpT)		

Sources: developed by the author based on R programming language

The results indicate that the p-value is less than 0.05, indicating the presence of heteroscedasticity (even after logarithmic transformation). Nevertheless, this issue can be readily addressed by employing robust standard errors..

Serial correlation is also highly likely to be present in panel data estimations. To check for autocorrelation, a diagnostic statistic such as the Wooldridge test is applied. The results of the latter are presented in table 4.

Table 4. Results of the Wooldridge test

Chi-square	Degrees of freedom	p-value
187.81	24	< 2.2e-16
data: log(ExpG) ~ log(PatP) + REER + FDI + log(ExpT)		

Sources: developed by the author based on the R programming language

Again, the p-value is less than 0.05, confirming the presence of autocorrelation.

To ensure that the statistical inference is valid, the aforementioned specification issues need to be addressed. To robust standard errors and control serial correlation, “vcovHC” and “arellano” commands are applied in R studio. The estimated results of the final REM autoregressive model after these adjustments are summarized in table 5.

Table 5. Random Effects Model (REM) estimation results

Variable	Coefficient	Std. Error	z-vale	p-value
Intercept	0.28440257	0.05930952	4.7952	1.625e-06
log(PatP)	0.00972848	0.00369314	2.6342	0.004332
REER	-0.00061332	0.00020182	-3.0389	0.002374
FDI	0.00402397	0.00105567	3.8118	0.000138
log(ExpT)	0.97212333	0.00742409	130.9417	< 2.2e-16
Adj. R-Squared: 0.99219				
Chisq: 433657 on 4 DF, p-value: < 2.22e-16				

Sources: developed by the author based on R programming language

The model is overall significant as the p-value (< 2.22e-16) of the model Chi-square test is less than 0.05. Furthermore, all the coefficients' p-values are also less than 0.05, confirming their significance. The overall results suggest a positive impact of the number of patent applications on the export of goods, although the effect size is relatively weak. On average, while holding other factors constant, a 1 percent increase in the number of patent applications is estimated to result in a 0.009 percent increase in exports. Though the significance is strong, the economic impact is relatively modest, requiring a 20 percent increase in the number of patent applications to raise exports by 0.2 percent $((1.2)^{0.000972848} -1)*100)$. The moderate impact may be attributed to the fact that patents may not perfectly represent innovations. But the latter is a broad concept and hard to measure at the level of countries. OECD’s (2018) definition of innovation regards a new or significantly improved product or service that should be sold in the market. However, for the majority of countries, such statistics are not conducted annually or at other regular intervals, which makes panel analysis impossible due to the absence of time series data. Consequently, in the context of macro-level analysis, where innovation is a central component of interest, it is often represented by several proxy measures. Nonetheless, proxies do not fully capture the essence of the phenomenon, which can affect the model outcomes.

As anticipated, the effect of REER is negative; in other words, a 1 percent decrease in REER increases exports by approximately 0.06 percent (EXP((-0.0006)-1)*100), ceteris paribus. However, it is important to note that this effect, in economic terms, is not very strong either. The magnitude of the impact may vary for countries with different levels of development. The added value of products generally increases over time. Moreover, developed countries are known for producing and exporting high-value-added products with relatively low price elasticity, resulting in a diminishing influence of REER.

As expected, FDI appears to have a positive impact on exports, and this impact is somewhat stronger. In other words, a 1 percentage point increase in the FDI-to-GDP ratio results in a 0.4 percent increase in exports, with all other factors held constant.

Alongside panel data analysis, the Granger causality test is applied to investigate the causal relationship between exports and innovations.

H0: Patents do not Granger causes the export

H1: Patents Granger causes the export

Before applying the Granger causality test, it is necessary to check the stationarity of the series. To achieve this, the Augmented Dickey Fuller test is employed. Based on the test results, the first-difference method is applied to ensure the stationarity of the series. Subsequently, the Granger causality test is applied which results are depicted in table 6.

Table 6. Granger causality test results

Model 1: Exp1 ~ Lags(Exp1, 1:12) + Lags(pat1, 1:12)				
Model 2: Exp1 ~ Lags(Exp1, 1:12)				
	Res. Degrees of freedom	Degrees of freedom	F	Pr(F)
1.	1722			
2.	1734	-12	1.7677	0.04831

Sources: developed by the author based on R programming language

Since Pr(F) is less than 0.05, the null hypothesis is rejected with the conclusion that patents cause the export and not vice versa.

The empirical application of statistical tests confirms that patents have a positive influence on exports, even though the effect is not very strong.

In summary, the empirical analyses in this article provide sufficient evidence to support the hypothesized positive relationship between the number of patent applications (a proxy for innovations) and the export of goods per million population (a proxy for international competitiveness).

Conclusion

The article analyzed the impact of patent applications on the exports of 67 countries using a cross-country panel dataset spanning from 1993 to 2020. An alternative measure of international competitiveness is the export of goods per million people. And using the number of patent applications as a proxy for innovations, this empirical research demonstrates a positive impact on international competitiveness.The latter is also influenced by foreign direct investments and real effective exchange rates. While the first has a positive impact on competitiveness, the real effective exchange rate influence is negative as expected. In addition, the analysis also applied the Granger Causality to determine the causal relationship between exports and the number of patent applications. Consistent with the expectations, the empirical findings indicate that patent applications Granger-cause exports. This observation further validates the chosen model for this research. These findings further support the hypothesis that countries with higher levels of innovation are more likely to increase productivity, thereby enhancing their international competitiveness, especially in high-value-added manufacturing sectors. Thus, countries pursuing export promotion policies should also incentivize innovation. Hence, future studies should investigate national innovation policies and propose efficient strategies to attain the highest potential level of innovation performance. In general, this study enriches the series of empirical economic research in the sense that it examines the relationship and direction of influence of international competitiveness and innovation at the macro level.

References

Alekseeva, N., Klochkova, A., & Margaryan, A. (2022). Innovation Cluster As A Tool For Innovative Development Of The Russian Economy. *International Scientific Conference: European Proceedings of Social and Behavioural Sciences.* 126, 52-62. European Publisher. https://doi.org/10.15405/epsbs.2022.06.7

Avagyan, G., Vardanyan, K., Petrosyan, G., Navasardyan, M., & Margaryan, A. (2022). *Opportunities for increasing the competitiveness of RA Industry.* Yerevan: Tntesaget. Retrieved from https://asue.am/upload/files/amberd/%D4%B1%D5%B4%D5%A2%D5%A5%D6%80%D5%A4%2051.pdf

Balassa, B. (1965). Trade Liberalization and Revealed Comparative Advantage. *Manchester School of Economic and Social Studies, 33*, 99-123. https://doi.org/10.1111/j.1467-9957.1965.tb00050.x

Bronwyn, H., & Mairesse, J. (2006). Empirical studies of innovation in the knowledge-driven economy. *Economics of Innovation and New Technology, 15:4-5,* 289-299. https://doi.org/10.1080/10438590500512760

Burhan, M., Singh, K., & Jain, K. (2017). Patents as proxy for measuring innovations: A case of changing patent filing behavior in Indian public funded research organizations. *Technological Forecasting and Social Change, 123,* 181-190. https://doi.org/10.1016/j.techfore.2016.04.002

Brugel-European Think Thank. Retrieved from https://www.bruegel.org/publications/datasets/real-effective-exchange-rates-for-178-countries-a-new-database

European Commission. (2021). Retrieved from https://ec.europa.eu/eurostat/web/products-datasets/-/tipsex20

European Commission, Directorate-General for Research and Innovation. (2021). *Patents as a measure of innovation performance: selection and assessment of patent indicators:*

provision of technical assistance and study to support the development of a composite indicator to track clean-energy innovation performance of EU members. Publications Office. Retrieved from https://data.europa.eu/doi/10.2777/77424

Gujarati, D. N. (2003). *Basic Econometrics (4th ed.).* New Delhi: Tata McGraw- Hill Publishing Company Ltd, 640-652.

Hakhverdyan, D., & Shahinyan, M. (2022). Competitiveness, Innovation and Productivity of the Country. *Marketing and Management of Innovations*(1), 108-123. https://doi.org/10.21272/mmi.2022.1-08

IMF. (2022). Retrieved from https://datahelp.imf.org/knowledgebase/articles/537472-what-is-real-effective-exchange-rate-reer#:~:text=An%20increase%20in%20REER%20implies,(IFS)%20dataset%20portal%20here

Jirasavetakul , L., & Rahman, J. (2018). *Foreign Direct Investment in New Member State of the EU and Western Balkans: Taking Stock and Assessing Prospects.* IMF. Retrieved from https://www.imf.org/en/Publications/WP/Issues/2018/08/21/Foreign-Direct-Investment-in-New-Member-State-of-the-EU-and-Western-Balkans-Taking-Stock-and-46152

Katila, R. (2000). Measuring innovation performance. *International Journal of Business Performance Measurement, 2,* 180-193. Retrieved from https://web.stanford.edu/~rkatila/new/pdf/KatilaUsingpatentdata.pdf

Kutan, A., & Vukšić, G. (2007). Foreign Direct Investment and Export Performance: Empirical Evidence. *Comp Econ Stud, 49*, 430-445. https://doi.org/10.1057/palgrave.ces.8100216

OECD. (1998). *Trends in OECD Countries' International Competitiveness: The Influence of Emerging Market Economies.* OECD, Economics Department. Paris: OECD Publishing. https://doi.org/10.1787/345570563225

OECD/Eurostat. (2018). *The Measurement of Scientific, Technological and Innovation Activities.* Paris, Luxemburg: OECD Publishing. https://doi.org/10.1787/9789264304604-en

Porter, M. (1990). The Competitive Advantage of Nations. *Harvard Business Revie*, 73-91. Retrieved from https://economie.ens.psl.eu/IMG/pdf/porter_1990_-_the_competitive_advantage_of_nations.pdf

Sato, K., Shimizu, J., Shrestha, N., & Zhang, S. (2020). New empirical assessment of export price competitiveness: Industry-specific real effective exchange rates in Asia. *The North American Journal of Economics and Finance, 54*. https://doi.org/10.1016/j.najef.2020.101262

Schumpeter, J. (2010). *Capitalism, Socialism and Democracy* (1st ed.). London: Routledge. Retrieved from https://eet.pixel-online.org/files/etranslation/original/Schumpeter,%20Capitalism,%20Socialism%20and%20Democracy.pdf

Schwab, K. (2019). *The Global competitiveness report 2019.* Geneva: World Economic Forum. Retrieved from https://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf

Scott, B. R., & George, L. C. (1985). *U.S. Competitiveness in the World Economy.* Boston: Harvard Business School Press. Retrieved from https://www.hbs.edu/faculty/Pages/item.aspx?num=7176

Tadevosyan, R. (2021). Core determinants of companies innovation performance: case for Armenia. *Marketing and Management of Innovations, 3*, 108-116. https://doi.org/10.21272/mmi.2021.3-09

Tovmasyan, G. (2021). Capital investments, tourist tax and tourism development: The case study of Armenia. *Economics and Sociology, 14(1),* 199-213. https://doi.org/10.14254/2071-789X.2021/14-1/13

Tyson, L. D. (1992). *Who's Bashing Whom? Trade Conflict in High Technology Industries.* Washington, DC: Peterson Institute for International Economics. Retrieved from http://cup.columbia.edu/book/a/9780881321067

UNCTAD. (2005). Retrieved from https://unctad.org/system/files/official-document/ditctab20051ch2_en.pdf

UNCTAD. Retrieved from https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sCS_ChosenLang=en

UNCTAD. Retrieved from https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=96740

UN Population Division. (2021). World Population Prospects. Retrieved from https://population.un.org/wpp/

WIPO statistical database. Retrieved from https://www3.wipo.int/ipstats/index.htm?tab=patent