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Breaking The Middle-Income Barrier: A Study Of Patent Trends In High-Performing And Trapped Economies

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Abstract
Middle-income works as a barrier for some of the economies and lack of innovation is said to be one of the factors responsible for the low performance of various middle – income economies. The present study discusses the significance of innovation considering only one of the factors of innovation that is the patents granted by technology to various countries. The study uses descriptive, comparative and inferential statistics for the analysis. The study found no significant impact of patents granted by technology to escape the middle - income trap. The high performing economies India and Poland having positive correlation while China also is a high performing economy but shows a negative correlation. China as a high performing economy shows higher growth in absolute and relative terms in patents granted by technology. India is a high performing economy and Philippines is a low performing economy but India and Philippines show similar correlation. Brazil and Malaysia are low performing economies but show a negative correlation as China shows. Conclusively no proper significance was found the economies under consideration.

Keywords: *Middle-income trap, High performing economies, low performing economies, patents granted by technology, Trapped countries, non-trapped countries.*

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I. Introduction:

The term "middle-income trap" describes a situation in which a nation finds it difficult to move from a certain level of income to a high-income economy. Low labour costs and the ability to import foreign technology, two factors that initially drove rapid economic growth, often lose their effectiveness as the economy matures, leading to this stagnation. These economies find it more difficult to sustain growth without promoting more sophisticated, innovation-driven industries as wages rise and industries face fiercer international competition. This trap is especially important for developing and emerging economies that want to diversify their economies and become less reliant on low-cost manufacturing. Usually, structural changes, investments in technology and education, and laws that support high-value industries and innovation are needed to break the middle-income trap.

Transformation from commodity-based economy to knowledge-based economy is found to be one of the crucial reasons behind stuck of a country in to the middle-income trap (Paus, E., 2012). All economies and all type of economic activities are some how based on knowledge. But what is a knowledge-based economy? Knowledge based economy is an economy where knowledge is one of the factors of production and the economy that is dominant in the knowledge rather than capital and labor (Drucker, P. F. 1998). Some argues that the knowledge economy rests on technological changes. ICT is different from knowledge; it is the medium of production and distribution of knowledge (Smith, K. 2000). This means technological changes are indulge in the knowledge or technological changes is a subset of knowledge. A knowledge economy emphasizes the use of intellectual abilities over physical resources and natural materials. It focuses on enhancing every aspect of production, from research and development through manufacturing to customer engagement. This transformation is evident in the growing portion of a country's GDP derived from "intangible" assets like intellectual property and services related to managing knowledge. (Powell, W. W., & Snellman, K., 2004). The discussion on the knowledge economy explores several key aspects: Firstly, it emphasizes innovation and continuous learning as crucial for keeping pace with technological advancements and market changes. Secondly, it underscores the rising demand for educated, skilled individuals, highlighting the critical role of intellectual capital. Thirdly, it highlights the integration of diverse stakeholders like scientists and firms into interconnected networks that facilitate the creation and dissemination of knowledge. Lastly, the shift from an industrial to a knowledge-oriented society brings about both positive and negative impacts on individuals and work dynamics, underscoring the importance of careful navigation and adaptability. Together, these dimensions illustrate the complex nature of the knowledge economy and its profound implications for society and the labor market (Hadad, S., 2017). The concept of a

knowledge economy emphasizes how different market participants collaborate throughout the entire process of creating and utilizing goods and services, from inception to completion. It stresses that the goal isn't just technological innovation but also enhancing overall productivity and fostering job creation within urban settings for businesses (Raspe, O., & Van Oort, F., 2006). A knowledge-based society to flourish and contribute to sustainable development goals, it relies heavily on a strong capacity for creativity and a natural inclination towards innovation. (Melnikas, B., 2010). By leveraging the principles of a knowledge economy—such as innovation, education, and skilled workforce development—countries can enhance their competitiveness, increase productivity, and ultimately surpass the middle-income trap. (Kusujiarti, S., & Kusdarjito, C., 2021) Patent grants by technology show the production of part of knowledge which works towards achieving higher growth. Patent in technology shows the movement of an economy towards being a knowledge-based economy. The present study accounts the trend of patents to know the significance of patents in being an economy surpassing middle income trap. This study acknowledges seven countries out of which 3 are middle income countries but they are not in the trap and 4 countries are the middle-income countries those are in the middle-income trap. India, China, Poland are the three countries those are middle income countries but they are not in trap and 4 countries namely Brazil, Malaysia, Philippines and South Africa are the countries those are in middle income trap (Felipe, et al. 2011). A comparative study among trapped and non-trapped countries with respect to knowledge economy taking the aspect of patents by technology will give an answer to the question of whether these patents work significantly in removing the barrier of middle-income trap.

Research Gap

Research on the precise role of patent trends in propelling economic advancement in middle-income countries relative to high-performing economies is still lacking, despite the acknowledged significance of patents in promoting innovation and economic growth. The value of intellectual property in economic development has been extensively discussed in the literature to date, but there hasn't been much in-depth research on how differences in patent activity directly help people escape the middle-income trap. Further research is required to determine whether increased innovation and patent filing rates in particular industries are associated with faster growth and smoother transitions from middle-class to high-income status. Closing this gap can yield important information about how specific patent laws could support middle-income economies' ability to maintain growth and improve their competitiveness globally.

Objectives:

1. To analyze and compare patent filling trends in high-performing economies and middle-income trapped economies, identifying key differences and similarities.
2. To investigate the correlation between patent trends and economic growth, determining how intellectual property contributes to breaking the middle-income barrier.
3. To know the significance of patents by technology in surpassing middle-income trap.

II. Review Of Literature

- **Theories of the Middle-Income Trap -** The idea of the "middle-income trap" has been widely discussed in the literature on economic development. It refers to the difficulties that nations encounter when trying to move from middle-income to high-income status. After achieving a certain level of per capita income, countries in this trap frequently see a slowdown in growth, primarily as a result of diminishing returns on the factors that initially fuelled their growth, such as imported technologies and cheap labour (Eichengreen, Park, & Shin, 2013). According to Aiyar et al. (2013), economies are unable to transition from low-cost manufacturing to high-value-added industries, which is partly due to a lack of industrial diversification and a limited capacity for innovation. These economies essentially face structural bottlenecks that prevent them from developing and competing on a global scale. These bottlenecks include skill gaps, weak institutional frameworks, and insufficient investments in technology.
- **Growth and Innovation -** Numerous studies demonstrate how innovation and technological developments propel economic growth and help people surpass income barriers. The endogenous growth theory and Romer (1990) both stresses how important technology and knowledge are to long-term, steady economic growth. Productivity gains and overall economic performance have been demonstrated to be strongly correlated with innovation, which is frequently gauged by patent activity (Gribiche's, 1990). According to research by Furman, Porter, and Stern (2002), economies that have robust intellectual property laws and R&D expenditures typically produce more innovative products, which promote economic growth. According to these studies, middle-income countries may benefit greatly from targeted policies that promote patenting in strategic areas in order to achieve long-term growth.
- **Trapped vs. High-Performing Economies -** An understanding of the role of innovation and patents in economic development can be gained by comparing case studies of economies that have successfully made the

transition to high-income status with those that are still stuck in the middle-income trap. Taiwan and South Korea, for example, are prime examples of economies that have effectively used innovation and technology to break free from the middle-income trap. Both nations fostered high-tech industries, established strong intellectual property frameworks, and made significant investments in R&D, all of which contributed to their long-term growth and ability to compete globally (Lee, 2013). On the other hand, nations like Brazil and Malaysia offer opposing examples, where a lack of emphasis on innovation and insufficient technological advancement have led to protracted middle-income stagnation (Gill and Kharas, 2007). The significance of innovation policy and institutional support in propelling the shift from middle- to high-income economies is highlighted by these comparative insights.

III. Methodology:

Sample Collection: To analyze and compare the patent filling trends in high performing economies and middle income trapped economies first a sample of seven economies: high performing middle economies and trapped middle economies was taken. The sample was selected in a non-random way from the list of economies which were found in trap and not found in trap in the study of Felipe, 2011 titled "Tracking the middle-Income: What is it, who is in it, and Why?"

Data Collection: Data on patent fillings was taken from the website of WIPO (World Intellectual Property Rights). Many types of data on patent fillings are available there but data on patent fillings by technology was taken for the study. Patent fillings by technology granted and published is given but data on patent granted was taken. The time period for which data is available is 1980 to 2022 and it was last updated in 2023. Felipe's study gives the trapped economies during the era of 2010. So, it is required to study the data for at least last 20 years i.e., 1980. The various types of technology on which patents are given are 35. These technologies are listed below.

- Electrical machinery, apparatus, energy
- Audio-visual technology
- Telecommunications
- Digital communication
- Basic communication processes
- Computer technology
- IT methods for management
- Semiconductors
- Optics
- Measurement
- Analysis of biological materials
- Control
- Medical technology
- Organic fine chemistry
- Biotechnology
- Pharmaceuticals
- Macromolecular chemistry, polymers
- Food chemistry
- Basic materials chemistry
- Materials, metallurgy
- Surface technology, coating
- Micro-structural and nano-technology
- Chemical engineering
- Environmental technology
- Handling
- Machine tools
- Engines, pumps, turbines
- Textile and paper machines
- Other special machines
- Thermal processes and apparatus
- Mechanical elements
- Transport
- Furniture, games
- Other consumer goods
- Civil engineering

Statistical Tools: For the study all the 35 types of patents in technology were add up to find total number of patents year per year in the selected countries. For the study descriptive and comparative statistics, and inferential statistics will be applied as per requirement. For easier identification of comparisons and trends graphs and charts will be used.

Consistency of data: The data for some of the years was not given for the same countries. So, to ensure consistency of the data, zero filling was added. As it was assumed here that in those years where data is not given the countries filled zero patents.

Figure 1

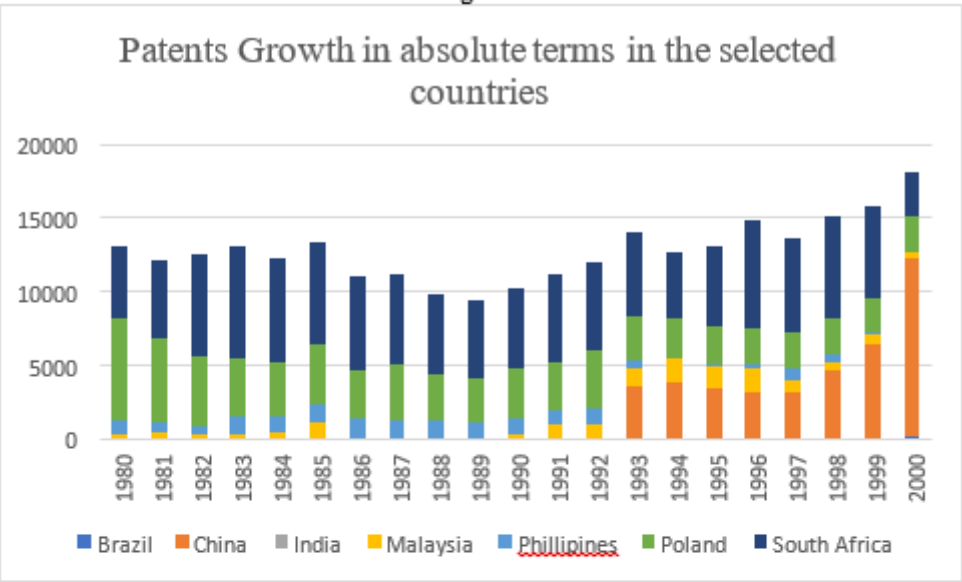
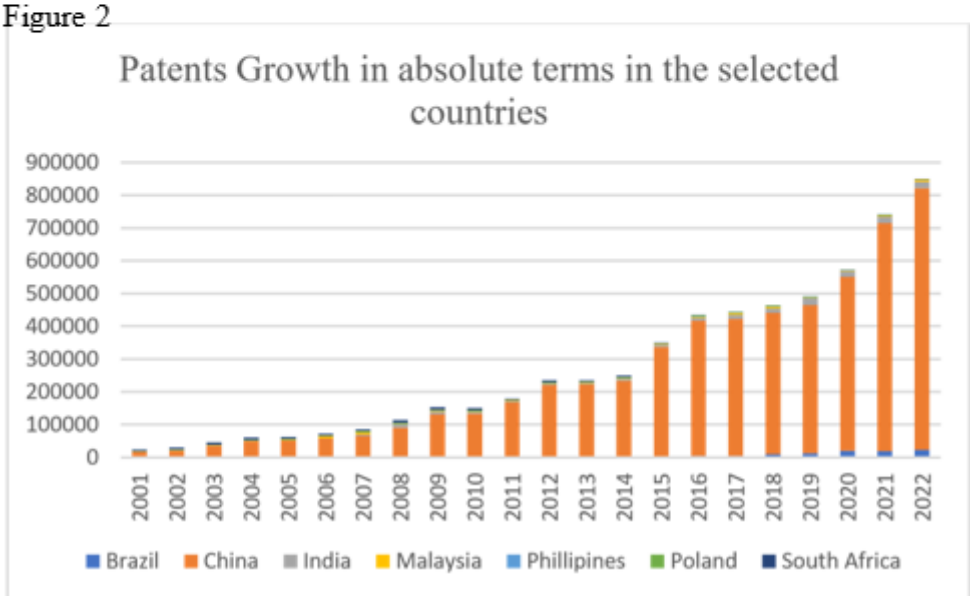


Figure 2



Analysis: In case of **Brazil** the patents done are almost zero for the era from 1980 to 1998. The patents start to increase gradually from 1999 with 26 patents to year 2008 with 857 patents. A noticeable rise peaking at 3521 patents in the year 2011 and then slightly fluctuating. A sharp increase specially after 2017, reaching the highest value of 23588 in 2022. In case of **China** patents granted from 1980 to 1992 were zero. Starting from 1993 the patents begun to rise gradually. This was a big number that is 3499. There found a noticeable increase around the year 2000. The growth becomes more significant in the mid-2000s. The data shows substantial growth from 2015 onwards. The data shows zero units for the first 13 years. This could indicate a period before the initiation of sending application for granting patents to the PCT (The Patent Cooperation Treaty). Starting in 1993, there is

gradual increase from 3499 to 6369 patents in 1999. This period likely represents the initial phase of growth. There is a significant jump in 2000 to 12007 patents, indicating a possible change or event that spurred growth. Growth continues steadily, reaching 128647 patents in 2009. The period from 2010 onwards shows rapid and substantial growth. By 2022 the value reaches 798423 patents, which is significant increase from previous years. The data from 2010 onwards suggests exponential growth. The increases are more substantial and frequent. Notable jumps in the data occur in the years 2000, 2008, 2015, and 2021, indicating key periods of accelerated growth. India did not show any patent grant in 25 years from 1980 to 2004 except for a small increment by 10 in the year 2005. Starting in 2005, the patents granted begun to increase gradually, with notable increase in 2007, 2008 and 2016. The number of patents granted in 2006 is 156, and it rises significantly to 4569 in 2007 and then to 3165 in 2008. From 2017 onwards, there is a more pronounced increase in patents, with significant jumps in 2018, 2019, and 2020. The number of patents granted reached a peak of 20532 in 2019 and remain high in 2020, 2021, 2022. The delayed in grants of patents compared to China with no patents for a longer period. Starting in 2005, the growth is gradual, indicating initial stages of development in patents in technology. From 2007 to 2016 the growth is steady, with occasional spikes. Post-2017, there is a significant and sustained increase in patents. Both countries India and China show rapid growth in recent years, but the growth rate and scale differ significantly.

The data for **Malaysia** shows varying patents from 290 in 1980 to 1011 in 1985. There are zero patents recorded from 1986 to 1989. Starting in 1990, the values begin to increase gradually. The values show a gradual rise from 275 in 1990 to 661 in 1999. The values increase more significantly in the 2000s. Notable jumps include:1394 in 2001, 6525 in 2006, 6872 in 2007, 3020 in 2009 post2010, there is continued growth with fluctuations. The patents reach 5687 in 2022, indicating significant growth over the years. From 1980 to 1985, the data shows variability with some years having significantly higher patents. A period of zero values from 1986 to 1989 may indicate a pause or lack of data collection. From 1990 onwards, the data shows a steady increase, with significant jumps in specific years. Post-2000, the data shows sustained growth with notable peaks and some fluctuations. Malaysia shows activity from 1980 with a pause from 1986 to 1989, China starts growing in 1993, and India begins with notable number of patents in 2005. Malaysia has an initial phase of variability followed by gradual increase and significant growth post-2000, China's growth is steady from 1993 becoming exponential post-2010, and India's growth is slow initially but becomes substantial post-2017. **The data for Philippines** shows fluctuating values from 879 in 1980 to 1044 in 1992. There are periods of both increase and decrease, with significant values in 1983 (1263), 1985 (1248), and 1986 (1293). From 1993, there is a significant drop, with very low values recorded between 1994 and 2013. Values are particularly low in 1994 (8), 1995 (5), 1998 (576), 2000 (5), and 2008 (1). Starting in 2014, there is a resurgence with values increasing sharply to 834 in 2014 and peaking at 1546 in 2016. After 2016, the values show a decline with fluctuations, reaching 0 in 2022. Notable values include 971 in 2017 and 736 in 2018. From 1980 to 1992, the data shows significant variability with both high and low values. From 1993 to 2013, there is a noticeable decline and period of low activity. There is a resurgence in 2014, with a peak in 2016, followed by a decline in subsequent years. The data for **Poland** starts high at 6987 in 1980. There is a decline from 1980 to 1989, reaching a low of 2886. Slight recovery and fluctuations occur from 1990 to 1992, with a peak of 3961 in 1992. From 1993, there is a general downward trend, hitting a low of 1560 in 2003. This period shows consistent year-to-year decrease. Post-2003, the data shows fluctuations with periods of growth. Notable peaks include: 4007 in 2008, 3768 in 2016, 3438 in 2007, The values fluctuate but generally show a recovery trend compared to the 1993-2003 period. In the recent years (2017-2022), the data shows moderate fluctuations with a peak of 3372 in 2021 and a slight decline to 2222 in 2022. Initial high number of patents in the early 1980s, followed by a steady decline until the early 2000s. Recovery and growth post-2003, with significant peaks in 2008 and 2016. Moderate fluctuations in the most recent years, indicating some stability.

The data patents granted for **South Africa** starts at 4879 in 1980 and increases to a peak of 7554 in 1983. There is a gradual decline from 1984 to 1989, reaching 5407. The early 1990s see a slight recovery, with values fluctuating around 5900. From 1993 to 1999, the values show variability, peaking again at 7389 in 1996. There is a decline in 1994 to 4437 and a partial recovery towards the late 1990s. The early 2000s show significant fluctuations, with a notable drop in 2000 (2980) and subsequent recovery. 2008 marks a peak of 8656, followed by a decline to 6134 in 2010. A sharp decline occurs from 2011, dropping to 2552. From 2012 to 2015, there is variability but generally lower values. The most recent years (2016-2022) show very low values, with a steep decline to 119 in 2022.

Figure 3

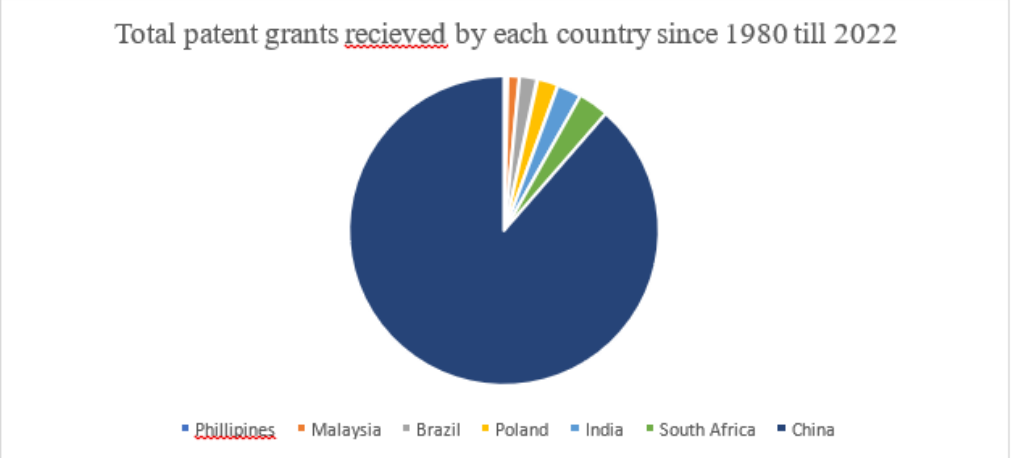


Table 1

Country	Total number of patents	Patents as a percent of total patents of China
Philippines	22089	0.39
Malaysia	79727	1.42
Brazil	117425	2.1
Poland	135091	2.41
India	160516	2.87
South Africa	203875	3.64%
China	5590793	

Source: Calculated

Philippines had remains very poor in receiving the patent grants in technology with the smallest number of grants 22089 out of other selected countries. **Malaysia** gains the second last position in achieving the number of grants in patents in technology with total patents 79727. **Brazil** gains third last position in receiving patent grants in technology with a total of 117425. **Poland** comes at 4th last position with total grants 135091. **India** comes at 5th last position with total grants 160516 and **South Africa** at 5th last position with total number of grants 203875. **China** has become a leading country in receiving grants in technology with a total 5590793 grants. South Africa has so far received only 3.64% of the total patent grants achieved by China while India lags with 2.87%. Still South Africa is a trapped economy while India is not a trapped country. So, it can be concluded that the mere patents granted to the countries do not mean a significant role in escaping the middleincome trap. There may various other factors come into ton play in being a country into the trap and also not being into the trap.

Correlation Analysis:

Table 2: The table shows correlation between GDP Growth rate and patent growth rates for the selected countries including zero and non-zero growth rates.

Sr. No.	Country	Correlation
1	Brazil	-0.03906
2	China	-0.12908
3	India	0.150841
4	Malaysia	-0.05317
5	Philippines	0.13671
6	Poland	0.190131

7	South Africa	0.086145

Source: Calculated

Table 3: The table shows correlation between GDP growth rate and patent growth rates for the selected countries including only non-zero growth rates.

Sr. No.	Country	correlation
1	Brazil	0.304179
2	China	-0.06076
3	India	0.171575
4	Malaysia	-0.00943
5	Philippines	0.13671
6	Poland	0.14955
7	South Africa	0.086145

Source: Calculated

Poland exhibits the highest positive correlation among the India, Poland, Philippines and South Africa but the size of correlation is weaker. Similarly, the correlation for China, Malaysia and Brazil is negative with a weaker size. Positive correlations in some countries suggest that economic growth is accompanied by increased innovation, while negative correlations in others suggest different dynamics. These differences highlight the importance of country-specific factors in understanding the relationship between economic growth and innovation. Countries with positive correlations, like India, the Philippines, Poland, and South Africa, may benefit from increased innovation, which can lead to higher productivity, new industries, and economic diversification. These factors are critical for sustaining long-term growth and moving beyond the middle-income trap. For countries like Brazil, China, and Malaysia, the weak negative correlations suggest that other factors may be more influential in driving GDP growth or that innovation is not being fully leveraged for economic advancement. Brazil is the only country for which when correlation was found with including the patent growth rates only for those years for which the data is greater than zero the correlation increased to positive .30. This shows a moderate impact of patent growth rates in technology on the growth rates of GDP but still Brazil is a trapped country. India shows a increase from 0.15 to 0.17. Malaysia shows a decrease from -0.05 to -0.009. Poland shows a decrease from 0.19 to 0.14 and China shows a decrease from -0.12 to -0.06

The correlation was found between the growth of number of patents and the growth rates of GDP to know weather the patents granted to the countries affect the growth rate of GDP so that to drag out the countries from the middle-income trap. The correlation for India, Philippines, Poland and South Africa is positive while for Brazil, China, and Malaysia is negative. Whereas Philippines, South Africa, Malaysia and Brazil are the trapped countries and India, China and Poland are not the trapped countries. The correlation is very weak so it is hard to say that merely the number of patents granted in technology has a significant effect in exit of countries from middle income trap. Patents grants in technology is a very little part of innovation and technology and research and development. May be the collective knowledge ride a great impact on trap.

IV. Conclusion:

However, the patents by technology are zeros for some of the beginning years for some of the countries but yet the series provide solution for the comparison between the selected trapped and non-trapped countries to know the significance of patents by technology to escape the middle-income trap. High performing economies like India, China, and Poland do not show a very big difference if China is left in comparison. This shows patents granted by technology are having no significant impact in escaping middle income trap. Correlation between growth of patents granted by technology show no proper correlation for high performing economies and for low performing or trapped economies. So, it is hard to say that merely patents granted by technology bear a significant impact in escaping middle income trap. In overall terms patents granted by technology is a little part of knowledge and innovation so it does not show a significant impact for high performing economies and also for low performing economies in escaping middle-income trap.

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