Does China Really Dominate Global Innovation? The Impact of China’s Subsidized Patent Application System

JONATHAN PUTNAM, HIEU LUU, AND NGOC NGO
Contributors, Forum for Intellectual Property, Hudson Institute
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China is becoming an increasingly important player in the innovation economy. Between 2000–2018, the number of patent applications filed in China by Chinese residents increased from 25,346 to 1,393,815—an increase of 5,400 percent.¹ In China’s flagship industry, telecommunications, China’s Huawei is now the leading filer worldwide of 5G-related patent applications.² A recent Wall Street Journal article asserts “an underlying truth about next-generation communication networks: Technology developed in China will be at the center.”³ Although China has undoubtedly become an important innovator in recent years, it is important to remember that simply counting Chinese patent applications overstates China’s true level of innovation.⁴ Often omitted from the “Chinese innovation dominance” narrative is China’s subsidization of patent applications to reach government-mandated filing targets. As a recent report by the US Patent and Trademark Office (USPTO) observes, “subsidies likely encourage parties to seek patents to receive the subsidy rather than to protect an innovation.”⁵ The report notes that other “nonmarket factors,” such as government mandates about the number of patent filings and resulting countermeasures, might also substantially contribute to patent application activity.

In a recent paper, we examined the “Chinese innovation dominance” narrative based on the number of patent applications, and our study confirms the concerns expressed in the USPTO report.⁶ The context for our study is the fact that any country’s total number of patents results from a global race in which all the world’s innovators are
competing to produce something that is truly “new.” Just as one gallon of gasoline powers a car the same distance in China as in any other country, the inputs that drive innovation in China—R&D expenditures, the number of labor hours of scientists and engineers, etc.—should yield a real innovation with about the same frequency as in any other country. Therefore, our study asks, given the rate at which innovative inputs lead to patent applications in other countries of the world, “How many patent applications would we expect Chinese innovators to produce, with the resources that China actually devotes to innovation, in the absence of a subsidy?”

Using data on R&D expenditures, researchers, GDP, and population from 2000–2018, our study predicts patent application levels in 23 countries and regions that account for more than 97 percent of the world’s patent applications. Our model fits these data well, explaining more than 99.6 percent of the global variation in patenting, including in China. Critically, as shown in Figure 1 above, our research finds that China’s real output of innovations in 2018 was about 212,000 patent applications—not the almost 1.4 million patent applications actually filed. Thus, our analysis indicates that the total number of patent applications in China in 2018 was inflated above the level produced by real innovation by more than 500 percent.

Figure 1. Actual, predicted and non-subsidized resident applications in China from 2000-2018

Our study further investigated the impact of governmental subsidies on other patenting activities, such as Chinese patenting in other countries, or "patent exports." China also subsidizes these exports, but generally limits the subsidy to applications filed in only 2-3 countries. Our study finds that China may actually export fewer innovations than might be expected, given its size and real domestic innovation output (absent subsidization). Since patent exports are an indicator of quality (because higher-quality innovations are valuable in more countries), this finding suggests a tradeoff between patent quantity and quality. Put simply, the data suggest that China’s dramatic increase in the number of patent applications might be mostly offset by a decrease in innovation quality.

Our study focused on the telecommunications industry to examine this tradeoff between quantity and quality of patent applications in more detail. Given that a Chinese telecom inventor files for patent protection in China, the probability that this inventor also files abroad has increased—but the average number of foreign countries in which this inventor seeks patent protection has fallen, as shown in Figure 2.

This pattern is consistent with the results one would expect from China’s subsidies, which limit the number of export countries in which a subsidy is available. It is also consistent with our original hypothesis that subsidies increase the...
quantity of patent applications filed abroad but reduce the average quality of these patent applications.

There is a similar pattern in a recent study of patent applications related to 5G telecommunications standards, where China leads the rest of the world in the total quantity of applications filed but lags in the number of foreign applications (the "patent exports") per domestic patent family (see Table 1 above). The data show that, despite filing more than double the number of domestic applications on 5G technologies (compared to domestic 5G applications in the US, Column [1]), China in fact generated fewer total patent exports from its domestic applications (Column [3]). China’s patent exports per domestic 5G innovation are less than half the US rate (Column [5]), or only about 62% of the worldwide average (Column [6]).

While subsidies for patent applications produce more patent applications—the reason for the subsidy in the first place—the additional applications are unlikely to be as valuable if innovators patent their most valuable innovations first. Just as adding water to wine dilutes its alcohol content, the ultimate impact of the additional, low-quality applications is to dilute average overall patent quality.

After accounting for how subsidies affect the total number of patent applications and the quality of the additional applications, our study consults past economic research to help assess the impact of quantity on quality. The most conservative approach suggests that the overall average quality of China’s patent applications cannot be more than about 21 percent of the quality that would have been observed in the absence of a subsidy; the true ratio is probably less. Thus, China’s 500+ percent increase in the quantity of patent applications is largely offset by the approximately 80 percent reduction in average quality, relative to its unsubsidized level.

Over the past two decades, China’s economy has grown impressively, while its patented innovations have grown

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Table 1. Patents/applications disclosed as potentially essential to the 5G standard

<table>
<thead>
<tr>
<th>REGION</th>
<th>PATENT FAMILIES</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>12,566</td>
<td>35.5%</td>
<td>11,685</td>
<td>22.2%</td>
<td>0.93</td>
</tr>
<tr>
<td>Europe</td>
<td>4,528</td>
<td>12.8%</td>
<td>7,240</td>
<td>13.7%</td>
<td>1.60</td>
</tr>
<tr>
<td>US</td>
<td>6,195</td>
<td>17.5%</td>
<td>11,930</td>
<td>22.7%</td>
<td>1.93</td>
</tr>
<tr>
<td>Other Asia</td>
<td>9,276</td>
<td>26.2%</td>
<td>16,941</td>
<td>32.2%</td>
<td>1.83</td>
</tr>
<tr>
<td>Other</td>
<td>2,827</td>
<td>8.0%</td>
<td>4,874</td>
<td>9.3%</td>
<td>1.72</td>
</tr>
<tr>
<td><strong>Total / mean</strong></td>
<td><strong>35,392</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>52,670</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>1.49</strong></td>
</tr>
</tbody>
</table>


at an even higher rate. But this patent application trend should not simply be accepted at face value. The Chinese government has subsidized patent applications as part of its overall domestic industrial policy agenda, which underlies China’s claim to have “won” the global innovation race, especially in next-generation technologies like 5G or AI. Our study shows that high rates of patenting do not necessarily mean dominance, or even leadership, among the world’s innovation economies. China’s recent announcement that it plans to end subsidies for patent applications by 2025 perhaps acknowledges that its policy is no longer necessary or desirable. In any case, uncritical reports of China’s innovation dominance, overall or in prominent high-tech sectors, should be viewed skeptically, especially by policymakers.

Jonathan Putnam, Hieu Luu, and Ngoc Ngo are economists at Competition Dynamics, Inc. In telecommunications-related matters, Competition Dynamics has consulted for AT&T, Constellation Designs, Ericsson, Evolved Wireless, Google, InterDigital, Nokia, Palm, Qualcomm, SITO, Time Warner Cable, TQ Delta, TriQuint, and VoiceAge EVS. The views expressed here, as well as any errors, are ours alone. Awo Bos, Nick Fucci, and Oliver Shih contributed research assistance.

Endnotes

7 We distinguish real patent counts from nominal patent counts, by analogy to real and nominal price levels in the context of price inflation.
9 According to “sources with the administration,” “The patent policy change aims to eliminate the improper behavior of Chinese patent applications not protecting innovation and to shift the country’s focus from improving IP quantity to quality.” “China to cancel all patent subsidies,” Xinhuanet, February 5, 2021, http://www.xinhuanet.com/english/2021-02/05/c_139724293.htm.
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Hudson Institute
1201 Pennsylvania Avenue, N.W.
Fourth Floor
Washington, D.C. 20004

+1.202.974.2400
info@hudson.org
www.hudson.org