Research Article

Innovation as an accelerating effect on Gross Domestic Product (GDP) per capita

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Abstract

Most economists agree that innovation is a key driver of economic growth, prosperity and human well-being. Patents are an important indicator of innovation output. This study aims to investigate the relationship between patents as an innovation output and Gross Domestic Product (GDP) per capita as an economic welfare.
In the study 166 countries were analyzed and a high positive correlation between patent grants per million population and GDP per capita as 0.804. The inequality in income distribution in the world is also clearly seen in the distribution of patent grants. High-income countries have 61 percent of global income whereas they have 66.9 percent of total patent grants in the world. Low-income countries have 0.5 percent of global income whereas they have 0.3 percent of total patent grants in the world. Global average patent grants per million population is 221.3 in 2020. Patent grants per million population is 943.6 in high-income countries and 8.6 in low-income countries. Test results show that, the natural logarithm of patent grants per million population increase 10 percent, it causes approximately 4.1 percent increase in natural logarithm of GDP per capita. In other words, if patent grants per million population in the world increase 23.3, it causes approximately 523.1 USD increase in global GDP per capita in average.

Keywords: Innovation, Patents, GDP per capita

1. Introduction

According to the neoclassical growth theory put forward by both Solow (1956) and Swan (1956), technology besides labor and capital is crucial factor of economic growth. He assumed that the countries will have the same steady state in long-run due to the conditional convergence, so they will converge, thus the poorer countries will catch up the rich countries. Solow (1956) defined the particularly easy type of technological change as simply multiplying the production function by an increasing scale factor and indicated that technological progress is the only factor, which effects the long-run economic growth rather than capital and labor force. The fact that countries have limited capital and labor, using these factors will cause diminishing marginal returns hence the addition amount of one of these factors of production change the output less than the increase in factors. However, the emergence of economic growth as a result of usage of an unlimited resource such as knowledge, technology and innovation can be explained by the law of increasing marginal returns. The former, which accepts the technology as a multiplier of production function, explains the exogenous growth model while the latter, which involves the technology inside the production function, is the assumption of the endogenous growth model (Chirwa and Odhiambo 2018). Contrary to Solow's view, Romer (1986) stated that per capita output does not need to converge in different countries which have different income per capita; and argued that growth may be consistently slower in less developed countries or may not even occur at all.

Romer (1990) described the stock of human capital as main determinant of the economic growth rate. Romer identified the ideas as non-rival and partially excludable good rather than standard and ordinary rival goods. The ideas can be used by other persons even after the owner’s death too and can be protected by patents. The design can take place either inside the firm or the firm can produce the actual good under the permission and license of another firm who has patent of the design. The idea owner firm will be a monopolistic power rather than a price-taker firm as in the perfectively competitive market. There is increasing return to scale and the scale is human capital (skilled labor as a result of formal education and on-the-job training) not the population. The output will increase more than the increase in rival inputs (capital, labor) when they were used with non-rival inputs (ideas). The rate of production of new designs by researcher can be explained by human capital and knowledge stock so that the growth in knowledge stock increases the productivity of human capital in the research sector. New ideas will make labor more productive. Romer’s economy model has three sectors:

- The research (R&D) sector, which uses human capital and the existing stock of knowledge to produce new knowledge and designs for new producer durables,

- Intermediate-goods sector, which uses the research sector's designs to produce the large number of producer durables that are available for use in final goods production at any time,
- Final goods sector, which uses labor, human capital, and the set of producer durables that are available to produce a consumed or saved as new capital output.

A successful patented innovation is the motivation of research firms who expects the monopoly profit until a next innovation which will obsolete the current intermediate. According to the economic growth model proposed by Aghion and Howitt (1992), only technological progress which was emerged due to the competition among innovative research firms, causes economic growth. They were influenced by Schumpeter's creative destruction process and stated that each innovation consists of a new intermediate that can be used to produce the final output more efficiently than before. Technical change enables the reallocation of resources, including labor, between industries and firms. Technical change can cause creative destruction. It may also include mutual advantage and support among competitors or between suppliers, manufacturers and customers (OECD/Eurostat/European Union 1997). Schumpeter (1942) stated that as a result of the innovation resulting from the opening of new markets and organizational development, new production units replace the outdated ones, lead to a process that radically changes the economic structure from within, constantly destroys the old one, and creates the new one. Briefly, it both increases the productivity and causes creative destruction as a result of industrial mutation.

Innovation, as a driven force of the development of a country, is very important for the competition of both firms at micro level and countries at macro level in international markets. Simply put, more output with the same input, meaning innovation can lead to higher productivity. Thus, thanks to increased productivity, the economy grows and as productivity rises, the wages of workers increase (European Central Bank, 2017).

Schumpeter (1947) defined the adaptive response as the economy or an industry or some firms in an industry do something that is inside of the range of existing practice, whereas the creative response as outside of existing practice. The defining characteristic of entrepreneur is simply to do new things or do things in a new way that are already being done, hence it is innovation. A firm can be both inventor and entrepreneur. The inventor produces ideas, the entrepreneur does the things, which may but need not embody anything that is scientifically new. The innovative entrepreneurs can either reform or revolutionize the production pattern. It can be either by an invention or, more generally, an untried technological possibility to produce a new commodity or an old one in a new format. The new format may be to open a new source of supply for inputs or intermediate (semi-manufactured) products or a new outlet (market) for products, or it may be to reorganize an industry (a new form of industrial organization). Schumpeter (1942), described the innovation as the activity of capitalist enterprises.

He also kept the "invention" distinct from the "innovation" and stated that entrepreneurs do innovation. Innovation is possible without invention, and not every invention necessarily means that it will stimulate an innovation, and invention by itself does not have an economically meaningful effect (Schumpeter 1939). Innovations are not evenly distributed over time, they tend to cluster and appear in bunches. First, some firms, and then most firms, follow a successful innovation. Innovation is not randomly scattered throughout the entire economic system at any given time, but tends to be concentrated in certain sectors and environments (Schumpeter 1939).

Invention, which is the pre-stage before innovation, constitutes the first development of a scientifically or technically new product or process. Innovation is accomplished by introducing an invention, consisting of a new product or process, to the market. Diffusion (or dissemination) is the process that sees a successful innovation gradually become widely available for use in relevant applications through adoption by firms or individuals (Schumpeter (1942, OECD 2003). The invention phase has less impact on the state of an economy than the diffusion and imitation process (Śledzik 2013).

There is a technological gap between the scientific/technological leader (frontier) economies and the follower ones who behind the leaders. The former, has the opportunity to "catch up" the latter by importing and diffusing the advanced technologies, which belong to the leader economies. Economic growth rate will be inevitably different between the countries so that the technological leader economies grow at a rate at which they move whereas the small or follower economies grow at a speed of their adaptation and usage of the technologies of the leaders (Smith 1994).

The firms, which have monopolistic power to apply higher prices in the markets have more advantage than the price-taker ones in perfectly competitive markets so that their maximized profits can be used for new research and development (R&D), patent grants and hence innovation. The monopolistic profits will push firms to produce more sophisticated goods and services, so that the combination of exports of the countries, which host innovative firms, will be more value-added (higher unit export value) than other countries. Patent grants, which are output of researchers and R&D expenditures' innovative activities will cause an increase in high-tech exports (Gürler 2021).

Development starts with usage of labor in primary sectors such as agriculture due to the labor factor abundance in low income countries, which have enough population. At second stage of development, industrialization starts and productivity and efficiency become important in secondary sectors. Basic inputs such as labor is retrieved from migration from rural to urban regions and capital is used from domestic or other countries' savings as investments. In addition, the developing countries can get credits from international financial markets Due to the lack of capital. At this stage, technology is imported till the sufficient know-how accumulation emerges at universities and entrepreneurs (Gürler 2021).

Competitive thoughts should diffuse all over the country starting from individuals to the firm level. A creative generation should be achieved by giving importance and priority to the human capital in the country. Government and universities should help the private sector to access the technology at the beginning. Private entrepreneurs should be supported to make R&D and innovation by incentives and tax reliefs. The country as a whole should be a technology producing country rather than a technology importer and user (Gürler, 2016). The competition is not only at country level, but between the regions, cities and even the enterprises as well. Even the cities are in a competition to create an eco-system where the domestic and foreign the entrepreneurs can make their investment and production, by registering their patents, designs and innovations and exporting their competitive products and services in the international markets (Gürler 2021). Exiting from the Middle Income Trap will only be possible by new technological progress through R&D, education and institutional innovation rather than investing more capital (Yeldan et al., 2012).

R&D, technological improvements, innovation and patents become the main determinants of a firm and country's competitiveness in Industry 4.0 and Industry 5.0 eras. Competitiveness of countries comes from the competitiveness of entrepreneurs. While the state and universities lead R&D in the first stage of development, activities of the R&D companies/centers, R&D carried out within the scope of companies and made by universities should create technology and innovation in following stages. In particular, entrepreneurial universities and the private sector can be both in cooperation and competition to make innovation.

Porter (1990) stated that the firms can achieve competitiveness through innovation activities. Porter (1998) classified the countries by their development stages as input driven (primary sectors), investment driven (secondary sectors of industrialization), innovation driven and wealth driven. The World Economic Forum (2016) used similar country classification as Porter in their Global Competitiveness Index (Reports), and divided the countries by their development stages as factor (inputs/resources) driven, efficiency driven and innovation driven countries.

WEF (2017) describes innovation-driven countries as the countries have R&D, patents and innovation to achieve more sophisticated products and production process. If there is a long-term stay at a certain income level whether low or middle, the country can be said to be trapped. In middle-income countries, if GDP per capita, which is stuck in a certain range, is a sign that the country has fallen or is about to fall into the Middle

Income Trap. However, if the stagnation in income per capita growth is short-term and the economy can recover and the growth trend continues, it will not be difficult for the country to get out of the trap (Gürler 2016).

Invention, innovation and patents are related topics so that a patent has an exclusive right granted to an invention, which may be either a product or process. In the patent application, it is obligatory to disclose the technical information about the invention to the public (WIPO, 2022a).

On the other hand, GDP per capita is one of the main indicators of a country's economic performance. It is commonly used as a broad measure of average living standards or economic wellbeing in a country, however average GDP per capita gives no idea about how GDP is distributed between citizens. In a country, increasing average GDP per capita does not mean that it distributes equally. As GDP per capita increases, inequalities between the citizens may also increase so that more people may be worse off (OECD 2012).

As mentioned above, innovation is the core determinant of long-run economic growth. This study aims to investigate the relationship between patent, which is one of the core output of innovation and GDP per capita, which is an important indicator of economic welfare, prosperity and human well-being in a country.

2. Materials and Methods

In this study, the relationship between total patent grants (direct and PCT national phase entries) for the year 2020 and GDP per capita in current USD prices for 166 countries for 2021 year. The data for patent grants were collected from the WIPO (2022b) and the data for GDP per capita and population were from the International Monetary Fund (IMF) (2022). Patent grants per million population for each country was taken into consideration to benchmark the relationship with GDP per capita. Classification of the countries according to the Gross National Income (GNI) per capita, calculated using the World Bank Atlas method, for the current 2022 fiscal year is World Bank (2022):

- Low-income economies (GNI per capita of $1,045 or less in 2020),
- lower middle-income economies (GNI per capita between $1,046 and $4,095),
- Upper middle-income economies (GNI per capita between $4,096 and $12,695),
- High-income economies (GNI per capita of $12,696 or more).

2.1. Country selection

In the study patent grant, population and GDP per capita data can be found for 166 countries in the world. There was a lack of data for the indicators listed above for some countries.

The country set is analysed considering the indicators.

- High-tech exports (million $, 2020), high-tech exports are calculated by OECD (2011) classification,
- Total patent grants (direct and PCT national phase entries, resident and abroad, 2020),
- Population (2020, 2021),
- Total patent per million population is found by dividing the patent grants to the population for each country (2020)
- GDP per capita (current USD prices, 2021),
- GDP (current USD prices, 2021).

2.2. Data selection

As the mentioned above there was a lack of data for some countries so that cross-section data analysis was made rather than panel data analysis. The natural logarithm (ln) of the data were used in the analysis due to the big difference in the countries' data both for patent grants and GDP per capita.

The normality of the data is very important in statistical analysis. To test the normality of the data, and to show the relationship between the indicators by the scatter diagrams, the 22nd version of the Statistical Package for Social Sciences Data (SPSS) (IBM 2022) and the 9th version of the EViews software (QMS, Emeryville, California, United States 2022) were used.

Jarque-Bera (JB)[1] test, Shapiro-Wilks (SW) test and Kolmogorov-Smirnov (KS) test were used to analyse the normality of the data. For the normally distributed data set parametric Pearson correlation test and for non-normally distributed data set Spearman's rho non-parametric correlation test should be used to the normality tests result.

To test the normality of the data, the null and alternative hypotheses are as:

H_0: The data set is statistically distributed normal,
H_1: The data set is not statistically distributed normal.

If the test statistic is smaller than the critical value, in other words the probability value (p) is greater than the critical value (p=0.05), we are not able to reject the null hypothesis with 95% confidence, so that the data is normally distributed. If the test statistic is greater than the critical value, in other words the probability value (p) is smaller than the critical value (p=0.05), so we reject the null hypothesis and accept the alternative one with 95% confidence, so that the data is not distributed normal.

[1] $JB = (\frac{n}{6}) * (S^2 + \frac{(K-3)^2}{4})$

3. Results

Patent grants, of course used in economy and diffused between the firms, are good innovation indicator for a country. Innovation will cause increasing returns to scale so that countries who are leader and following the leader will have higher income per capita. On the other hand, the countries which have technology gap with leaders will have low income.

The world population was 7.58 billion and total world output was 95.2 trillion USD in 2021. High-income countries have population as 1.180 billion in 2020, 1.182 billion in 2021. Their patent grants per million population are 943.6 in 2020 and they have 49.2 thousand USD GDP per capita in 2021. The countries in the highest income group have the highest patent grants. This group has 15.6 percent of global population, 66.9 percent of total patent grants and 61 percent of total global output.

Low-income countries have population 580.6 million in 2020, 594.9 million in 2021. Their patent grants per million population are 8.6 in 2020 and they have 754.7 USD GDP per capita in 2021. The countries in the lowest income group have the lowest patent grants with lower-middle countries. This group has 7.8 percent of global population, 0.3 percent of total patent grants and 0.5 percent of total global output.

Middle-income (lower-middle income and upper-middle income) countries have population as 5.76 billion in 2020, 5.80 billion in 2021. Their patent grants per million population are 94.7 in 2020 and they have 6,314 USD GDP per capita in 2021. The countries in the middle-income group has 76.6 percent of global population, 32.8 percent of total patent grants and 38.5 percent of total global output (**Table 1**).

Table 1 The patent grants per million population and GDP per capita data for income groups

Income group	Total patent grants (direct and PCT national phase entries, 2020)	Population (million, 2020)	Population (million, 2021)	Patent grants per million population (2020)	GDP per capita (current prices $, 2021)	GDP, current prices (million $, 2021)
H	1,113,364	1,179.9	1,182.1	943.6	49,164.6	58,119,506.9
L	4,984	580.6	594.9	8.6	754.7	448,960.1
LM	21,886	3,212.7	3,254.7	6.8	2,897.8	9,431,346.3
UM	522,940	2,541.9	2,549.1	205.7	10,675.0	27,211,901.3
World	1,663,174	7,515.0	7,580.8	221.3	12,559.5	95,211,714.7

Source: IBM (2022), the World Bank (2022), WIPO (2022), IMF (2022); H: High-income countries, L: Low-income countries, LM: Lower-middle income countries, UM: Upper-middle income countries

2.1. Normality of the data

As mentioned above, according to the results of the normality tests, non-parametric tests should be applied for non-normally distributed data set especially to check the correlations between indicators. All Jarque-Bera, Kolmogorov-Smirnov and Shapiro-Wilk test results are greater than the critical value, in other words the probability value (p) is smaller than the critical value (p=0.05) and statistically significant, so that we reject the null hypothesis and accept the alternative one with 95% confidence. The results show that patent grants per million population and GDP per capita data are not normally distributed (**Table 2**). As a result, Spearman's rho non-parametric correlation test should be used to the normality tests result of both data.

Table 2 Test of Normality

		Jarque-Bera		Kolmogorov-Smirnov		Shapiro-Wilk	
Indicator	Degrees of freedom (df)	Test statistic	Probability (Sig.)	Test statistic	Probability (Sig.)	Test statistic	Probability (Sig.)
Patent grants	166	98,189.8	0.00	0.41	0.00	0.20	0.00
GDP	166	989.1	0.00	0.26	0.00	0.65	0.00

Source: IBM (2022), EViews (2022)

2.2. The relationship between patent grants per million population and GDP per capita

In the study 166 countries were analyzed. Spearman's rho non-parametric correlation test was applied to test the normality of both data. It is found that a high positive correlation coefficient as 0.804 between patent grants per million population and GDP per capita. Correlation is significant even at the 0.01 level (2-tailed).

Table 3 Spearman's rho non-parametric correlation test results

			Patent grants	GDP
Spearman's rho	Patent grants per million population	Correlation Coefficient	1.000	0.804*
		Sig. (2-tailed)		0.000
		N	166	166
	GDP per capita (current USD)	Correlation Coefficient	0.804*	1.000
		Sig. (2-tailed)	0.000	
		N	166	166

Source: IBM (2022) N: number of observations

The figure which was estimated by SPSS software below shows the relationship between patent grants per million population (2020) and GDP per capita (2021). In the figure, it is clear that there is a high positive relationship between two variables. The equation[2] indicates that natural logarithm of patent grants per million population increase 10 percent, it causes approximately 4.1 percent increase in natural logarithm of GDP per capita. In other words, if patent grants per million population in the world increase 23.3, it causes approximately 523.1 USD increase in global GDP per capita in average. Turkey, as a sample country, has 3,244 patent grants and 9,926 USD with 83.6 million population in 2020. If patent grants per million population increase 4.1 (total 341.2 patent grants) in Turkey, it causes approximately 398 USD increase in GDP per capita in average (**Figure 1**).

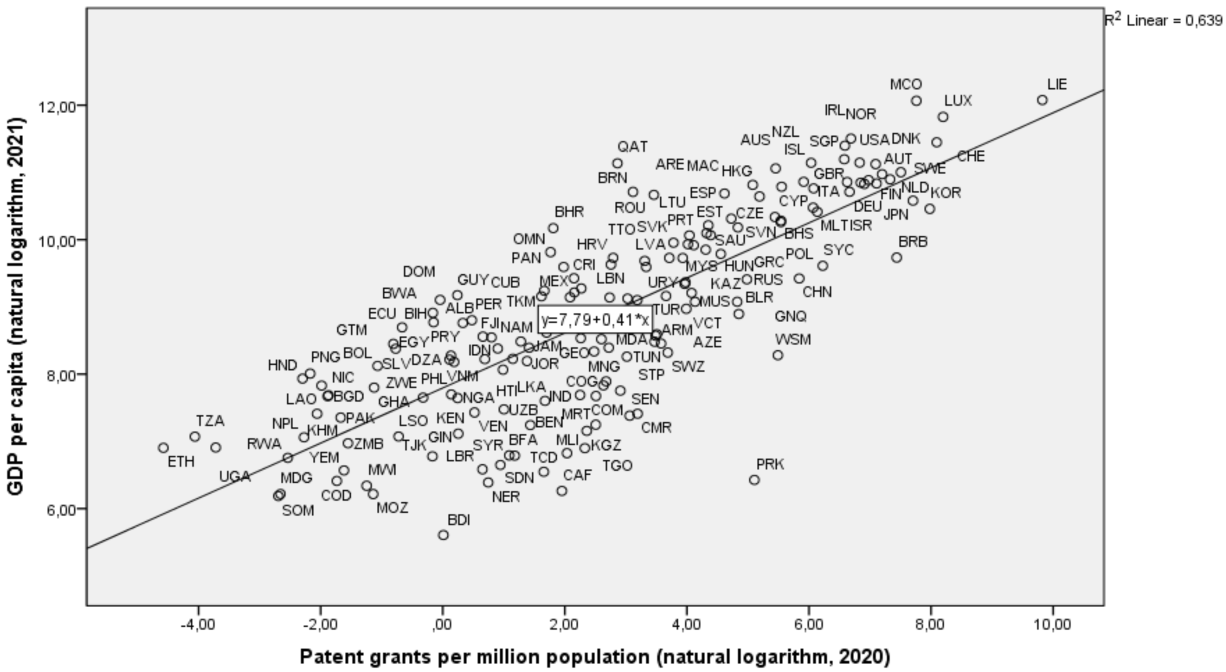

Figure 1 The relationship between patent grants per million population and GDP per capita by country (natural logarithm, ln)

4. Discussion and Conclusion

After accepting the technological progress as an endogenous input factor of production and knowledge as a determinant of increasing marginal return of scale,

[2] $Y_i = \beta_0 + \beta_1 X_{1i} + \varepsilon_i$ where Y (GDP per capita) is the dependent , X_{1i} (patent grants per million population) the explanatory variable, β_0 is the intercept and β_1 is the coefficient of the explanatory variable (slope), ε is the stochastic disturbance term for the sample, and *i* is the *i*th country in 166 countries (Gujarati & Porter, 2009).

income growth studies gained speed to tell the difference and unequal distribution of GDP per capita especially between high-income and low-income countries.

In this study, it is found that the natural logarithm of patent grants per million population increase 10 percent, it causes approximately 4.1 percent increase in natural logarithm of GDP per capita. In other words, if patent grants per million population in the world increase 23.3, it causes approximately 523.1 USD increase in global GDP per capita in average. Fagerberg (1988) stated that GDP per capita, patents and investments contributed significantly to explain the differences in growth of advanced (developed) and newly industrializing (developing) countries. It is concluded that semi-industrialized countries cannot only rely on a combination of imports of technology and investments to catch up with advanced countries, but must also increase their national technological activities. In his study, the author found that as a country moves closer towards the technological leaders, the endogenous technological capabilities already increases.

In another study, Fagerberg (1994) indicated that productivity as measured by GDP per capita should be expected to correlate with measures of national technological activity, such as R&D and patent statistics, which are appropriately dampened by some country size measures. For the years 1890-1977, Pavitt and Soete (1982) tested this relationship for 14-15 OECD countries, and they found that the results were particularly supportive for the post-World War II period.

In explaining growth differences, pure technological competence difference between countries such as patenting, became more important (Verspagen 2001). While the convergence of poor countries to rich countries is slow; within the high-income group, there is convergence in GDP per capita and productivity levels (Dowrick 1991). It should be noted that this occurs on the basis of the difference between output growth rates and productivity. These differences emerge against the background of the underlying structural differences (Smith 2000). Two major areas of structural difference can be identified:

- Persistent differences in governance systems at the national level, (Lazonick, 1992).
- Building and maintaining highly specialized technological capabilities that are reflected in their patterns of R&D expenditures, patenting, scientific publication, etc. (Archibugi and Pianta, 1992; Patel and Pavitt, 1994).

5. Acknowledge

Study limitations

There was a missing data for the patent grants and GDP per capita for some countries.

Disclosure

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Authors' contributions

All authors analyzed and interpreted the data and wrote the manuscript together. All authors read and approved the final manuscript.

Table 4 Authors' contributions

Contribution	Dr. Metin Gürler
Conception or design of the work	Yes
Data collection	Yes
Data analysis and interpretation	Yes
Drafting the article	Yes
Critical revision of the article	Yes
Final approval of the submitted version	Yes

Availability of data and material

Data sources are indicated in the study and data can be provided if needed. The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical statement

No ethical approval is needed for the study since it does not depend on outcomes from studies involving related data with humans or animals.

Short bibliographies

Metin Gürler has completed his undergraduate study at İhsan Doğramacı Bilkent University, Department of Economics in 1994. He has completed his master education at Marmara University, Department of Economics. He completed his PhD studies in the same department and worked in various manufacturing and service sectors as a professional and entrepreneur at different levels while he has been working as a consultant in many competitiveness, strategy, innovation and cluster projects. He gave undergraduate and graduate level courses at İstinye University in 2016–2017. He is teaching "International Competitiveness Policy", "Current Issues in Foreign Trade", "International Retail Management", "International Trade Policy" and "Target Products & Target Markets" courses at Medipol University since 2018; "International Economics", "Globalization", "Introduction to Macroeconomics" courses at Haliç University and "Introduction to Economics" at Galata University. Competitiveness of sectors, cities, provinces and nations, clusters, middle-income trap, growth economy, economic policy, education, health tourism, health economy, innovation, foreign trade and human capital are his main study areas.

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APPENDIX

Table 5 The patent grants per million population, GDP per capita data and income classification by country

Country	Country classification	Patent per million population (2020)	Gross domestic product per capita, current prices (2021)
Albania	UM	1.4	6,375
Algeria	LM	1.1	3,701
Andorra	H	179.5	41,873
Argentina	UM	9.7	10,658
Armenia	UM	35.8	4,701
Australia	H	233.7	63,529
Austria	H	1,071.3	53,368
Azerbaijan	UM	33.4	5,398
Bahamas	H	254.5	28,579
Bahrain	H	6.1	26,136
Bangladesh	LM	0.2	2,147
Barbados	H	1,697.9	16,875
Belarus	UM	127.8	7,295

Belgium	H	753.9	51,875
Belize	LM	11.9	4,177
Benin	LM	4.2	1,398
Bhutan	LM	2.7	3,185
Bolivia (Plurinational State of)	LM	0.3	3,369
Bosnia and Herzegovina	UM	0.9	6,440
Botswana	UM	0.9	7,417
Brazil	UM	13.5	7,564
Brunei Darussalam	H	22.6	44,809
Bulgaria	UM	53.3	11,684
Burkina Faso	L	3.3	887
Burundi	L	1.0	272
Cambodia	LM	0.1	1,654
Cameroon	LM	24.3	1,655
Canada	H	369.7	52,079
Central African Republic	L	7.0	525
Chad	L	5.2	697
Chile	H	27.3	16,070
China	UM	343.6	12,359
China, Hong Kong SAR	H	160.5	49,727
China, Macao SAR	H	101.0	43,772
Colombia	UM	7.1	6,156
Comoros	LM	12.3	1,406
Republic of Congo	LM	14.5	2,677
Costa Rica	UM	8.6	12,408
Côte d'Ivoire	LM	13.9	2,522
Croatia	H	16.3	16,818
Cuba	UM	5.0	9,478
Cyprus	H	230.9	30,846
Czech Republic	H	125.9	26,411
Democratic People's Republic of Korea	L	165.1	618
Democratic Republic of the Congo	L	0.2	609
Denmark	H	1,201.8	67,758
Dominican Republic	UM	1.0	8,986
Ecuador	UM	0.5	5,979
Egypt	LM	1.1	3,926
El Salvador	LM	0.5	4,345
Equatorial Guinea	UM	124.5	8,745
Estonia	H	77.5	27,282
Eswatini	LM	39.9	4,109
Ethiopia	L	0.0	996
Fiji	UM	2.2	5,147
Finland	H	1,523.4	54,008

France	H	783.8	44,853
Gabon	UM	24.2	8,976
Georgia	UM	13.5	5,014
Germany	H	1,220.0	50,795
Ghana	LM	0.3	2,441
Greece	H	61.0	20,256
Guatemala	UM	0.4	4,674
Guinea	L	1.3	1,230
Guyana	UM	1.3	9,644
Haiti	LM	2.7	1,765
Honduras	LM	0.1	2,790
Hungary	H	74.3	18,968
Iceland	H	417.6	69,033
India	LM	9.5	2,185
Indonesia	LM	2.5	4,357
Iran (Islamic Republic of)	LM	40.9	16,784
Iraq	UM	9.6	5,088
Ireland	H	802.3	99,013
Israel	H	941.4	51,416
Italy	H	431.8	35,473
Jamaica	UM	5.5	5,525
Japan	H	2,216.4	39,340
Jordan	UM	4.1	4,417
Kazakhstan	UM	58.9	9,977
Kenya	LM	1.2	2,205
Kyrgyzstan	LM	10.6	1,283
Lao People's Democratic Republic	LM	0.1	2,514
Latvia	H	55.6	20,581
Lebanon	UM	15.4	9,310
Lesotho	LM	0.5	1,181
Liberia	L	1.9	724
Liechtenstein	H	18,458.3	175,814
Lithuania	H	56.9	23,473
Luxembourg	H	3,631.0	136,701
Madagascar	L	0.1	502
Malawi	L	0.3	567
Malaysia	UM	52.7	11,399
Mali	L	7.7	920
Malta	H	462.1	33,329
Mauritania	LM	12.3	2,153
Mauritius	UM	62.4	8,744
Mexico	UM	8.6	10,040
Monaco	H	2,344.5	173,688

Mongolia	LM	15.2	4,418
Montenegro	UM	8.1	9,350
Morocco	LM	4.0	3,620
Mozambique	L	0.3	501
Namibia	UM	3.6	4,842
Nepal	LM	0.1	1,164
Netherlands	H	1,337.2	58,292
New Zealand	H	257.8	48,424
Nicaragua	LM	0.2	2,177
Niger	L	2.1	595
Nigeria	LM	1.3	2,089
North Macedonia	UM	11.6	6,714
Norway	H	726.5	89,090
Oman	H	5.8	18,299
Pakistan	LM	0.2	1,562
Panama	UM	7.2	14,664
Papua New Guinea	LM	0.1	3,005
Paraguay	UM	1.9	5,207
Peru	UM	1.6	6,643
Philippines	LM	1.2	3,572
Poland	H	95.1	17,815
Portugal	H	75.5	24,264
Qatar	H	17.5	68,581
Republic of Korea	H	2,919.7	34,801
Republic of Moldova	UM	32.6	5,285
Romania	UM	28.0	14,667
Russian Federation	UM	145.8	12,198
Rwanda	L	0.1	859
Saint Vincent and the Grenadines	UM	54.1	7,877
Samoa	LM	242.4	3,947
San Marino	H	1,000.0	50,458
Sao Tome and Principe	LM	18.3	2,331
Saudi Arabia	H	80.5	23,507
Senegal	LM	21.4	1,607
Serbia	UM	20.6	9,178
Seychelles	H	505.2	14,931
Singapore	H	719.0	72,795
Slovakia	H	43.8	21,053
Slovenia	H	254.8	29,193
Somalia	L	0.1	487
South Africa	UM	17.2	6,950
Spain	H	112.8	30,090
Sri Lanka	LM	3.1	3,743

Sudan	L	2.6	773
Sweden	H	1,816.6	60,029
Switzerland	H	3,269.8	93,720
Syrian Arab Republic	L	3.0	890
Tajikistan	LM	0.8	878
Thailand	UM	8.1	7,336
Togo	L	10.3	992
Trinidad and Tobago	H	15.7	15,201
Tunisia	LM	20.4	3,867
Turkey	UM	38.8	9,528
Turkmenistan	UM	5.3	10,311
Uganda	L	0.0	1,000
Ukraine	LM	32.1	4,828
United Arab Emirates	H	31.8	42,884
United Kingdom	H	435.0	47,203
United Republic of Tanzania	LM	0.0	1,177
United States of America	H	925.4	69,231
Uruguay	H	51.0	16,756
Uzbekistan	LM	5.3	2,002
Venezuela (Bolivarian Republic of)	UM	1.7	1,686
Viet Nam	LM	2.0	3,725
Yemen	L	0.2	712
Zambia	LM	0.2	1,067
Zimbabwe	LM	0.7	2,102

Source: IBM (2022), the World Bank (2022), WIPO (2022), IMF (2022)