THE MYSTERIOUS DIVERGENCE IN CHINA'S PRODUCTIVITY AND INNOVATION PATTERNS

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Economic theory suggests that innovation and productivity are inextricably linked. The intuition, backed by empirical evidence and typically restricted to goods production, suggests that the more a country innovates and commercializes new technology, the more efficiently it will use its resources to produce its goods. This briefing describes China's puzzling developments in this regard. Although conventional indicators (e.g., R&D expenditures, patent filings, global innovation rankings) suggest that China is innovating rapidly, total factor productivity suggest that China's productivity growth has been sluggish—especially since the 2008-09 global financial crisis. In this briefing, we showcase these diverging trends using empirical analysis and information collected from the literature, and find that traditional indicators may be overestimating China's growth in innovation. This may be attributable to the poor quality of filed patents, the government-directed nature of lending and R&D spending, and China's broad misallocation of capital, especially since the financial crisis.[1]

Surging Innovation in China? Three metrics are often used to measure a country's general level of innovation: (a) research and development (R&D) expenditures; (b) patent applications; and the (c) "Global Innovation Index" (GII).[2] Figures 1 and 2 showcase China's R&D growth and surge in patent applications, which are interrelated given that R&D increases typically lead to more patents applications. The GII also shows that innovation is rapidly advancing according to a composite of indicators, as China ranked 11th in global innovation in 2019 and only 43rd a decade earlier. State direction, such as the "Made in China 2025" policies, have supported its innovation drive.

Innovation Should Lead to Productivity Growth. If China is investing heavily in innovation through R&D, and such innovation leads to an increasingly large share of global patent applications, China's productivity would be expected to grow rapidly. The economic literature provides ample theoretical and empirical evidence of this worldwide, including seminal studies by Coe and Helpman (1995) and Griffith, Redding, and Van Reenen (2004).[3] To capture such changes, researchers often use a "standard growth

Figure 1. R&D Expenditures (in % of GDP)

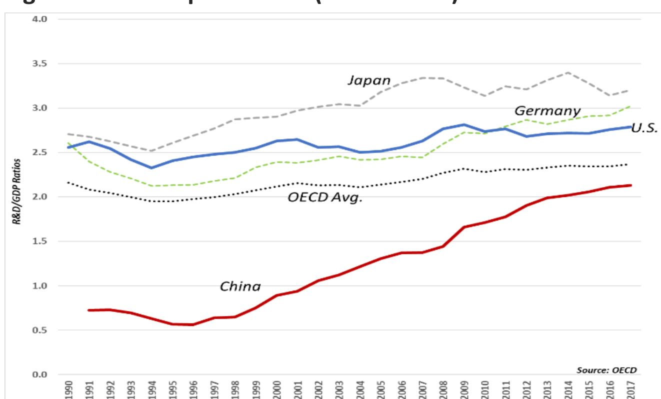
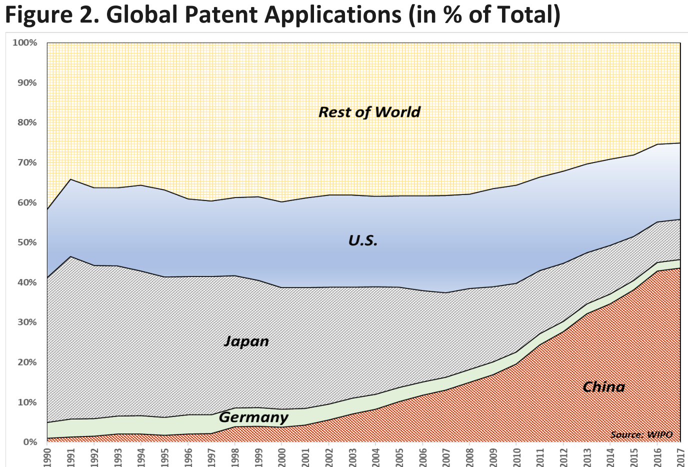


Figure 2. Global Patent Applications (in % of Total)



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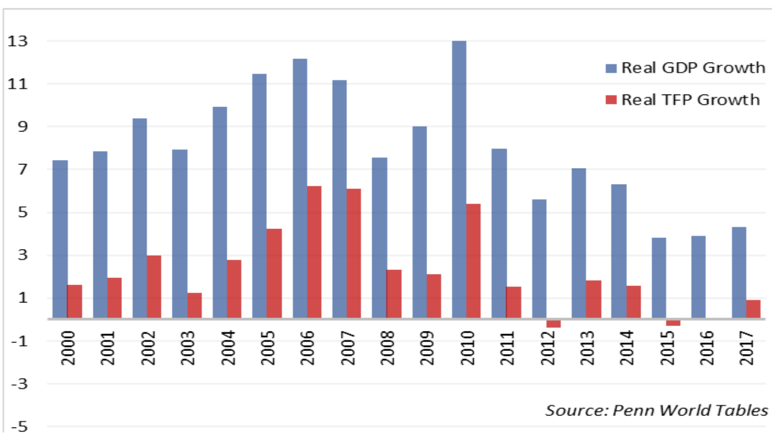
[1] See Hammer and Abbyad, "[Does China Still Have a Debt Problem?](#)" *USITC Executive Briefing on Trade* (2018) and forthcoming research.
[2] The Global Innovation Index (GII) is produced by Cornell University, INSEAD, and World Intellectual Property Organization, and ranks 127 countries according to a composite score of innovative metrics. Although 2 of its 82 metrics overlap with what has been identified (R&D and patent applications), the other 80 are based on other conventional and new (e.g., high-tech exports, mobile phone app creation) innovation indicators. While its sample of countries/methodologies are modified over time, the GII provides approximate assessments of innovation.
[3] Griffith et al. (2004) find that R&D increases productivity through two channels: stimulating innovation and enhancing technology transfer.

accounting" (SGA) framework to identify drivers of economic activity by decomposing GDP growth into its main components: (1) labor force expansion/contraction; (2) changes in capital accumulation[4]; and (3) "total factor productivity" (TFP). This TFP term measures how efficiently a country uses its labor and capital and is broadly considered an effective, albeit imperfect, proxy for overall growth in productivity.

China's Precipitous Productivity Drop After the Financial Crisis. Using SGA and other estimates, the literature is fairly conclusive in its findings that China's productivity generally increased during its rapid economic reform era (1978-2007).[5] This was mainly attributable to two structural transformations. The first involved a surge in agricultural productivity that freed labor to be reallocated towards the non-agricultural sector. Since productivity in the non-agricultural sectors was already five times greater at the time, this phenomena had a dramatic impact on TFP growth (Zhang 2017). The second transformation related to ownership reform. China's allowance of a non-state sector to evolve redirected labor and capital endowments away from state-owned enterprises (SOEs) and towards private firms and newly formed joint venture enterprises with foreign firms (Zhu 2012). This reallocation led to an increase in TFP of approximately two percentage points in 1998-2005 (Hsieh and Klenow 2009). Given its evolving competitive landscape, even SOE productivity increased since 2000 through government-directed merging, corporatization, and restructuring (Zhang 2017).

Figure 3. Real GDP and Real TFP Growth (%)



Despite increased productivity growth in 2000-07, TFP growth has been a drag on China's GDP since the global financial crisis of 2008-09. Figure 3 illustrates the deceleration from 6% in TFP growth in 2007 to -0.3% in 2015.[6] Other estimates, including those from the EIU (2019), Bailliu *et al.* (2019), and Wei *et al.* (2017) found similar declines in TFP through 2015. The Conference Board found an even larger decline of -2.7% in 2015.

Implications. The economic literature on China's slowing productivity in the post-financial crisis period appear fairly conclusive. If that is the case, and theory and empirical analysis have shown a correlation between innovation and productivity, then it is plausible that traditional indicators have overestimated China's growth in innovation.[7] Forthcoming research on the quality of China's filed patents, the directed nature of official lending and investment practices, and China's broad misallocation of capital may provide at least partial explanations for this.

Sources: Coe & Helpman (1995), "International R&D Spillovers" *European Economic Review*, *39*(5), 859-887; Griffith, Redding, & Reenen (2004) "Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries," *Review of Economics and Statistics*, *86*(4), 883-895; Zhang (2017) "Productivity in China : Past Success and Future Challenges" *Asia-Pacific Development Journal* 24 (1): 1–21; Hsieh and Klenow (2009) "Misallocation and Manufacturing TFP in China and India" *Quarterly Journal of Economics* 124 (4): 1403–48; Bailliu, Kruger, Toktamyssov, and Welbourn, (2019) "How Fast Can China Grow? The Middle Kingdom's Prospects to 2030." *Pacific Economic Review* 24 (2): 373–99; Wei, Xie, and Zhang (2017) "From 'Made in China' to 'Innovated in China': Necessity, Prospect, and Challenges." *Journal of Economic Perspectives* 31 (1): 49–70; Zhu (2012) "Understanding China's Growth: Past, Present, and Future." *Journal of Economic Perspectives* 26 (4): 103–24.

[4] This is a frequently used technical term for the stock of manufacturing equipment.
[5] With notable exceptions following the 1989 Tiananmen event and the 1998-99 South East Asia Crisis.
[6] See Feenstra, Inklaar, and Timmer, "The Next Generation of the Penn World Table," *American Economic Review*, 105(10), 3150-3182 (2015).
[7] Minimal knowledge spillovers from a country's innovative activity may also inhibit TFP growth.

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