# A Snapshot of U.S. R&D Competitiveness: 2020 Update

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*The Organisation for Economic Co-operation and Development (OECD), the leading source for international data on science, technology, and innovation, updates its Science and Technology Indicators twice a year. Here's a look at some major trends from the most recent update. All data is accessible via OECD: https://www.oecd.org/sti/msti.htm*

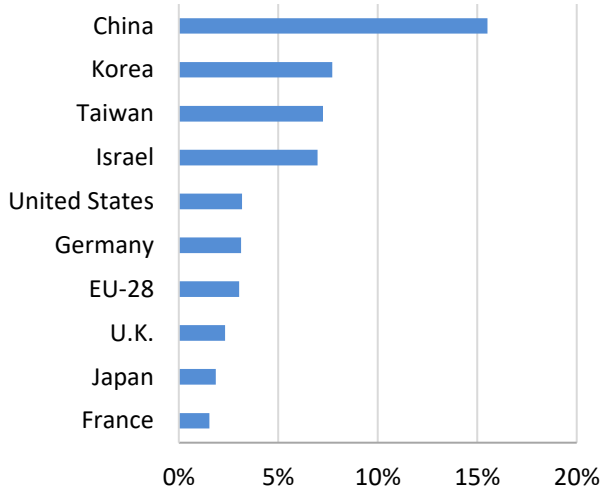
## Global R&D Expenditures: China Continues to Gain

Spending on research and development (R&D) – activities to generate new knowledge and create new technology – is a cornerstone input for innovation. The United States has long led the world in R&D spending, but China has gained rapidly in recent years. From 1995 through 2018, Chinese R&D investment from public and private sources increased by over 15% a year on average, an astounding figure roughly double the increases achieved by Korea, which had the second-highest growth among major funders (figure 1).

As a result of this growth, Chinese R&D reached $463 billion in 2018 according to OECD data, $89 billion behind the U.S. (figure 2). The U.S. currently accounts for less than 30% of the global total.

Up until recently, many analysts believed Chinese R&D spending would catch up with the U.S. as early as last year. Yet the data in figure 2 suggests this hasn't happened yet. Why not? The simple answer is that prices in China have risen, pushing up the cost of research more than had been previously estimated. OECD adjusts its international comparisons to achieve purchasing power parity, eliminating

**Figure 1: Annual Growth in R&D Expenditures Since 1995**



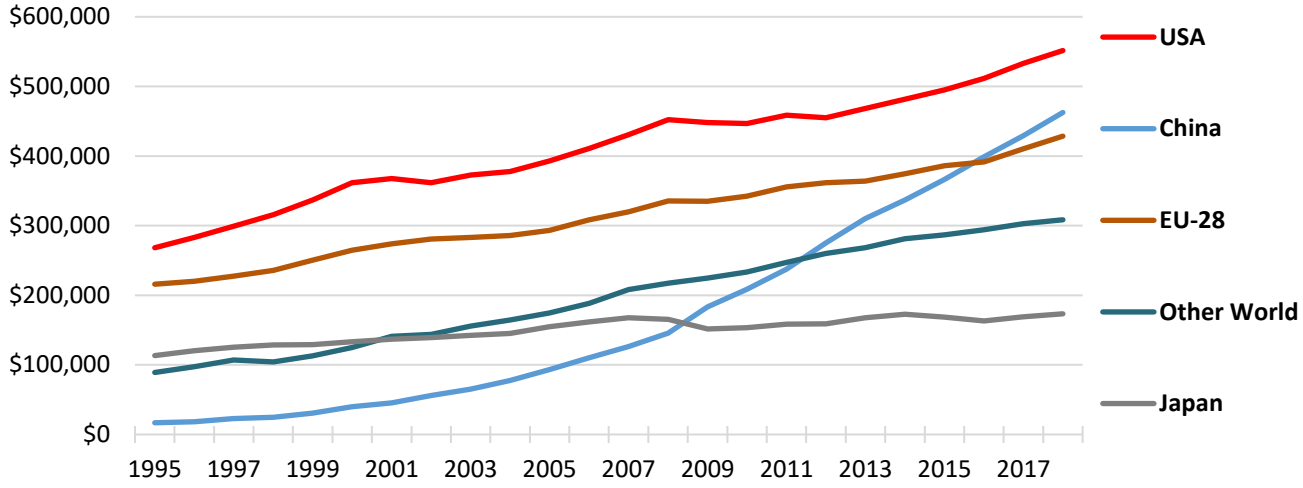

Including public and private sources. Analysis based on OECD Indicators data, October 2020. | AAAS

the differences in prices between countries and allowing for something closer to apples-to-apples comparisons. OECD had been relying on 2011 prices to make these adjustments but, earlier this year, updated its methodology to capture 2017 price levels. Over these six years, the prices of goods in China drifting upwards, approaching the global average.[1]

For R&D activities, the upshot is that China continues to increase spending substantially,

**Figure 2: World R&D by Country / Region**

(millions of constant dollars adjusted for purchasing power parity)




Includes public and private sources. Source: OECD Main S&T Indicators, October 2020 | AAAS

but those expenditures are buying less actual R&D than they would have when prices were cheaper. It also doesn't change the core fact that Chinese R&D has seen staggering increases over the past two decades, and remains an undeniable leadership rival to the U.S.

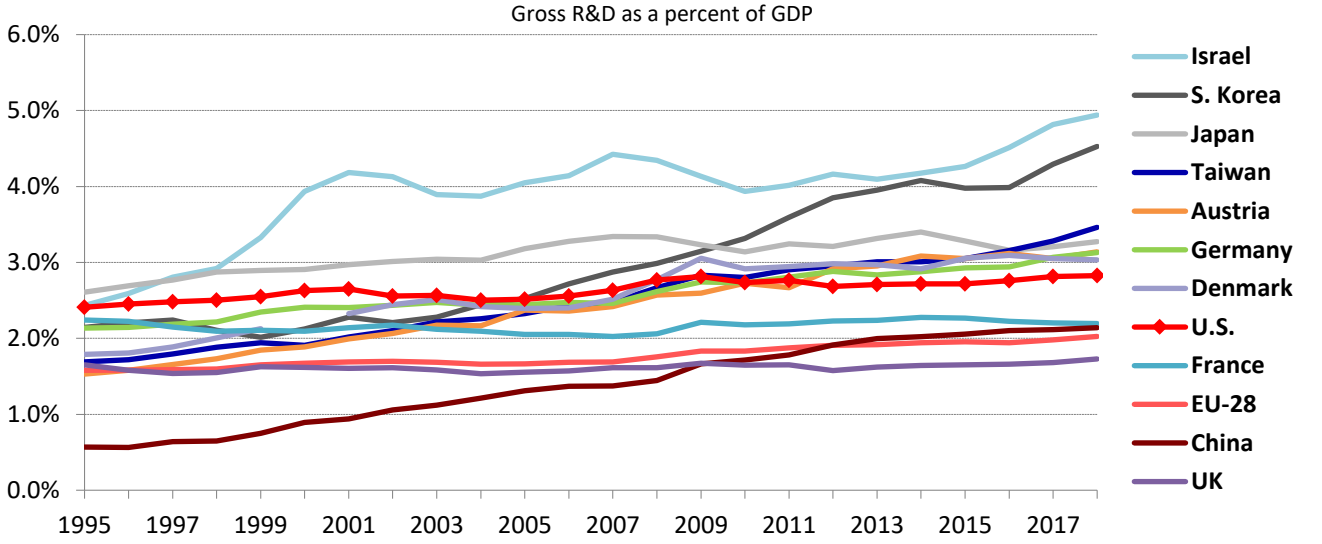
## R&D Intensity: U.S. is 10th

R&D intensity – or R&D as a share of gross domestic product, or GDP – indicates the *relative share* of resources devoted to R&D in an economy. This provides another indicator of how innovative an economy is. For instance, Israel and Korea, the two countries with the most R&D-intensive economies, spend far less than the United States or China on R&D in total dollars. But they also spend more on R&D per each dollar of GDP than others, indicating stronger relative focus on science and innovation.

In R&D intensity, the U.S. is now 10$^{th}$ in the world, dropping out of the top 5 following the mid-1990s. In that time, Korea, Taiwan, Germany, and others have surpassed U.S. R&D

**Figure 3: National R&D Intensity**

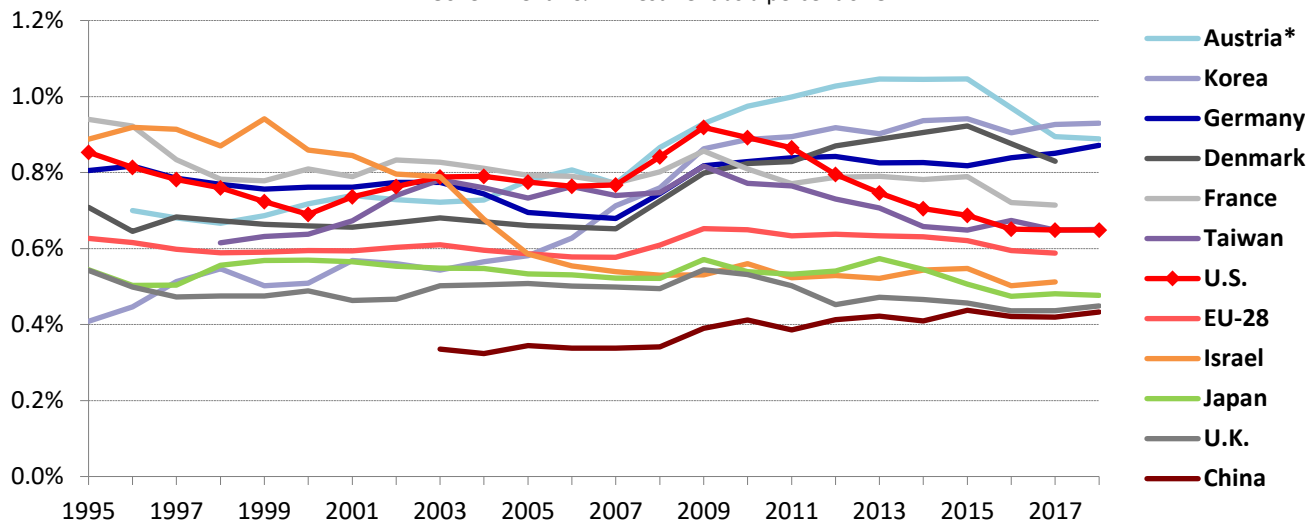
Gross R&D as a percent of GDP




Source: OECD S&T Indicators, October 2020. | AAAS

**Figure 4: Public R&D Intensity**

Government R&D investment as a percent of GDP




*Two-year rolling average. Source: OECD S&T Indicators, October 2020. | AAAS

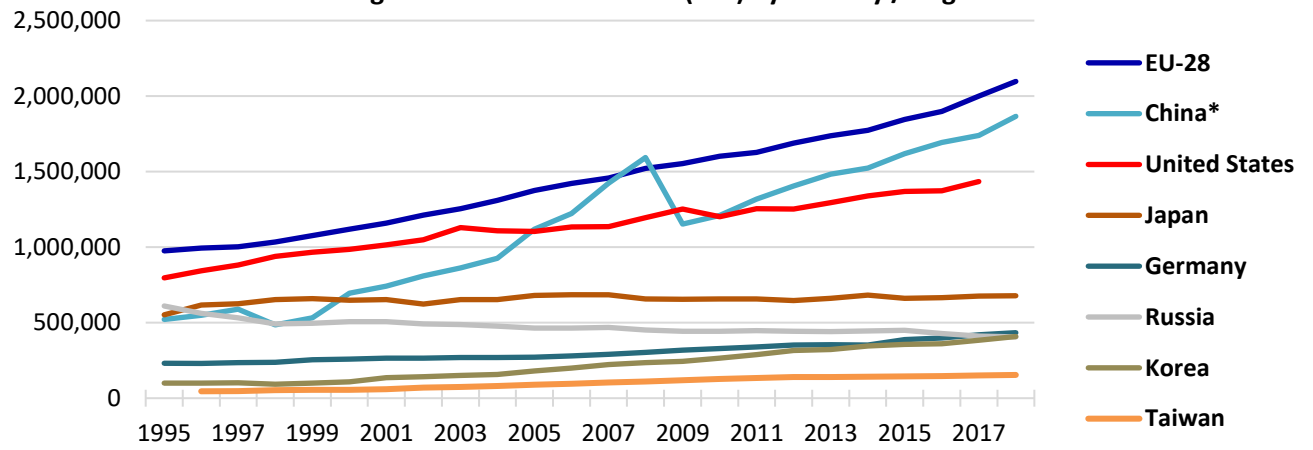
intensity (Figure 3). China has gained ground as well, though still lagging somewhat behind the U.S. As of 2018, Chinese R&D intensity stands at 2.1% and U.S. intensity at 2.8%. Israel and Korea are the global leaders, each above 4.5%.

The preceding section refers to public *and* private spending. Limited to only public R&D, the U.S. has similarly fallen in the leadership tables. As of 2017, the U.S. ranks 14th, again compared to top 5 in the mid-1990s. This decline appears to be a product of the federal R&D spending slowdown after the financial crisis (figure 4).

## Research Workforce: China Pulls Ahead

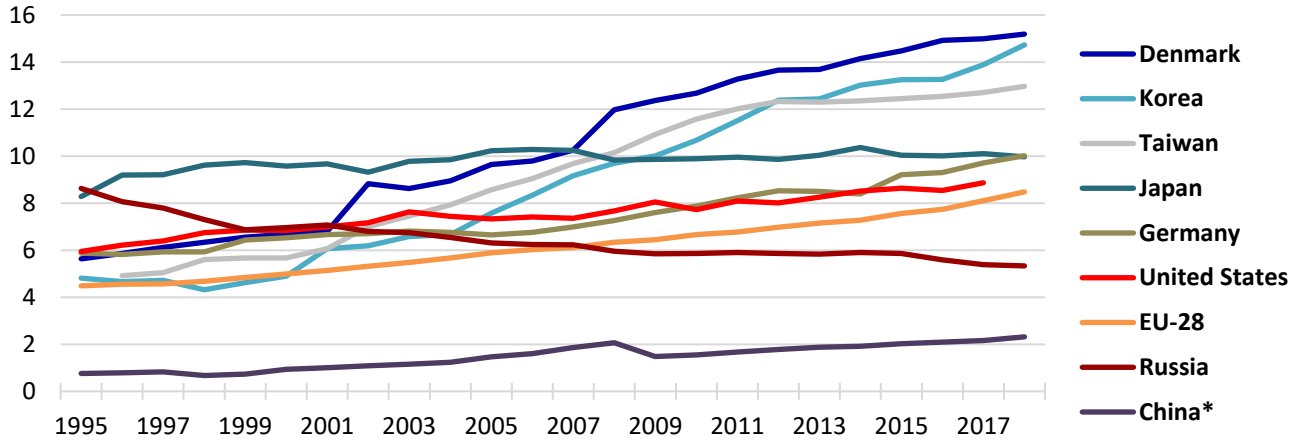
An innovative economy requires not just investment in R&D, but a workforce capable of performing that R&D and exploiting the knowledge produced by it. As measured by OECD, China's total headcount of full-time researchers has increased rapidly (including since 2009, when China's accounting definition of "researcher" was brought into accordance with OECD guidelines). There are now nearly 2 million fulltime-equivalent Chinese researchers, while U.S. researchers number nearly 1.5 million (figure 5).

**Figure 5: Total Researchers (FTE) by Country / Region**




*Counting methodology changed in 2009. Source: OECD S&T Indicators, October 2020 | AAAS

**Figure 6: Researchers per 1,000 in the Labor Force by Country / Region**




*Researcher counting methodology changed in 2009. Source: OECD Main S&T Indicators, October 2020 | AAAS

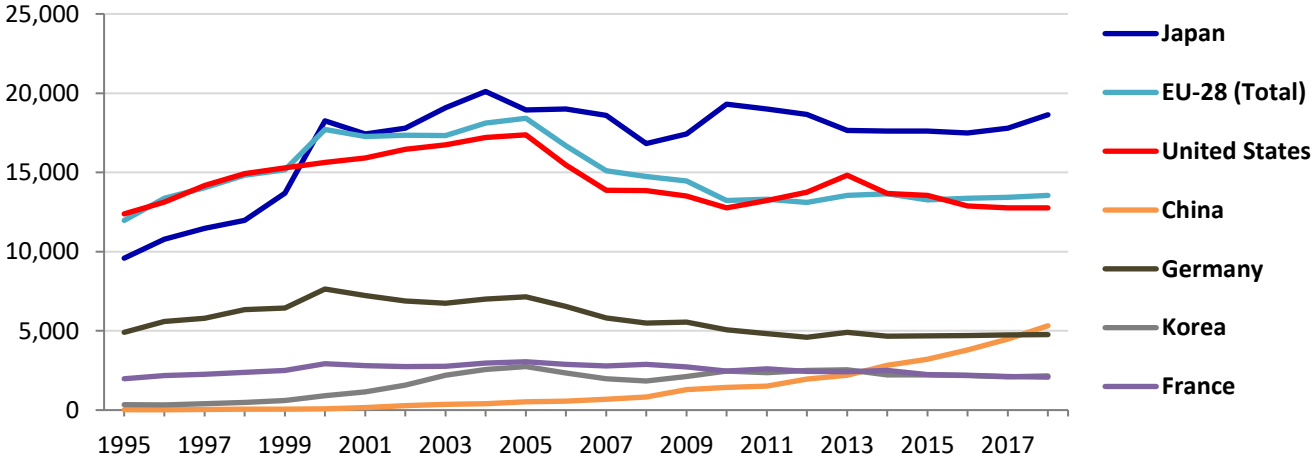
Just as with R&D, researcher headcounts can also be adjusted for the size of the labor force as an alternate indicator of how innovative an economy is. As shown in Figure 6, world leaders Denmark and Korea have over 50% more full-time research personnel per worker than the United States. China, again, has made progress, but lags given the sheer size of its labor force overall.

## Patenting: Japan Maintains Lead While China Rises

One way to look at the outcome of R&D investments is through patent counts, which seek to protect the intellectual property derived from new knowledge. For international comparisons, *triadic patents* can be particularly useful as indicators of valuable inventions. "Triadic patent families" refer to patents for the same invention registered in multiple patent offices including the U.S., Japan, and the European Union.

The most recent data on triadic patents by is shown in figure 7. While most national trends appear stable, one notable development is the more than 500% increase in triadic patent families originating in China since 2008, representing yet another indicator of China's rising innovative capacity.

**Figure 7: Number of Triadic Patent Families**




Source: OECD, Main Science and Technology Indicators, October 2020 © AAAS

## Looking Ahead

China has received substantial attention for obvious reasons, and the next Chinese five-year plan due next year will likely continue to emphasize science and innovation. But other nations also continue to build their science capacity and innovation competitiveness. Here are some brief highlights from select leaders.

**Japan.** The Japanese government has adopted a series of five-year science and technology roadmaps, called "basic plans," since 1995. The 5th and most recent plan called for an R&D intensity target of 4% of GDP, though Japan will likely miss that mark (see figure 3).

Deliberations over the 6th basic plan are underway, with its implementation expected in spring 2021. Activities will focus on R&D for advancing what Japanese research officials call a "human-centered and inclusive society." Japan continues to pursue an ambitious "Moonshot" R&D program, with goals including global leadership in AI, quantum computing, sustainability, disease prediction, and other topics.[2]

**Europe.** E.U. ministers continue to negotiate financial terms for Horizon Europe, the next overarching research funding scheme, with European Parliament eager to push for a greater research allocation this year.[3] In recent months, Germany has prioritized research and innovation during its presidency of the E.U. Council. Amid an apparent COVID-19 surge in Europe, leadership of the European Commission is also seeking to establish a new biomedical development agency modeled after the Biomedical Advanced Research and Development Authority (BARDA).[4]

At the national level, Germany has established a national R&D intensity target of 3.5%. As part of the investment effort, the German government has developed the High Tech Strategy 2025,[5] the latest in a series of such roadmaps. The current strategy incorporates AI, quantum, battery research, and a new bioeconomy innovation strategy.

Though no longer in the E.U., the United Kingdom continues its effort to revive its flagging science and innovation system. The most recent U.K. budget established a new high risk / high reward agency modeled after DARPA to be funded at £800 million (about $1 billion) over five years. The U.K. has established an R&D intensity target of 2.4% by 2027 though the Johnson government is hoping to take a more aggressive approach.

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[1] See the World Bank's International Comparison Program, which analyses these price changes: https://www.worldbank.org/en/programs/icp

[2] https://www8.cao.go.jp/cstp/english/moonshot/top.html

[3] https://www.sciencemag.org/news/2020/07/eu-leaders-slash-science-spending-18-trillion-deal

[4] https://sciencebusiness.net/news/eu-create-new-biomedical-research-agency-modelled-barda

[5] https://www.hightech-strategie.de/en/index.html