

STATISTICAL ANALYSIS ON GLOBAL INNOVATION INDEX

GROUP - 2

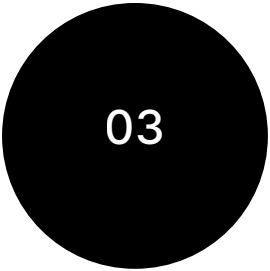
INTRODUCTION



Innovation is a key driver of economic and social progress.



The GII, published by WIPO, is a primary tool to measure national innovation performance.



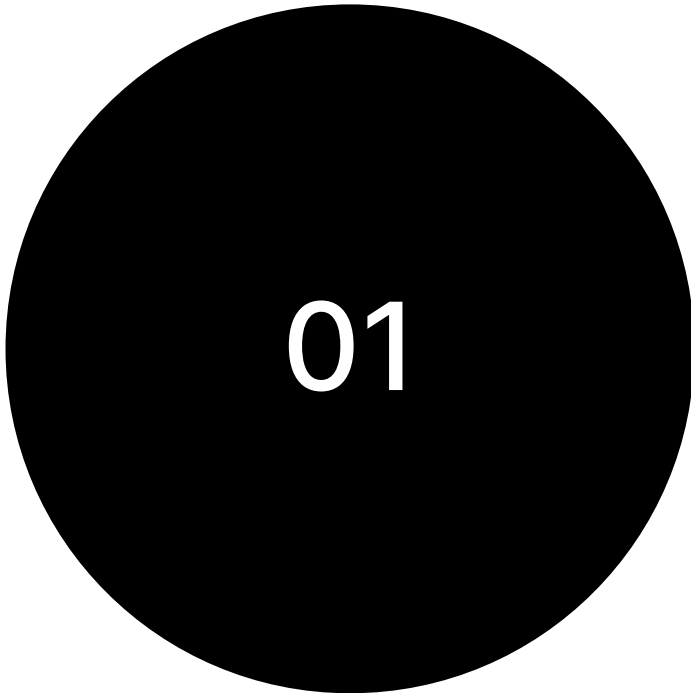
5 Input Pillars (Institutions, Human Capital, Infrastructure, Market & Business Sophistication) and 2 Output Pillars (Knowledge & Creative Outputs)



G20 nations, representing over 80% of global GDP, providing a mix of developed and developing economies



DATA DESCRIPTION



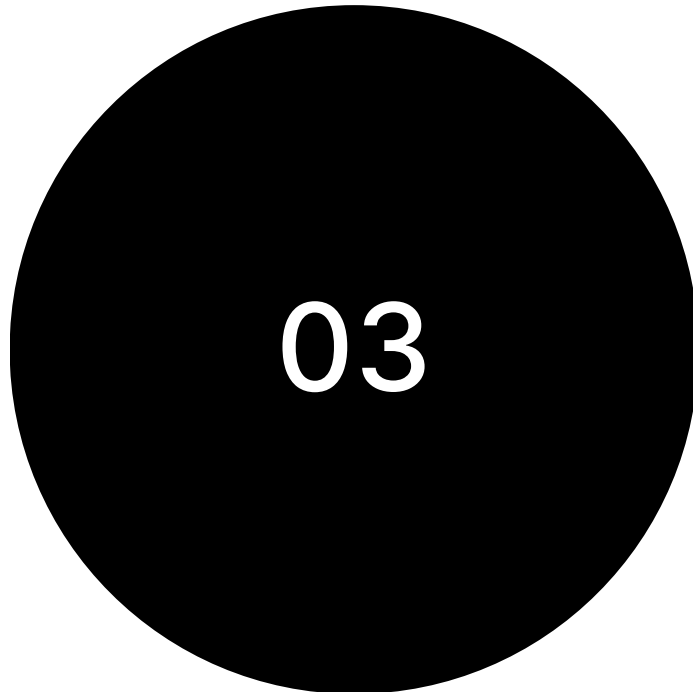
DATA SOURCE

WIPO Global Innovation Index
Dashboard (2025 Edition)



SAMPLE

G20 Nations (2015-2024)



INPUT AND OUTPUT
FORMULAS

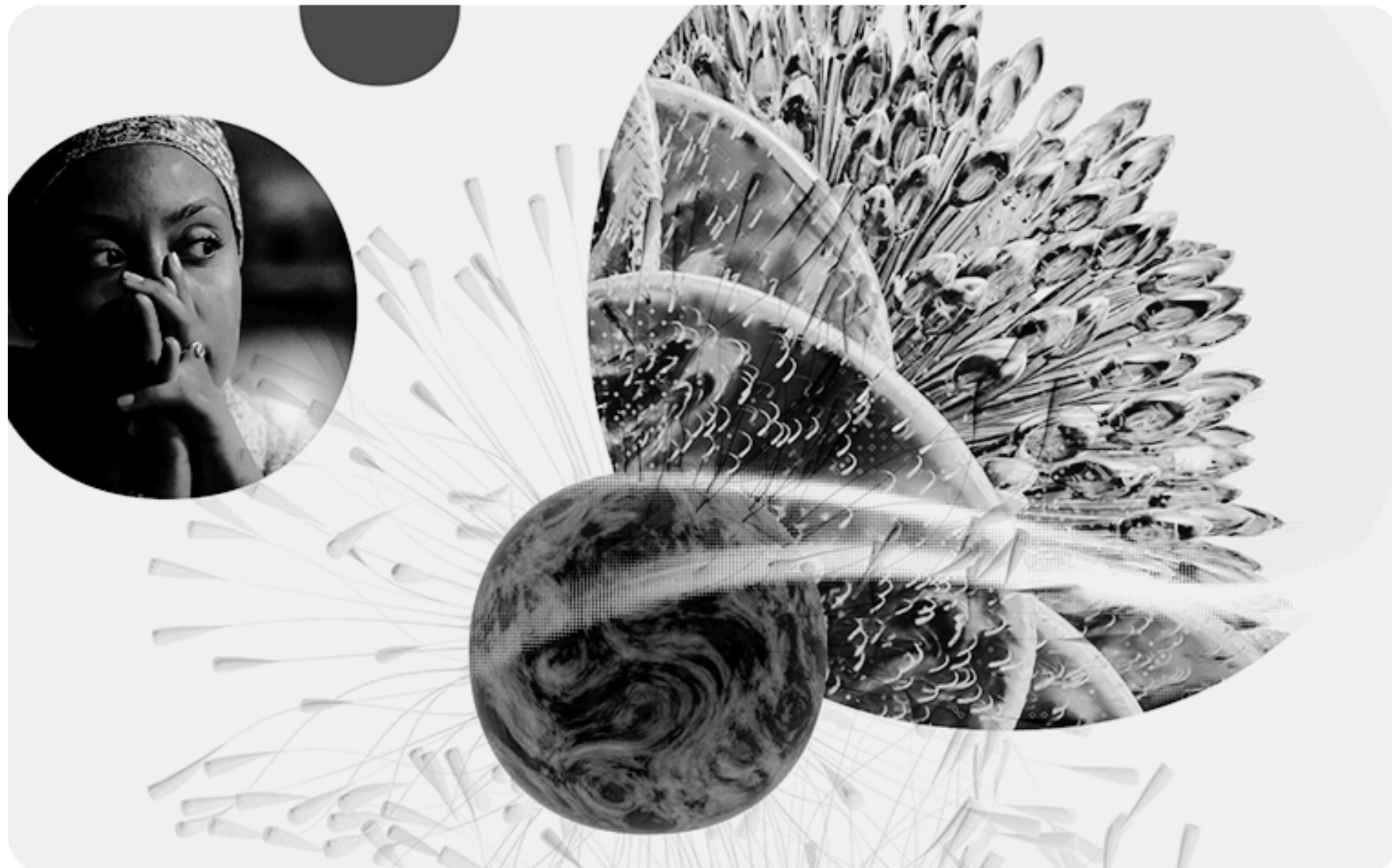
Input Sub-Index = $\frac{I_1+I_2+I_3+I_4+I_5}{5}$

Output Sub-Index = $\frac{O_1 + O_2}{2}$

GROUP -2

OBJECTIVE

A Multi-Criteria Approach to the Comparative Analysis of the Global Innovation Index Across G20 Nations



PROBLEM STATEMENTS

01

Comparing the innovation efficiency of developed and developing countries using the G20 countries.

02

To examine if there is any relationship between GDP per capita and Global Innovation Index(GII) and to analyze if India is “catching up” in terms of innovation performances compared to global expectations.

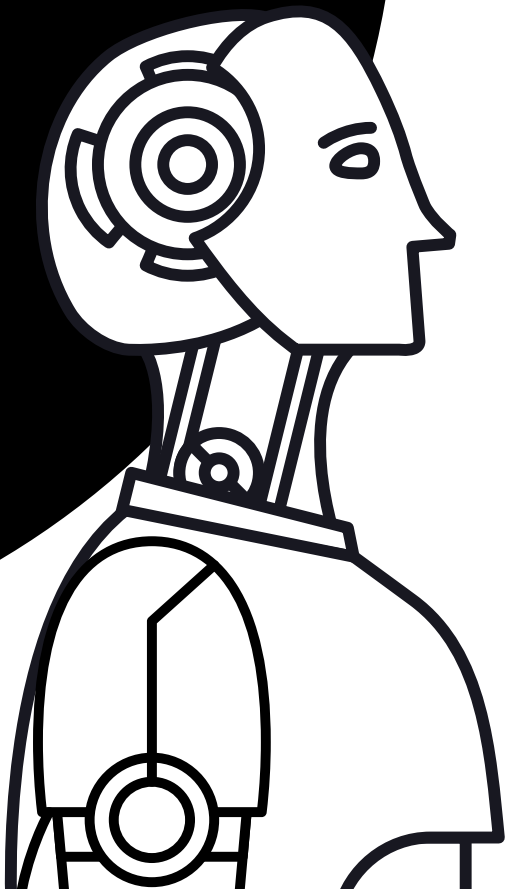
03

To analyze the contribution of key GII pillars to India’s overall Global Innovation Index performance, and identify which pillars exhibit the largest deviation from G20 averages.



PROBLEM STATEMENT-1

NAINA SINGH RAO



BEFORE DATA CLEANING

A	B	C	D	E	F	G	H	I	J	K
ISO3	ECONOMY	NUM	NAME	DAYR	VALUE_SCREEN	SCORE	RANK	SW_OVER	SW_INCRP	
ALB	Albania		Global Innovation Index			29.60708	67			
ALB	Albania	IN	Innovation inputs			40.98414	53			
ALB	Albania	IN.1	Institutions			58.70583	47		S	
ALB	Albania	IN.1.1	Institutional environment			57.27997	60			
ALB	Albania	IN.1.1.1	Operational stability for businesses*	2024	2	65.33333	58			
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ALB	Albania	IN.1.3	Business environment			69.35478	19			
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AFTER CLEANING DATA

A1	Possible Data Loss	f _x v	Economies													
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2	Argentina	2015	9	48	37.7	38.2	35.9	36.3	22.2	36.5	34.3	12500	28669.2061			
3	Argentina	2016	9	47.2	37.3	43.3	35.7	30.8	18	25.3	30.2	12130	27802.1057			
4	Argentina	2017	9	46.4	42.6	46.6	37.7	33.6	17.6	27.6	32	13070	28334.9042			
5	Argentina	2018	9	54.7	35.5	43.4	37.8	31.4	17.9	23.6	30.7	12390	27367.1151			
6	Argentina	2019	9	56.7	38.7	45.8	37.9	32.6	19.2	24	31.9	11210	26629.5529			
7	Argentina	2020	9	54.3	35.9	39.5	34.6	26.9	17.2	19.6	28.3	9040	23877.0931			
8	Argentina	2021	9	52.8	37	42.5	37.5	26.7	18.7	21.9	29.8	10070	26300.2743			
9	Argentina	2022	9	47.6	30.5	44	24.9	31.2	19	24.2	28.6	11820	27627.9635			
10	Argentina	2023	9	30.9	30	39.9	25.2	30.3	19.2	30.3	28	12890	27104.9811			
11	Argentina	2024	9	21.7	33.9	36.7	23	27.7	18.6	29.9	26.4	13440	26547.0503			
12	Australia	2015	12	89.3	57	63.7	66.7	47.5	34.8	56.5	55.2	60520	55691.6988			
13	Australia	2016	12	88.8	59.7	65.1	65.8	45	34.3	48.2	53.1	54100	56341.5182			
14	Australia	2017	12	87.4	60.2	64.8	65.3	45.4	32.1	46.1	51.8	51480	56684.6473			
15	Australia	2018	12	88.7	65.2	62.2	67.7	44.5	31.9	44.8	52	53080	57450.3811			
16	Australia	2019	12	88.8	57.7	60.9	68.3	46.1	31.6	41.1	50.3	54890	57837.0607			
17	Australia	2020	12	88.7	59	55.8	67.1	43.6	30.4	37.3	48.4	53630	57059.7436			
18	Australia	2021	12	88.3	57.4	55.7	66.4	43	29.1	39.6	48.3	57180	58182.3369			
19	Australia	2022	12	77.2	61.7	58.8	50.1	48.6	32.2	37.8	47.1	60710	59883.6471			
20	Australia	2023	12	75.6	59.5	58.8	53.7	50.7	34.9	44.6	49.7	63160	60461.1564			
21	Australia	2024	12	77	58.7	55.4	53.8	48.2	33.1	42.1	48.1	62550	60082.0058			

COLUMNS USED FOR PS-1

01

INPUT&OUTPUT PILLARS

02

COUNTRY

03

GII SCORE

04

YEAR

Methodology:

- Calculated Innovation Efficiency Index ($IEI = \text{Output}/\text{Input}$) for G20 (2015-2024)
- Classified countries as developed/developing using median GDP threshold
- Conducted two-sample t-test to compare mean IEI between group

THE EFFICIENCY MYTH

- **Headline:** No Significant Efficiency Gap Between Developed & Developing Nations.
- **Evidence:** A two-sample t-test found no statistically significant difference in the mean Innovation Efficiency Index (IEI).
 - Developed Nations' Mean IEI: 0.733
 - Developing Nations' Mean IEI: 0.680
 - t-statistic (1.003) < Critical Value (2.110) -> Do Not Reject Null Hypothesis.
- **Interpretation:** Effective transformation of innovation resources is achievable at various development levels.

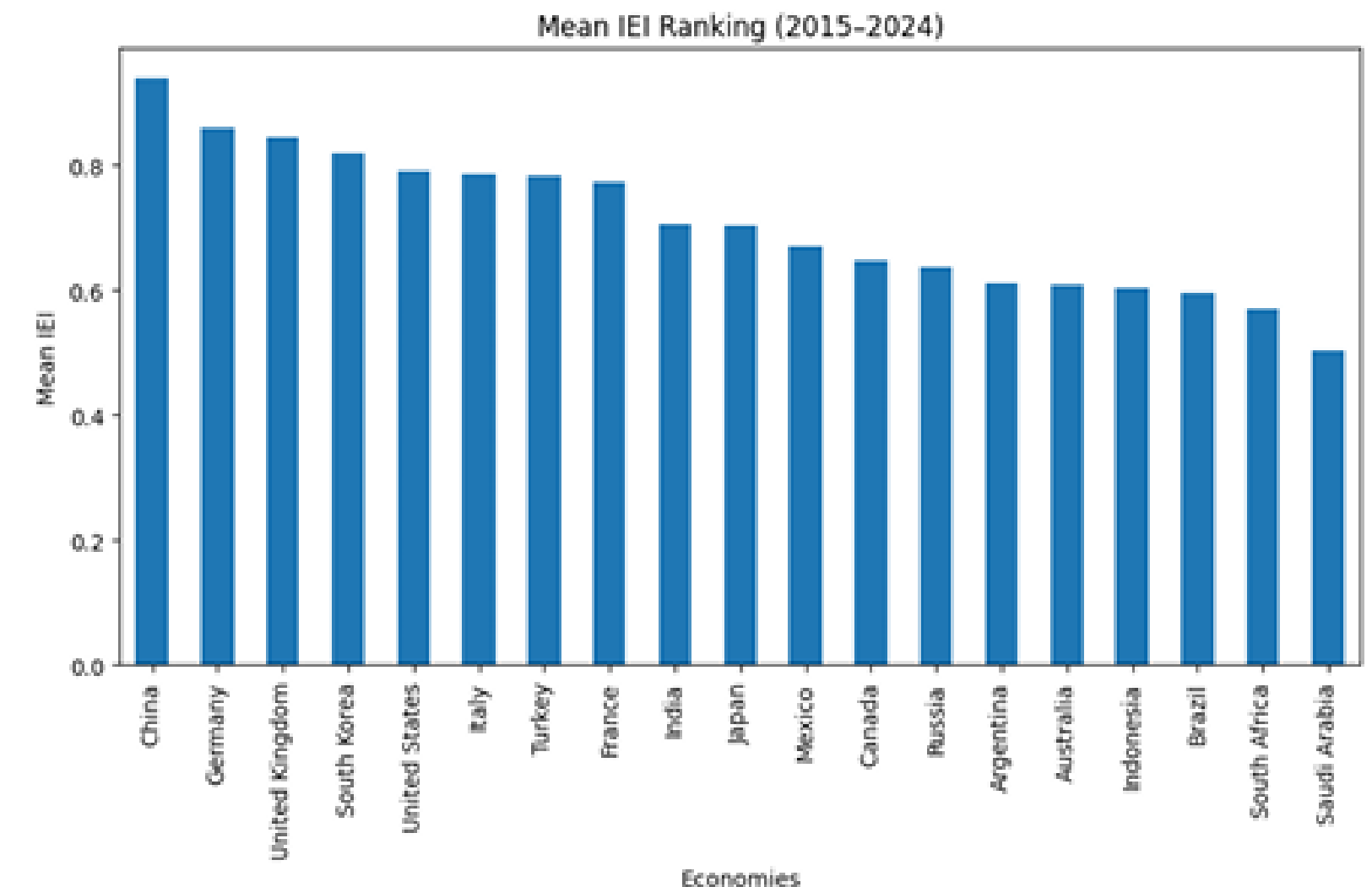


Figure 1.1: Bar graph depicting the country ranking mean (mean IEI) for years 2015-2024 of the G20 nations.

THE TREND

- **Purpose:** Tracks the Innovation Efficiency Index (IEI) over a decade to compare how well developed and developing countries convert inputs into outputs.
- **Trend:** Both groups show similar, slightly fluctuating trends over time.
- **Key Insight:** There is no consistent, widening gap. The efficiency of developed and developing nations is relatively close, challenging the idea of a fixed "efficiency divide."

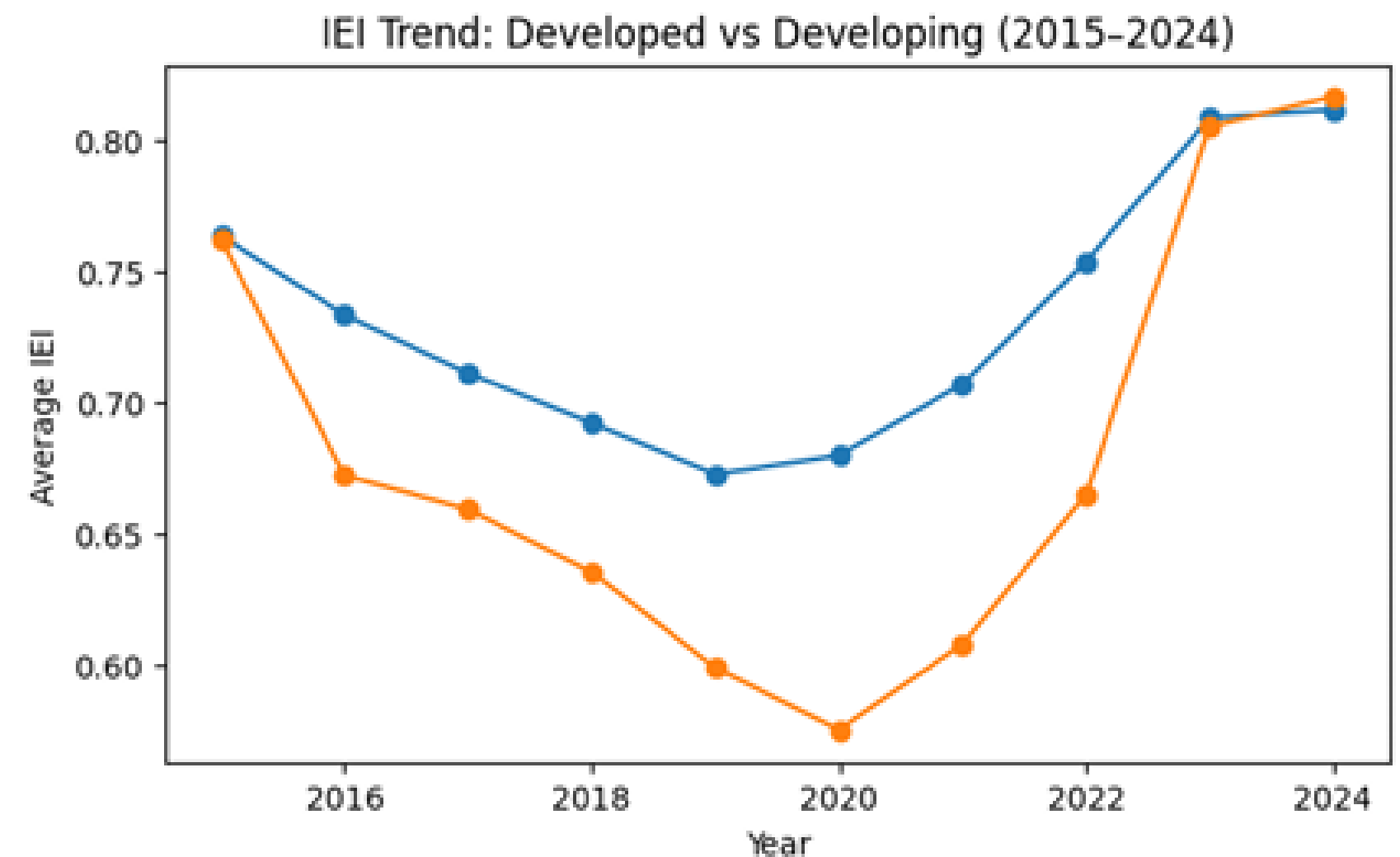
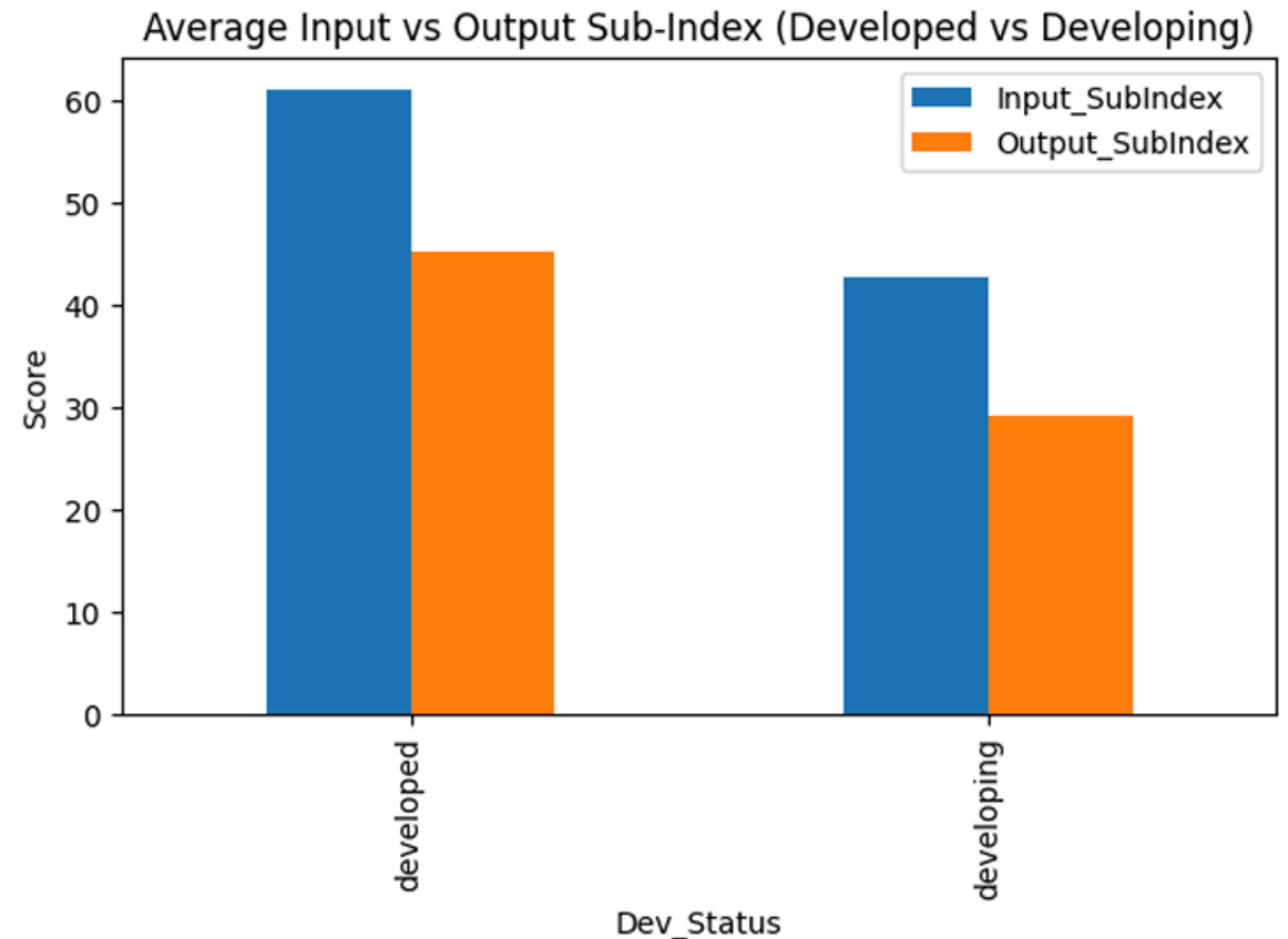


Figure: IEI Trend: Developed vs Developing (2015-2024)

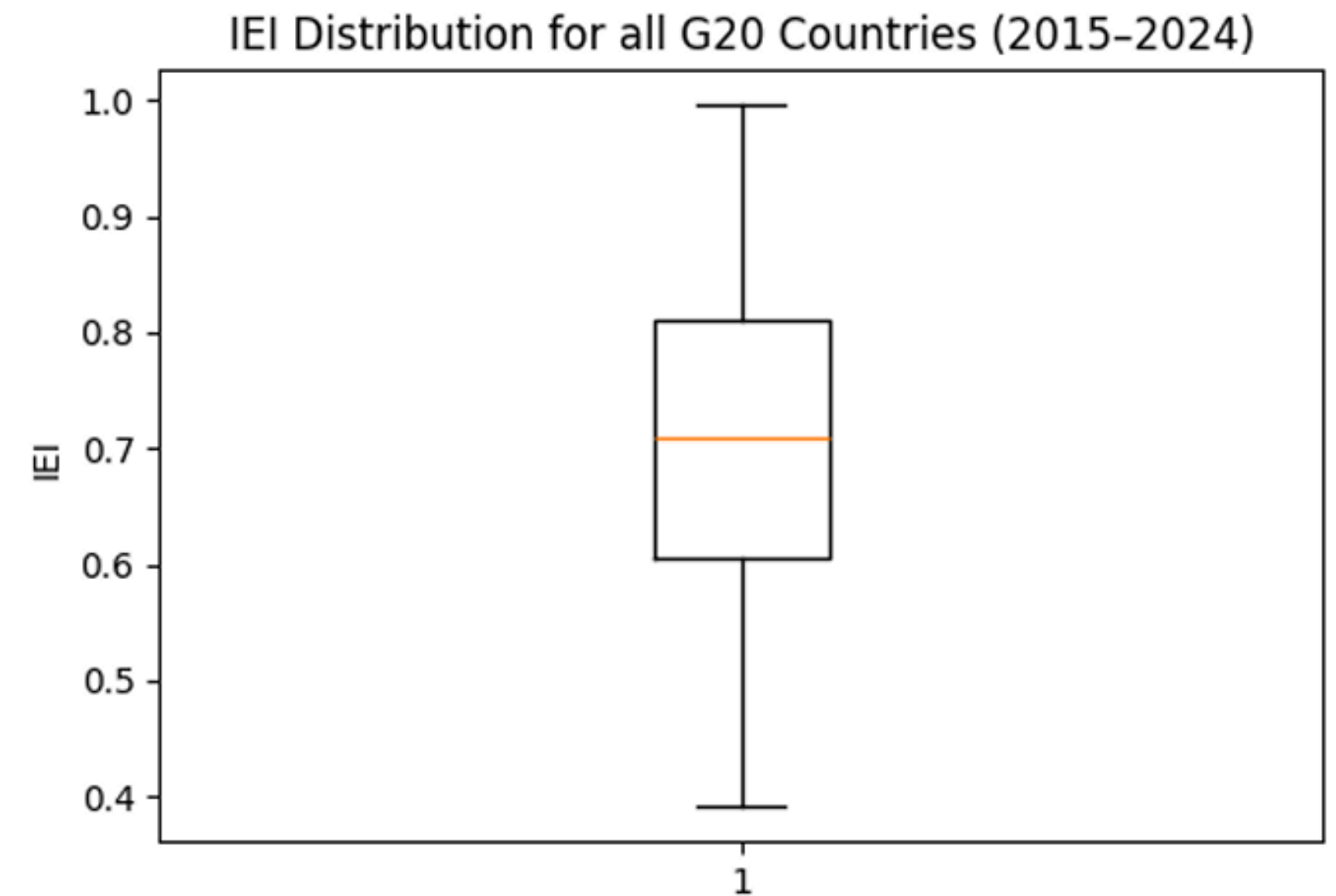
AVERAGE INPUT VS OUTPUT SUB-INDEX

- **Purpose:** Compares the average resources put in (Input) versus the results achieved (Output) for each group.
- **Comparison:**
Developed Countries: Have significantly higher average scores for both Input and Output sub-indices.
Developing Countries: Have lower average scores for both.
- **Key Insight:** While developed nations have more resources and get better results, the IEI (the ratio of Output/Input) shown in Graph 1 reveals that their efficiency in using those resources is not statistically different.



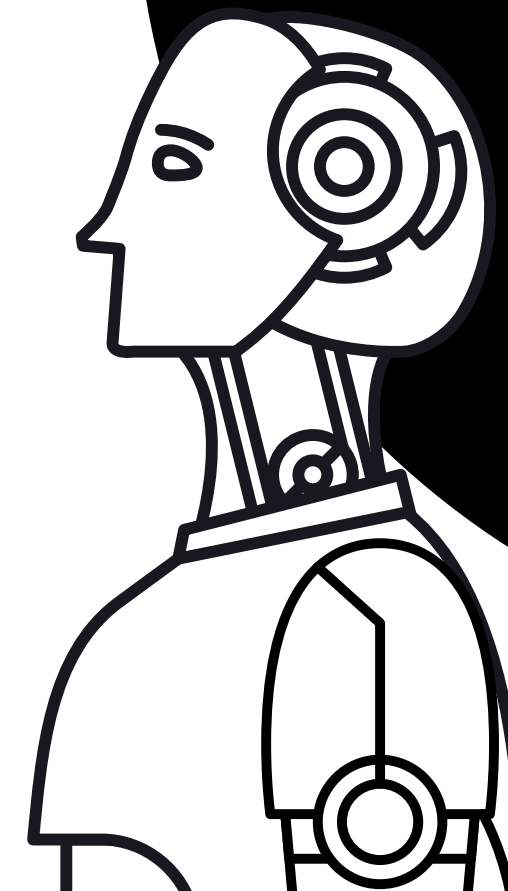
IEI DISTRIBUTION FOR G20 NATIONS (2015-2024)

- **Purpose:** Shows how the Innovation Efficiency Index is spread across all G20 countries over the 10-year period.
- **What it shows:** A box plot displaying the range, median, and spread of IEI values.
- **Key Insight:** There is a wide variation in efficiency among G20 nations. Some countries (the high outliers) are exceptionally efficient, while others (the low outliers) struggle to convert inputs, regardless of their development status.



PROBLEM STATEMENT-2

AKSHARA KUMAWAT



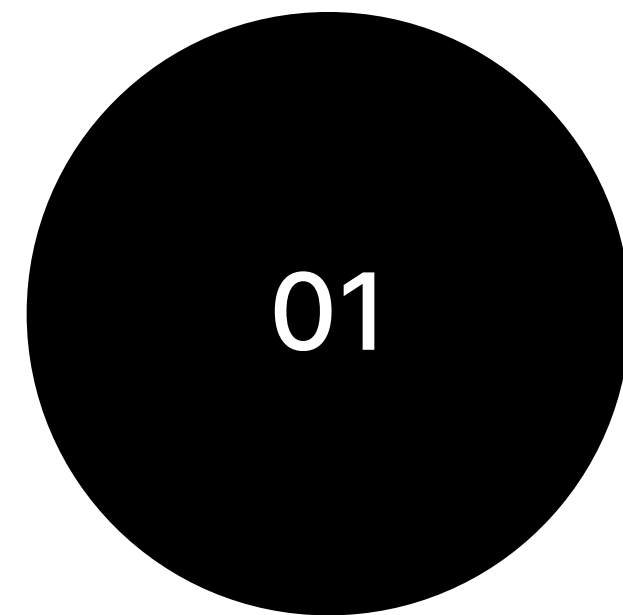
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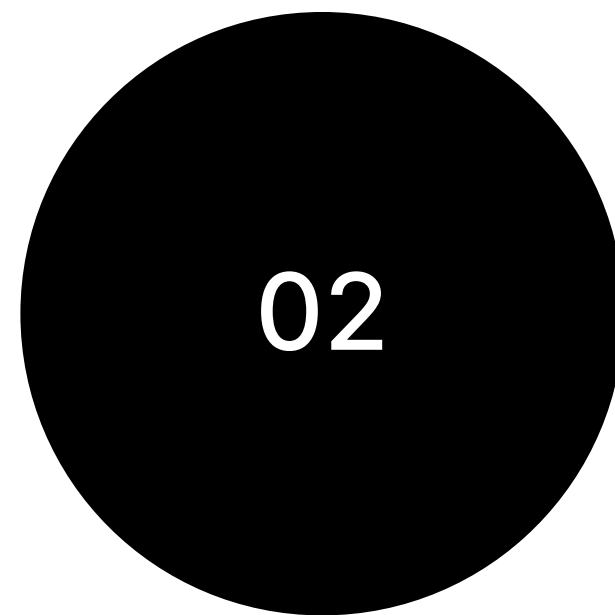
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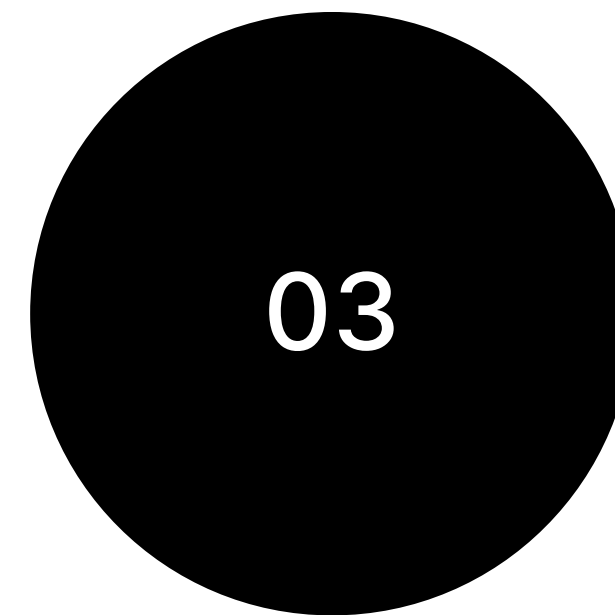
COLUMNS USED FOR PS-2:



RANK



COUNTRY



GDP PER CAPITA



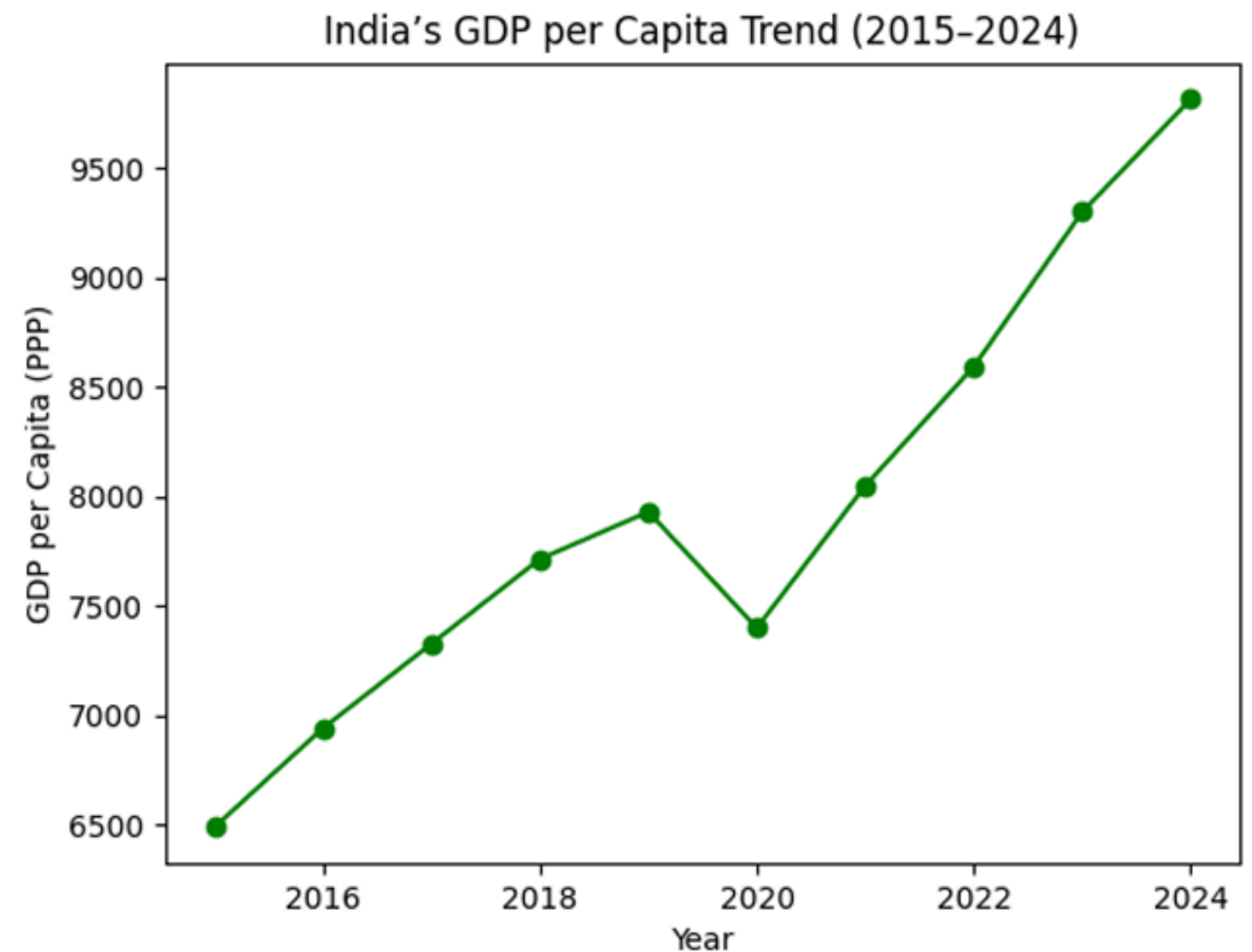
GII SCORE

Methodology:

- Collected India's GDP per capita and GII data (2015-2024)
- Computed Pearson correlation coefficient
- Analyzed year-on-year GII improvements
- Conducted hypothesis testing for relationship significance

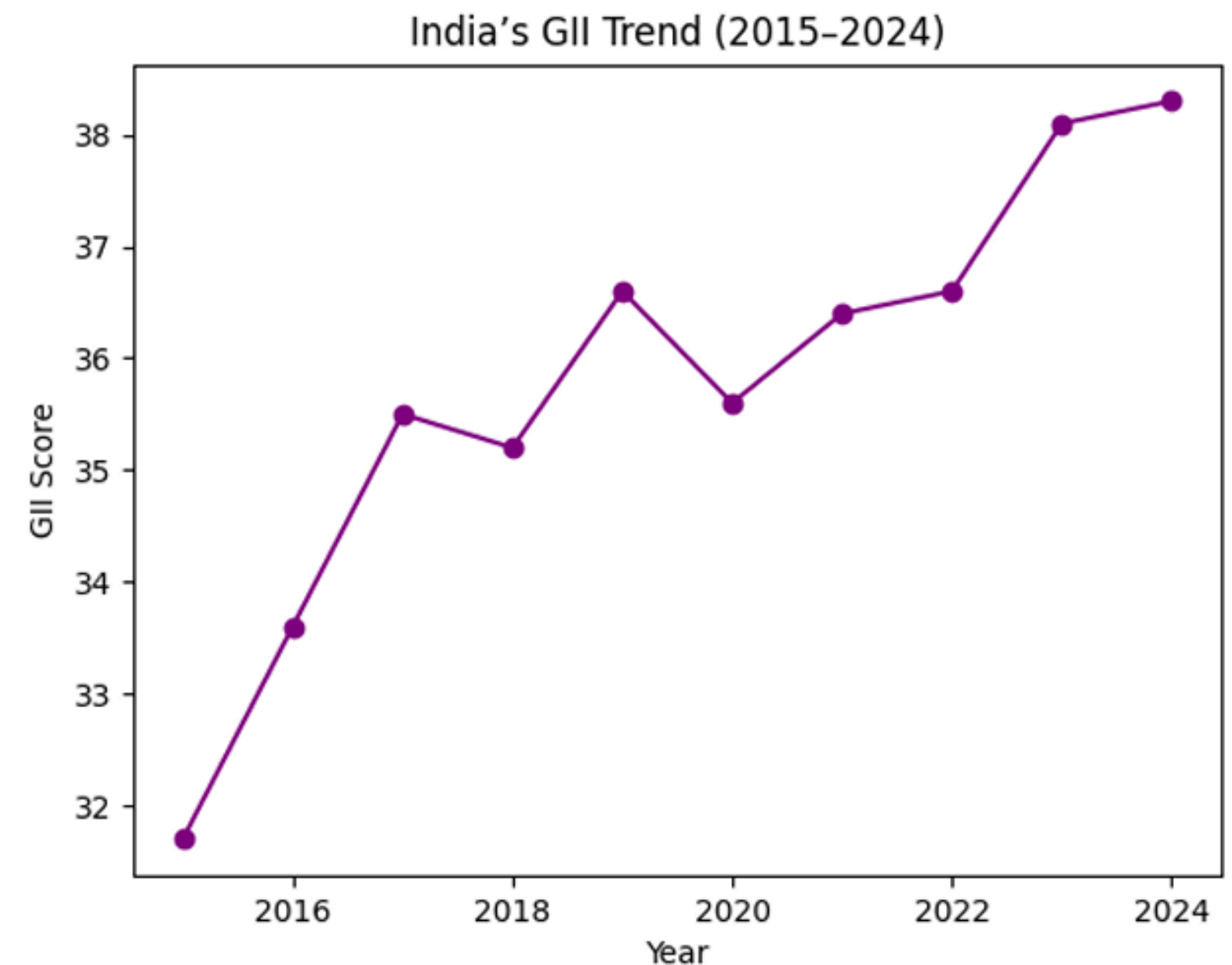
INDIA'S GDP PER CAPITA TREND (2015-2024)

- **Purpose:** Shows the growth of India's economic strength per person over the decade.
- **Trend:** A clear and strong upward trend.
- **Key Insight:** India's GDP per capita has increased significantly, indicating substantial economic growth. A slight dip around 2020 is likely due to the COVID-19 pandemic, followed by a strong recovery.



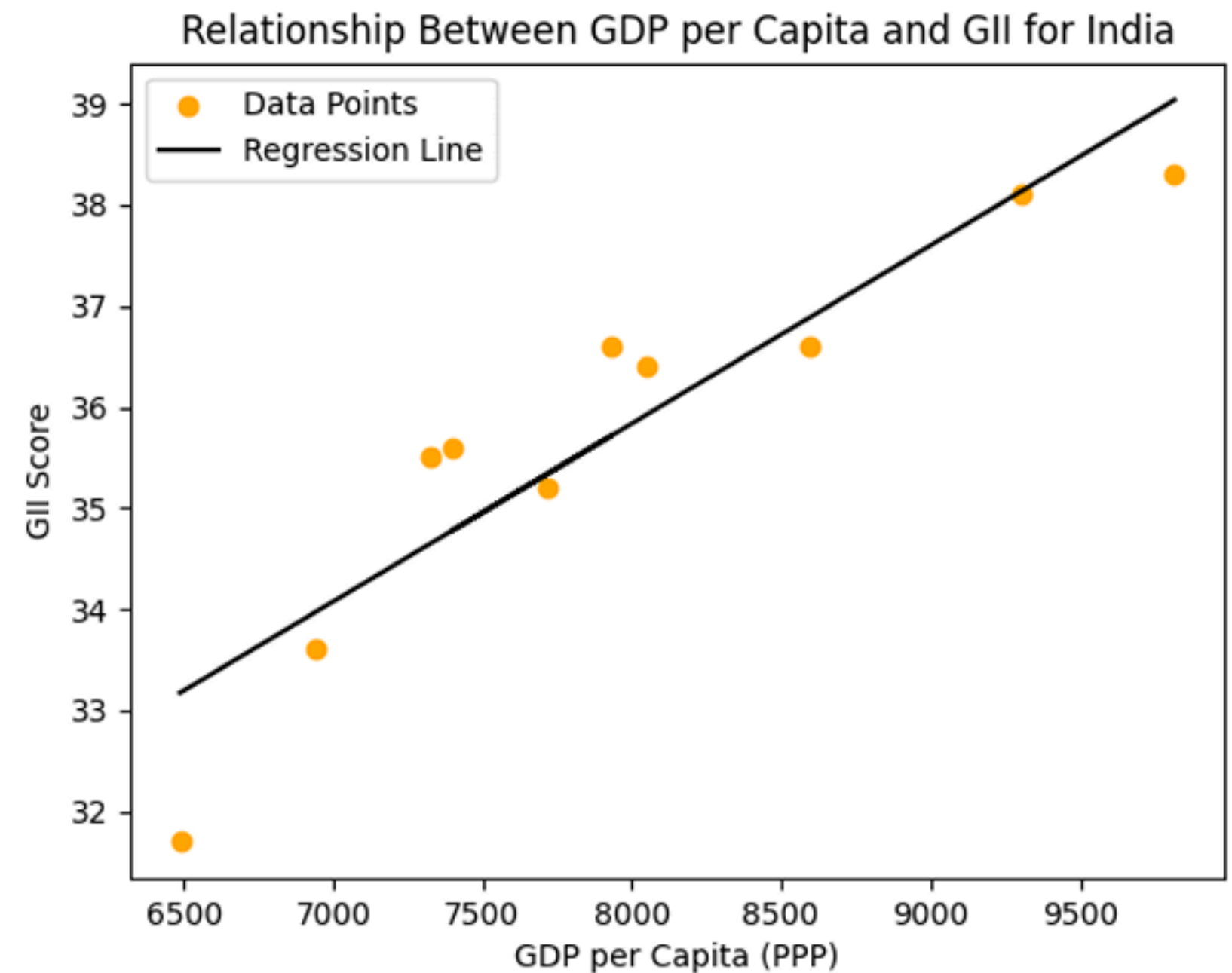
INDIA'S GII TREND (2015-2024)

- **Purpose:** Tracks the year-on-year change in India's Global Innovation Index (GII) score.
- **Trend:** A clear overall upward trajectory.
- **Key Insight:** India's innovation performance has consistently improved over the decade, rising from ~32 to ~38 points. This shows a steady enhancement of the national innovation ecosystem.



RELATIONSHIP BETWEEN GDP PER CAPITA AND GII FOR INDIA

- **Purpose:** Analyzes the link between economic growth (GDP) and innovation (GII).
- **What it shows:** A scatter plot where each point is a year, with a clear upward-sloping regression line.
- **Key Insight:** There is a very strong positive correlation. As India's GDP per capita increases, its GII score also increases. This proves that economic growth and innovation performance are closely linked and reinforce each other in India's case.

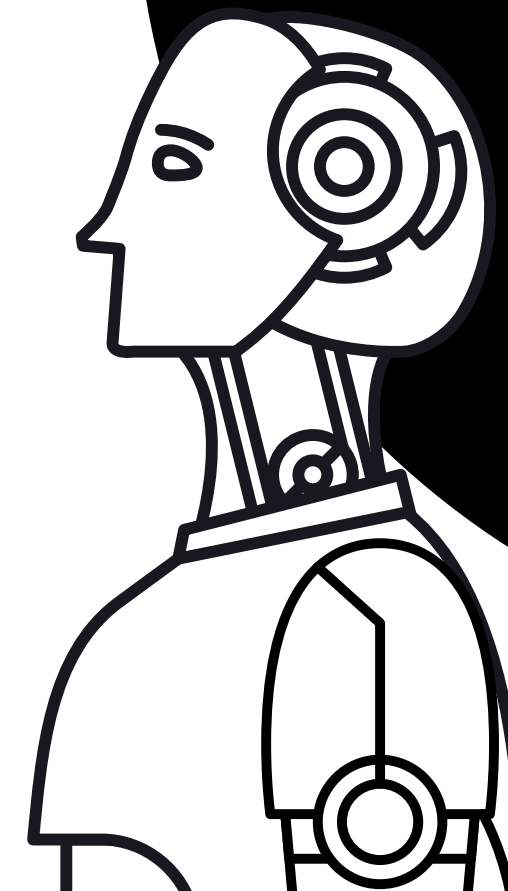


INDIA IS UNDOUBTEDLY "CATCHING UP"

- **Headline:** Strong Evidence of India's Rising Innovation Trajectory.
- **Evidence 1: Powerful Correlation:** A very strong positive correlation between GDP per capita and GII score ($r = 0.921$).
- **Evidence 2: Consistent Growth:** India's GII score rose from **31.7 (2015) to 38.3 (2024)**, a net gain of **+6.6 points**.
- **Evidence 3: Positive Trend:** 7 out of 9 year-on-year changes were positive.
- **Conclusion:** We reject the null hypothesis. India is successfully catching up.

PROBLEM STATEMENT-3

JHARNA SAXENA



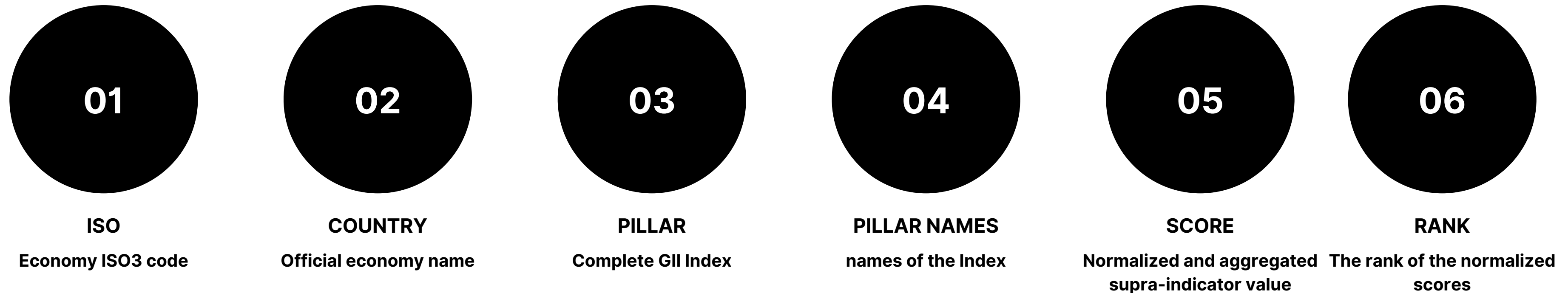
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ALB	Albania	IN.2.2.3	Tertiary inbound mobility, %	2023	1.657989979	4.090009	82			
ALB	Albania	IN.2.3	Research and development (R&D)			0	124			
ALB	Albania	IN.2.3.1	Researchers, FTE/mn pop.							
ALB	Albania	IN.2.3.2	Gross expenditure on R&D, % GDP							

AFTER DATA CLEANING

A	B	C	D	G	H	I	J	K
ISO3	Countries	Pillars	Pillar Name	Score	Rank	Strength v	Income gr	Neutral
ALB	Albania	IN.1	Institutions	58.7058	47		S	N
ALB	Albania	IN.2	Human capital and research	22.3831	99			
ALB	Albania	IN.3	Infrastructure	52.2786	40		S	
ALB	Albania	IN.4	Market sophistication	41.0513	47			
ALB	Albania	IN.5	Business sophistication	30.5017	61			N
ALB	Albania	OUT.6	Knowledge and technology outputs	16.4535	85			N
ALB	Albania	OUT.7	Creative outputs	20.0066	77			N
DZA	Algeria	IN.1	Institutions	42.0918	89			
DZA	Algeria	IN.2	Human capital and research	26.9291	82			N
DZA	Algeria	IN.3	Infrastructure	33.9571	97			
DZA	Algeria	IN.4	Market sophistication	10.4522	138	W	W	
DZA	Algeria	IN.5	Business sophistication	21.6268	119			
DZA	Algeria	OUT.6	Knowledge and technology outputs	11.0563	112			
DZA	Algeria	OUT.7	Creative outputs	10.5267	107		W	N
AGO	Angola	IN.1	Institutions	27.6362	123			
AGO	Angola	IN.2	Human capital and research	12.8668	132		W	N
AGO	Angola	IN.3	Infrastructure	26.8726	122			
AGO	Angola	IN.4	Market sophistication	20.7183	120			
AGO	Angola	IN.5	Business sophistication	16.1005	138		W	
AGO	Angola	OUT.6	Knowledge and technology outputs	5.45628	139	W	W	N
AGO	Angola	OUT.7	Creative outputs	4.97035	130			N
AGO	Angola	OUT.6	Knowledge and technology outputs	5.55235	139	W	W	N

COLUMNS USEFUL FOR PS-3:



Methodology:

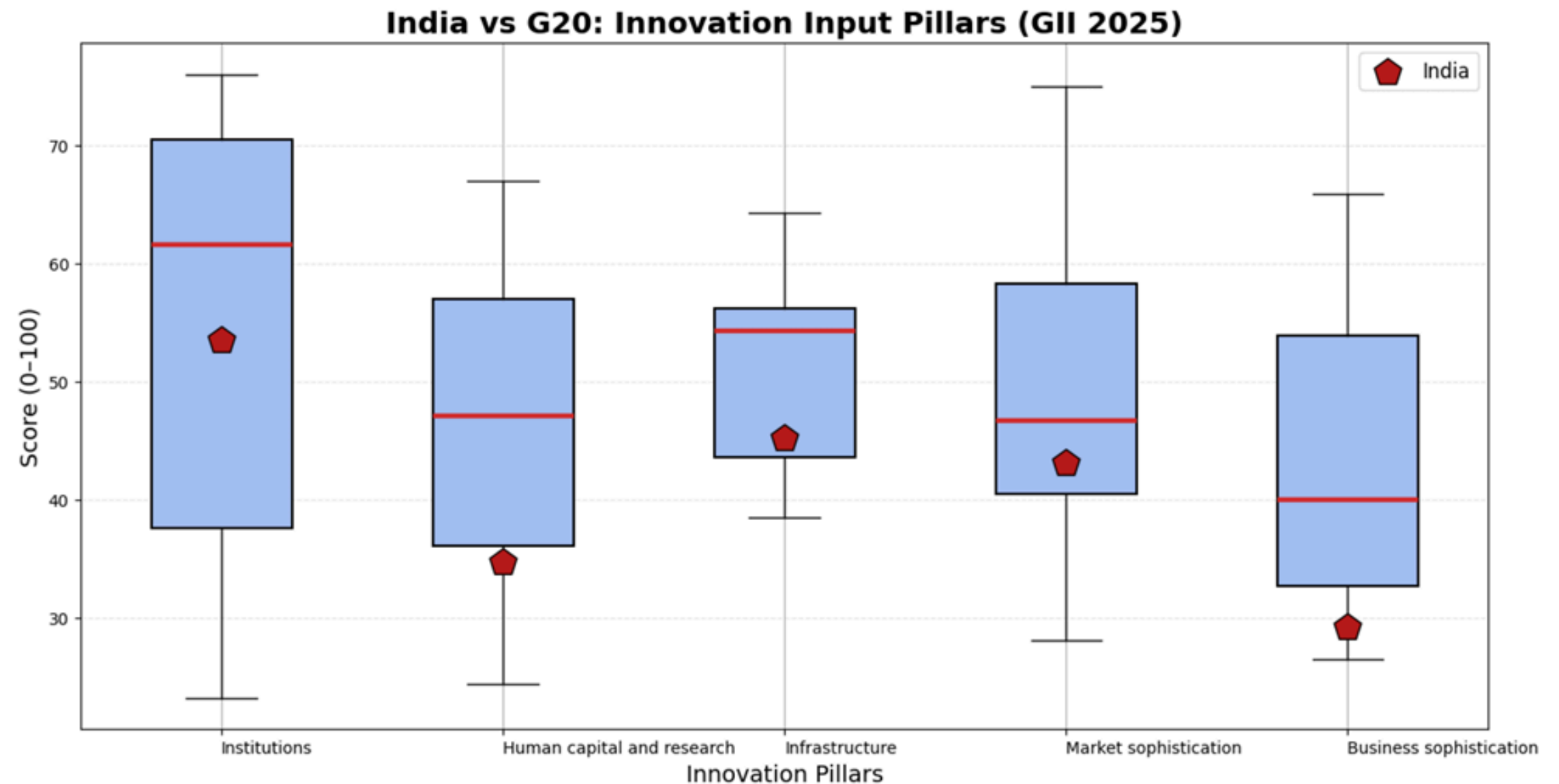
- Compared India's 5 input pillar scores against G20 averages
- Calculated gap differences and Z-scores
- Used descriptive statistics and correlation analysis
- Identified pillars with largest deviations through ranking

QUANTIFYING INDIA'S LAG

Pillar	India	G20 Avg	Gap	Z-Score
Institutions	53.49	56.31	-2.82	-0.16
Human Capital	34.73	46.78	-12.05	-1.01
Infrastructure	45.21	51.2	-5.99	-0.77
Market Sophistication	43.1	48.86	-5.76	-0.48
Business Sophistication	29.2	43.18	-13.98	-1.12

BOXPLOT FOR INNOVATION INPUT PILLARS

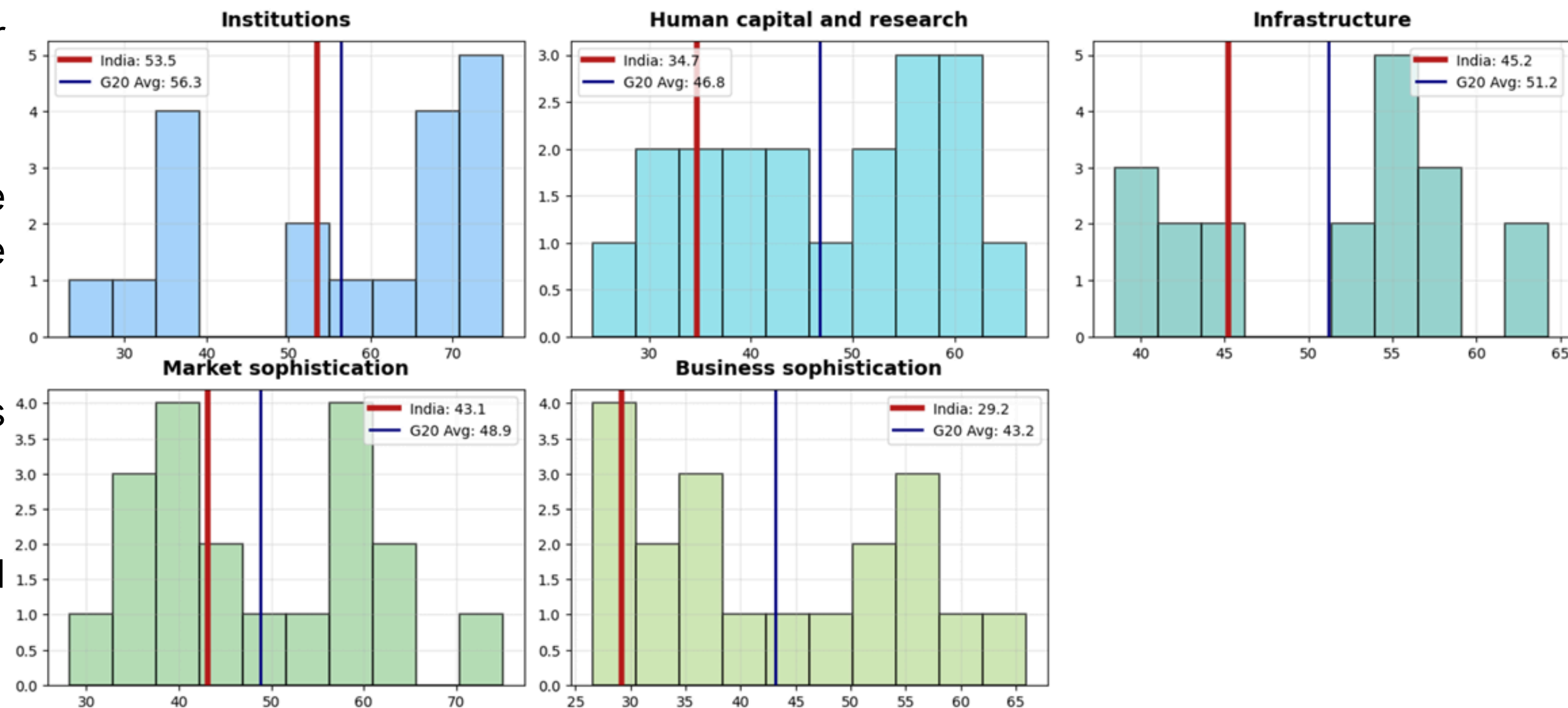
- **Purpose:** To compare the distribution of scores for each of the 5 input pillars across all G20 nations and locate India's position.
- **Key Insight:** India's score (marked by a red pentagon) is below the median (Q2) for all pillars.
- **Critical Finding:** India is in the lowest quartile (bottom 25%) for Human Capital & Research and Business Sophistication, identifying them as its weakest areas.



DISTRIBUTION OF GII 2025 PILLAR SCORES ACROSS G20 ECONOMIES

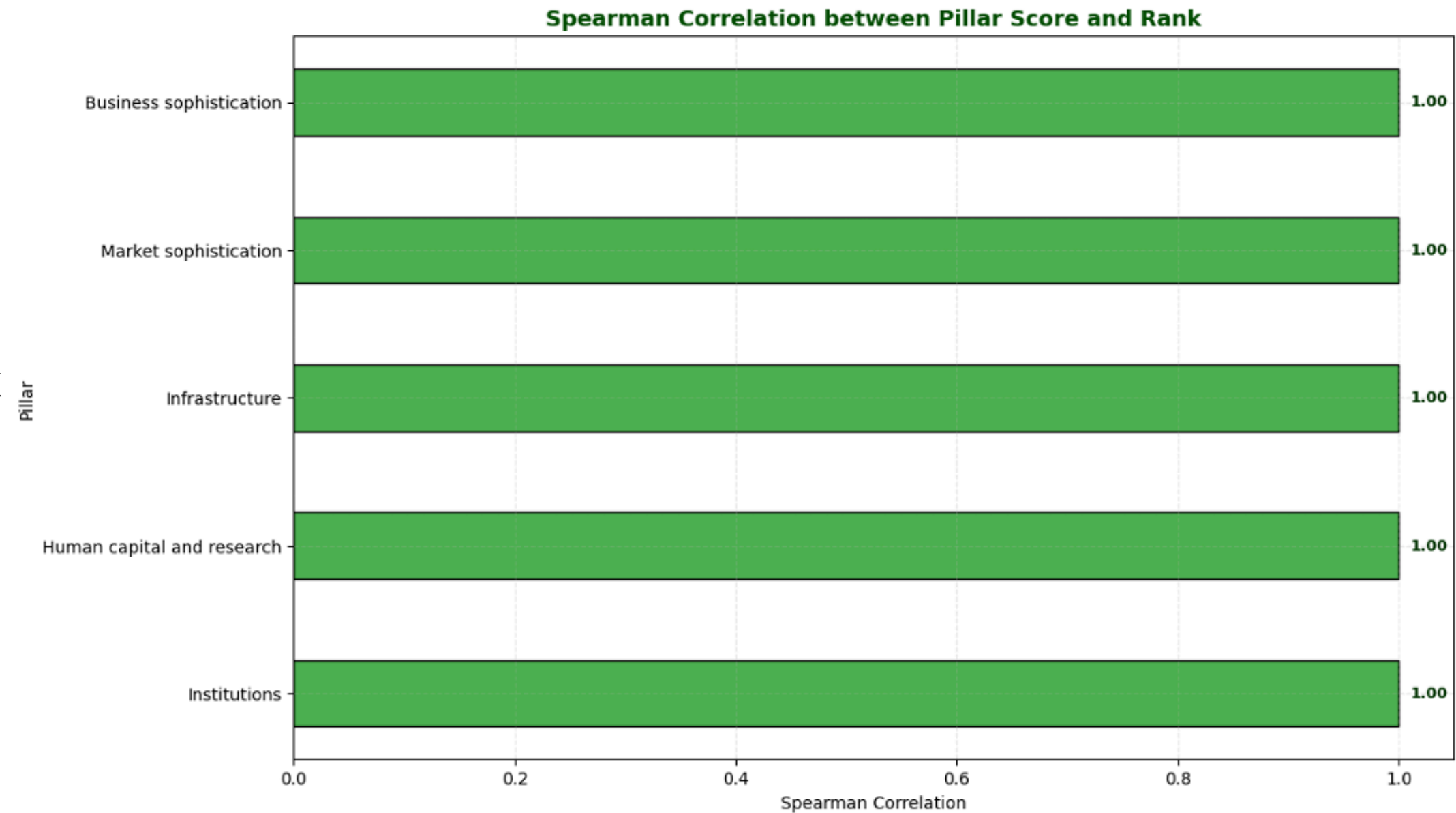
- **Purpose:** To highlight the gap between India's score and the G20 average for each pillar.
- **Visual:** Each pillar shows India's score directly compared to the G20 average line.
- **Key Insight:** The graph clearly shows that the largest gaps are in:
 - Business Sophistication (Largest gap)
 - Human Capital & Research (Second largest gap)
 - The smallest gap is in Institutions.

Distribution of GII 2025 Pillar Scores Across G20 Economies



HIGHER INNOVATION PILLAR SCORES DIRECTLY IMPROVE GLOBAL RANK

- **Finding:** A near-perfect positive correlation exists between pillar scores and a country's GII rank.
- **Meaning:** As nations strengthen core pillars Institutions, Human Capital, Infrastructure, Market, and Business Sophistication their innovation rank improves markedly.
- **Statistical Test:**
 H_0 : No relationship between pillar scores and rank
Result: $|t| = 9.52 > 3.182 \rightarrow \text{Reject } H_0$

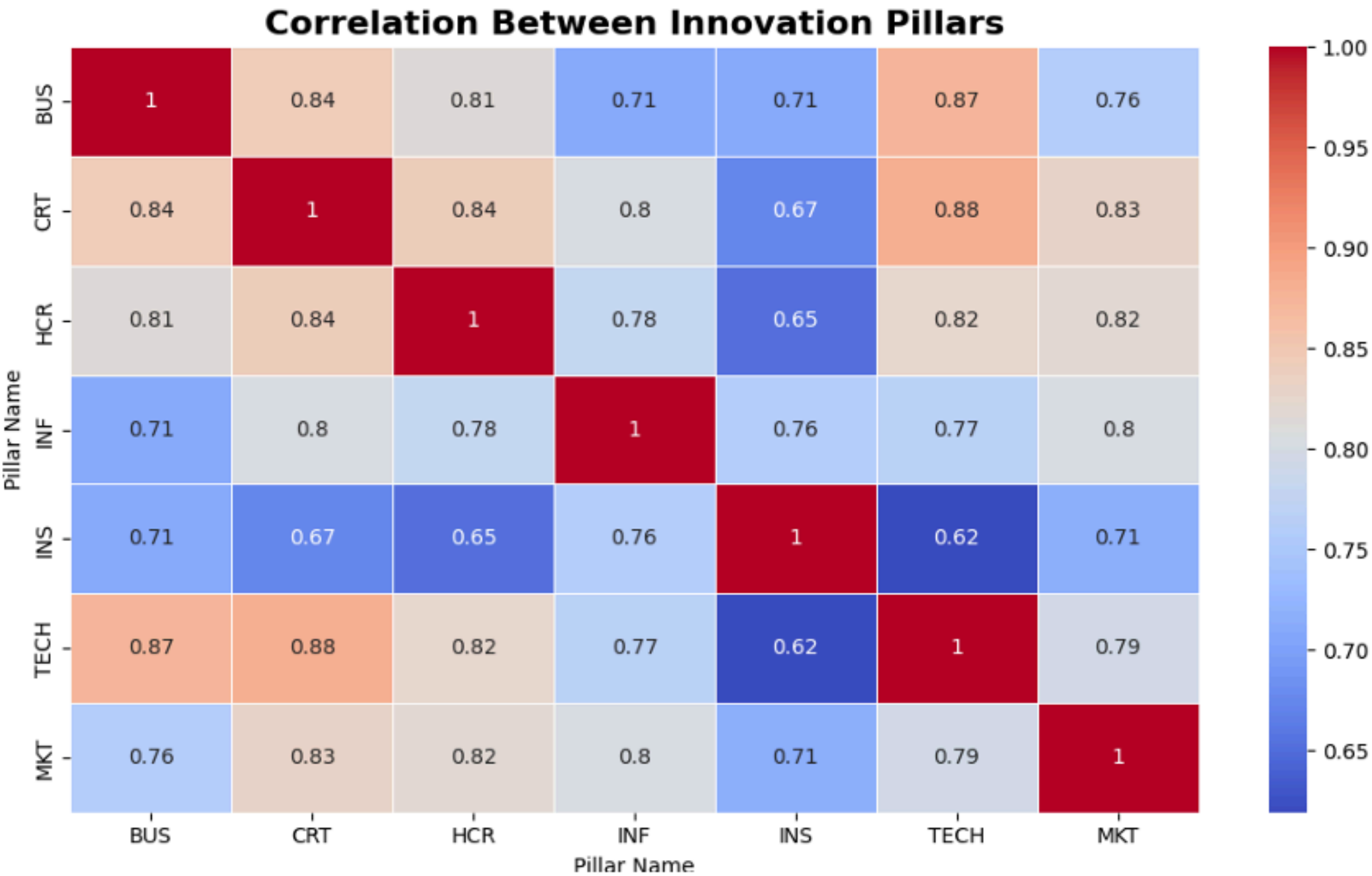


INNOVATION PILLARS MOVE TOGETHER, NOT SEPARATELY

- **Finding:** All five pillars show strong links, with correlations mostly above 0.70.
- Weak Business Sophistication pulls down Human Capital and Market Sophistication.
- Improving one pillar lifts others automatically.
-

India’s Issue: Gaps in Business and Human Capital are dragging the whole system down.

Takeaway: Targeting these weak pillars will trigger a multiplier boost across India’s innovation ecosystem.



CONCLUSION & POLICY IMPLICATIONS



- **Global Insight:** The innovation efficiency gap between developed and developing nations is not fixed. Effective policy can bridge it.
- **India's Status:** India is on a strong upward trajectory, with innovation closely tied to its economic growth.
- **India's Priority Areas:**
 - a.1 Priority: Boost Business Sophistication (Industry-academia links, patents, knowledge absorption).
 - b.2 Priority: Strengthen Human Capital & Research (Education quality, R&D investment, scientific capacity).
 - c. Continue improving Infrastructure and Market Sophistication.

THANK YOU!