Flash Economics

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Will the United States be dethroned in the innovation race?

When we look at the number of Bachelors and PhD graduates each year in Science-Technology-Engineering-Mathematics (STEM), we see that this number is much higher in China (around 1,700,000 in 2021) and India (1,200,000) than in the USA (400,000). This is due in particular to the low proportion of American students pursuing scientific studies (the number of scientific doctorates - PhDs - in relation to the total population is 8 per 100,000 inhabitants in the USA, compared with 15 per 100,000 in the UK and 13 per 100,000 in Germany). When it comes to indicators of excellence in science education (STEM), the USA ranks first, China second and India sixth.

European countries lag far behind in terms of the number of science graduates.

This data could lead us to believe that the United States will lose its dominant position in technology and innovation to China and India. But we mustn't overlook the R&D effort: it represents 3.6% of GDP in the United States and amounts to $784 billion in purchasing power parity (PPP), compared with $723 billion PPP in China, and $71 billion PPP in India ($410 billion PPP in the European Union). Nor should we overlook the quality of innovations: the "Global Innovation Index" of the World Intellectual Property Organization (WIPO) ranks the United States 3rd behind Switzerland and Sweden, China 11th and India 39th.

The size of a country is not the only determinant of its capacity to innovate: we need to take into account the research effort, the availability of funding, the quality of the education system, and the intensity of international exchanges between researchers.

At least until the election of Donald Trump, the United States remained in a leading position for innovation and technical progress.

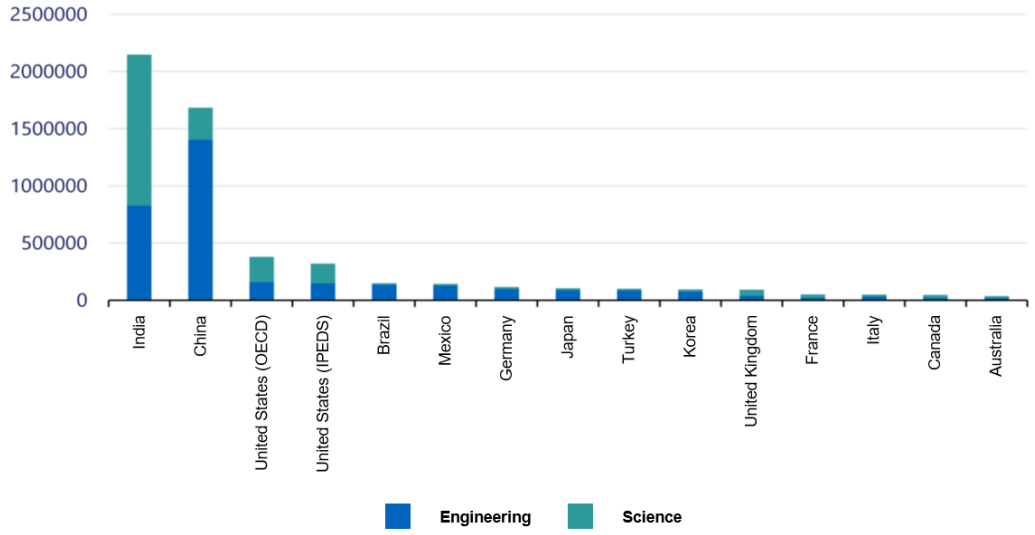
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One might think that the United States has lost its dominant position in innovation and technology

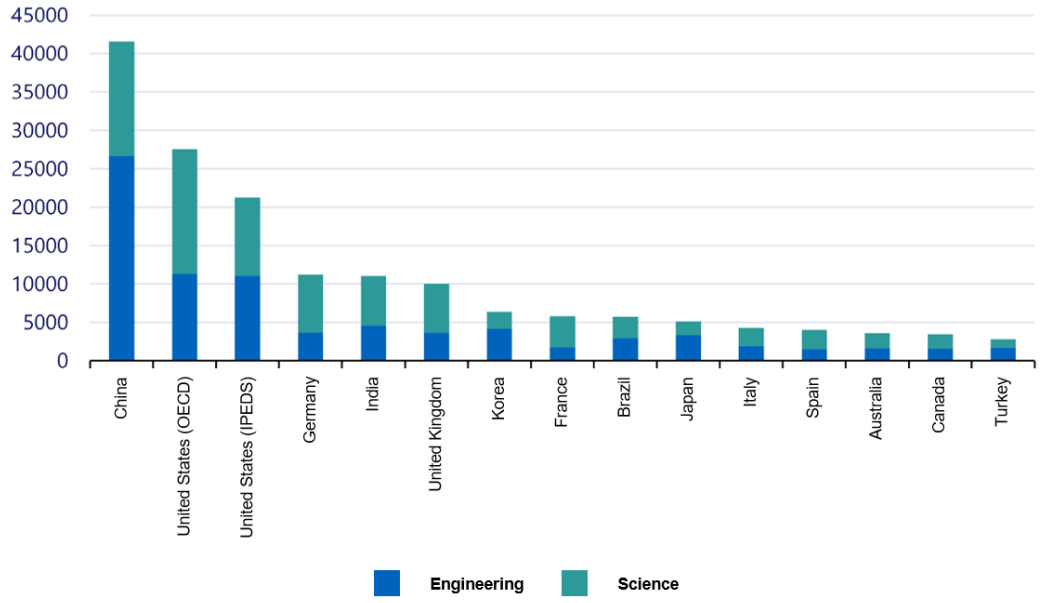
When we look at the number of graduates each year in Science-Technology-Engineering-Mathematics (STEM), we see that this number is much higher in China and India than in the USA (Charts 1A/B).

Chart 1A: Total number of undergraduate degrees awarded in science and engineering fields in 2021



Source: Council of Economic Advisors

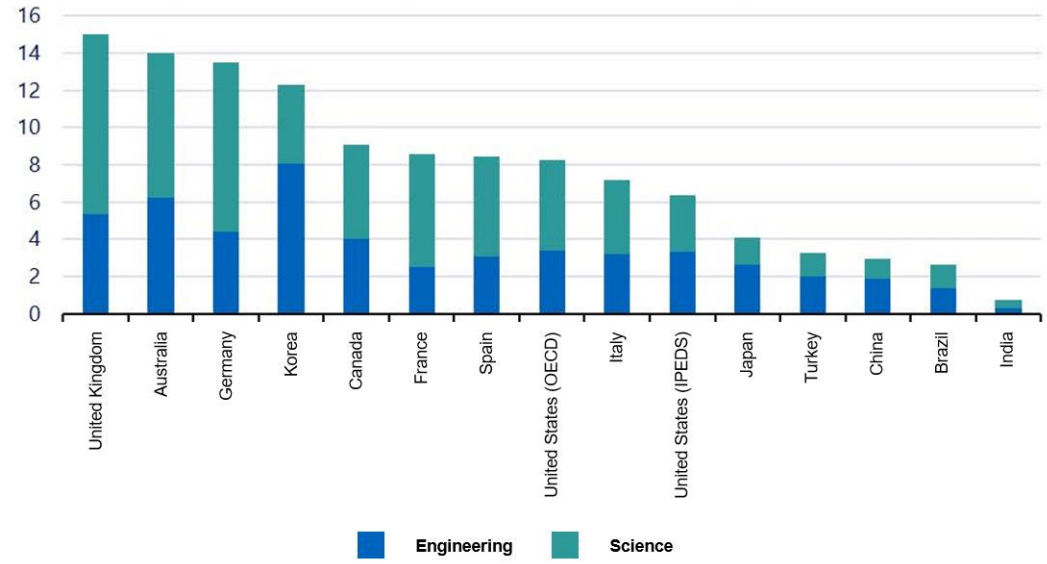
Chart 1B: Total number of doctorate degrees awarded in science and engineering fields in 2021



Source: Council of Economic Advisors

This is partly due to the size of the population, and partly due to the low proportion of students taking science and technology degrees in the USA (Chart 2).

Chart 2: Total number of doctorate degrees awarded in science and engineering fields in 2021 per 100,000 people



Source: Council of Economic Advisors

We can see that despite their smaller total population, France and Germany actually have a higher proportion of STEM graduates than the Unites States.

We can also look at **the level of students in Science-Technology-Engineering-Mathematics (STEM)** using the Index of Excellence in STEM Education, published by the Center for Excellence in Education[1] and based on rankings in the Biology, Chemistry, Maths and Computer Science Olympiads, Table 1.

Table 1: Index of Excellence in STEM Education (based on the combined outcomes of International STEM Olympiads)

Rank	Country
1	United States of America
2	China
3	Poland
4	Taïwan
5	Japan
6	India
7	Singapore
8	Iran (Islamic Republic of)
9	Vietnam
10	Israel
11	United Kingdom
12	Republic of Korea
13	Romania
14	Bulgaria
15	Kazakhstan
16	Hungary
17	Thailand
18	Serbia
19	Canada
20	Italy
21	Brazil
22	Austria
23	Ukraine
24	Indonesia
25	Bosnia and Herzegovina

Source: Center for Excellence in Education

[1] https://www.cee.org

We can see that the USA is ahead of China, and that China and the USA are ahead of India, but India's ranking is low. European countries are much further down the ranking.
All in all, both the size effect (number of STEM graduates) and the quality of science students give the impression that the **USA's dominant position in innovation and technology is under threat from China and India**.

A different assessment when it comes to R&D expenditure and the innovation effort

Table 2 shows R&D expenditure as a percentage of GDP (in descending order of R&D effort).

Table 2: Global ranking of economies by R&D intensity (GERD as a % of GDP), 2023

Rank	Economy	GERD, % GDP
1	Israel	6.02
2	Republic of Korea	5.21
3	United States	3.59
4	Belgium	3.43
5	Sweden	3.41
6	Japan	3.4
7	Switzerland	3.31
8	Austria	3.2
9	Germany	3.13
10	Finland	2.96
11	United Kingdom	2.9
12	Denmark	2.89
13	Iceland	2.66
14	China	2.43
15	Netherlands	2.3
16	France	2.18
17	Singapore	2.16
18	Slovenia	2.11
19	Czech Republic	1.96
20	Estonia	1.78
21	Canada	1.71
22	Portugal	1.7
23	Australia	1.66
24	Norway	1.56
25	United Arab Emirates	1.5
26	Greece	1.49
27	New Zealand	1.47
28	Poland	1.46
29	Spain	1.44
30	Croatia	1.43
31	Hungary	1.39
32	Italy	1.33
33	Türkiye	1.32
34	Thailand	1.21
35	Brazil	1.15
36	Hong Kong, China	1.07
37	Lithuania	1.02
38	Egypt	1.02
39	Slovakia	0.98
40	Luxembourg	0.98
41	Serbia	0.97
42	Ireland	0.96
43	Malaysia	0.95
44	Russian Federation	0.94
45	Iran (Islamic Republic of)	0.79
46	Bulgaria	0.77
46	Cyprus	0.77
48	Latvia	0.76
49	Rwanda	0.76
50	Tunisia	0.75
51	Jordan	0.69
52	Malta	0.69
53	Qatar	0.68
54	India	0.65
55	South Africa	0.6

Source : WIPO

The United States (3rd) is well ahead of China (14th) and India (54th). But the absolute level of **R&D spending is a better indicator of R&D effort**.

Table 3 shows the **level of R&D expenditure in purchasing power parity dollars**.

Table 3: The top 15 global R&D spenders (2023, in USD 2015 PPP)

Rank	Economy	Total R&D, billion USD
1	United States of America	783.6
2	China	723.0
3	European Union	410.0
4	Japan	183.5
5	Republic of Korea	121.3
6	United Kingdom	88.2
7	India	71.3
8	Türkiye	38.9
9	Brazil	37.1
10	Russian Federation	36.9
11	Canada	31.0
12	Israel	24.8
13	Australia	24.5
14	Switzerland	20.5
15	Egypt	15.8

Source: WIPO

We can see that two countries dominate the others in terms of R&D spending levels: the United States and China. The European Union's level of R&D spending is roughly half that of the United States.

But we need to introduce a new element to the analysis: **the quality of innovations**.

To do this, we use the **Global Innovation Index** measured by the World Intellectual Property Organisation.

It depends on the number of scientific publications, the R&D effort, the number of venture capital deals, the number of patents filed, the number of drugs approved, the number of Internet subscribers, the number of robots, the number of electric vehicles, the quality of cancer detection, life expectancy, global warming, etc. (Table 4).

Table 4: Global Innovation Index 2024 rankings

GII rank	Economy	Score
1	Switzerland	67.5
2	Sweden	64.5
3	United States of America	62.4
4	Singapore	61.2
5	United Kingdom	61.0
6	Republic of Korea	60.9
7	Finland	59.4
8	Netherlands	58.8
9	Germany	58.1
10	Denmark	57.1
11	China	56.3
12	France	55.4
13	Japan	54.1
14	Canada	52.9
15	Israel	52.7
16	Estonia	52.3
17	Austria	50.3
18	Hong Kong	50.1
19	Ireland	50.0
20	Luxembourg	49.1
21	Norway	49.1
22	Iceland	48.5
23	Australia	48.1
24	Belgium	47.7
25	New Zealand	45.9
26	Italy	45.3
27	Cyprus	45.1
28	Spain	44.9
29	Malta	44.8
30	Czech Republic	44.0
31	Portugal	43.7
32	United Arab Emirates	42.8

GII rank	Economy	Score
33	Malaysia	40.5
34	Slovenia	40.2
35	Lithuania	40.1
36	Hungary	39.6
37	Türkiye	39.0
38	Bulgaria	38.5
39	India	38.3
40	Poland	37.0
41	Thailand	36.9
42	Latvia	36.4
43	Croatia	36.3
44	Viet Nam	36.2
45	Greece	36.2
46	Slovakia	34.3
47	Saudi Arabia	33.9
48	Romania	33.4
49	Qatar	32.9
50	Brazil	32.7
51	Chile	32.6
52	Serbia	32.3
53	Philippines	31.1
54	Indonesia	30.6
55	Mauritius	30.6
56	Mexico	30.4
57	Georgia	30.4
58	North Macedonia	29.9
59	Russian Federation	29.7
60	Ukraine	29.5
61	Colombia	29.2
62	Uruguay	29.1
63	Armenia	29.0
64	Iran (Islamic Republic of)	28.9

Source: WIPO

We can see that the United States (3rd) is a more innovative country than China (11th) or India (39th), and that the countries of Northern Europe, Germany, the United Kingdom and France, have a fairly good situation in terms of innovation.

Summary: the number of Science-Technology-Engineering-Mathematics graduates is not sufficient to represent a country's innovation potential

If we consider only the number of STEM graduates, Charts 1a/b above, we conclude that the USA will lose its technological lead to China and India. The quality of science education is excellent in China and the USA, and very good in India (Chart 2, above).

But this judgement needs to be modified by an analysis of R&D expenditure (Table 3, above): only China rivals the USA, while India spends ten times less on R&D than China or the USA; and by an examination of the quality and number of innovations (Table 4, above): the USA is still far ahead of China, and India has a very low overall innovation index.

We can conclude that, despite the size effect (number of STEM graduates), the USA maintains its lead over China in innovation and technology, and that India has a reduced capacity for innovation.

This assessment will have to be modified if the Trump Administration persists in compromising the quality of scientific research in the United States.

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