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ECONOMIC Synopses

The Innovation Puzzle: Patents and Productivity Growth

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Evaluating innovation policy includes understanding the pace of technological progress. Economists often measure a country's rate of progress using the number of new patents, which are exclusive rights inventors receive for their inventions. Figure 1 shows that the U.S. Patent and Trademark Office granted U.S. inventors 50% more patents per capita in the 2000s than in the 1950s, which suggests an acceleration in the rate of technological progress.

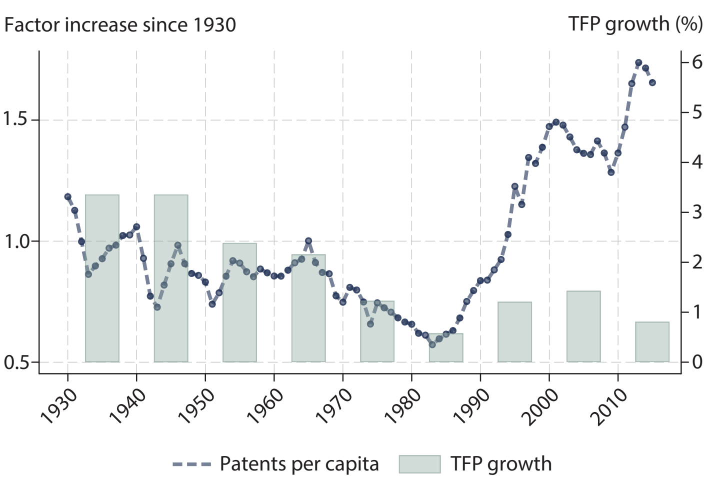
Productivity growth is another measure of technological progress: In the U.S. it tells a different story than the boost in patents. Figure 1 shows that U.S. productivity growth in the 2000s is about half as high as it was in the 1950s. Why are innovations embodied in patents not translating to higher productivity growth?

One possibility is that each patent embodies much less creative growth than in the past. A method to distinguish creative from derivative patents is to examine the share of original terminology contained in a patent. For example, patents about "cloud computing" in 2007, when the term was first used in patents, would be creative in 2007 and derivative afterward. The measure captures creativity in patents through inventors' tendency to articulate their creative inventions using original terminology (Kalyani, 2024).

Figure 2 plots the number of creative patents per capita and the total number of patents per capita. It shows that the number of creative patents is in line with the pattern of productivity growth: U.S. inventors produced only about half as many creative patents per capita in the 2000s than they did in the 1950s. However, the excess increase in patents is entirely driven by an increase in non-creative or derivative patents. The correlation between creative patents per capita and productivity growth over the decades is 75.7%.

This pattern—an increase in patents but a decline in creativity and productivity growth—is evident in the computer-related manufacturing industry. Figure 3 shows productivity growth, creative patenting, and patenting in computer-related manufacturing between 1970 and 2020. During the 80s and 90s, this industry experienced the largest increase in productivity—2.2% per year for 1987-1995 and 4.4% per year for 1995-2006. This rapid rise tapered off after 2006, when productivity growth in computer-related manufacturing fell to 1.9%. Creative patenting

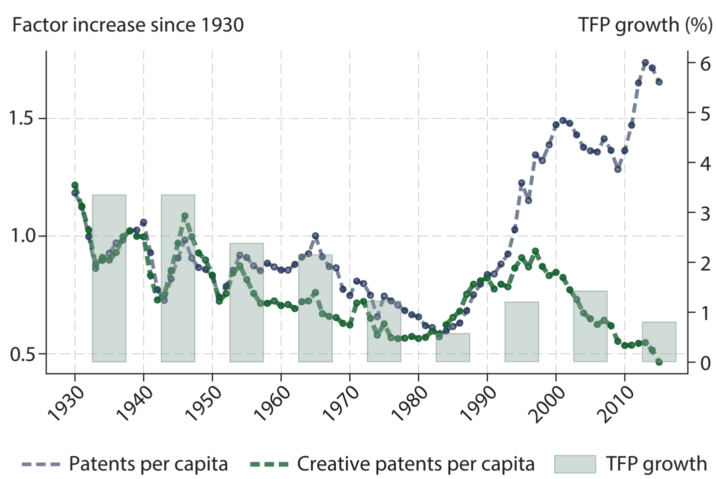
Figure 1
Patents Per Capita and Productivity Growth



NOTE: TFP, total factor productivity.

SOURCE: Bureau of Labor Statistics, U.S. Patent and Trademark Office, Gordon (2010), FRED® via Federal Reserve Bank of St. Louis, and author's calculations.

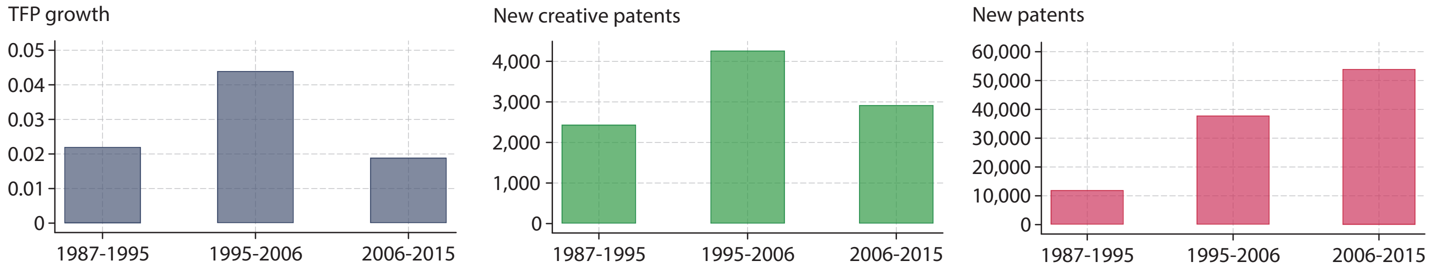
Figure 2
Patents, Creative Patents, and Productivity Growth



NOTE: TFP, total factor productivity.

SOURCE: Bureau of Labor Statistics, U.S. Patent and Trademark Office, FRED® via Federal Reserve Bank of St. Louis, Kalyani (2024), and author's calculations.

Figure 3
TFP Growth and Patenting in Computer-Related Manufacturing



NOTE: TFP, total factor productivity.
SOURCE: Bureau of Labor Statistics, U.S. Patent and Trademark Office, and Kalyani (2024).

followed the pattern of productivity growth, increasing by 70.1% during the 80s and 90s and decreasing by 29.8% afterward; but, in sharp contrast, new patenting in computer-related manufacturing continued to increase at an exponential rate.

A decline in creative patenting and productivity growth could be interpreted as a slowdown in the rate of technological progress. However, a caveat is that recent innovations might not be accounted for in either new patents or productivity growth, especially in service sectors. Total factor productivity (TFP) measures how much output is produced from a certain number of inputs (such as labor and capital). It is calculated as total output divided by a weighted measure of inputs such as labor and capital. But it is difficult to precisely measure outputs and inputs in services due to (i) the prevalence of intangible outputs and inputs, (ii) differences in labor quality, and (iii) unobserved organizational inputs. For instance, it is difficult to quantify the contribution of e-commerce or online retail to technological progress in retail because commonly used measures of TFP struggle to account for improved quality and convenience (outputs) and the use of intangibles such as software (inputs).

Ultimately, technological progress enables rising wages and living standards while it transforms industries and reshapes the economy. Understanding the pace and nature of technological progress is key for evaluating innovation policy and projecting economic growth. ■

References

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