

Political Measurements' Impact on Technological Innovation: Regulations and
Sanctions

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Abstract

Technological innovation system (TIS) refers to “a dynamic network of agents interacting in a specific economic/industrial area under a particular institutional infrastructure and involved in the generation, diffusion, and utilization of technology”, bringing about technological changes (Carlsson and Stankiewicz 93). Based on former studies on this topic, this essay introduces four main drivers of technology innovation system that may be influenced by different political measures: response to challenges, cooperation, incentive schemes, and access to technology input (Nevzorova et al.; Dahlman et al. 759). After that, this essay considers political measurements including international sanctions and domestic regulations. By examining how they interact with the main drivers of technological innovation listed above, we are able to evaluate whether particular political measurements accelerate or impede indigenous technology development. The last section of this article concludes the essay and proposes one potential measure that a state could adopt to react to various external uncertainty and stimulate local technology innovation.

Introduction

Current global economy has entered a new era where geopolitical environment becomes increasingly unstable and trade tensions intensify, stimulating countries to initiate various political measures that respond to this ever-changing environment. Meanwhile, as technology innovation gradually becomes a paramount factor for international competitiveness, greater attention is placed on this field for both emerging and mature economies. Therefore, how particular political measurements

influence technology development emerges as a crucial topic worth discussing.

Based previous studies on technology innovation and development, there are four main drivers of technology innovation. One of the main drivers is response to challenges. Technology innovation is usually in desperate need when countries are facing impending crises that cannot be resolved by existing technologies. This external pressure forces them to resort to innovative approaches as a “proaction to challenges”. Another important driver of technology innovation is cooperation: international, between-firm, firm-organization and other forms of collaboration provide a platform for technological knowledge diffusion and creation, constituting the key element for technology innovation. Incentive mechanism also support certain technology product in market competitiveness and penetration. This encourages more exploration and innovation in related areas. Last but not the least, access to technology input is crucial, for it helps countries acquire capabilities needed for efficient production and innovation (Nevzorova et al.; Dahlman et al. 759). After analyzing how regulations and sanctions influence drivers of technological innovation above, this essay finds that the two political measures can both accelerate and impede innovation, and the key to technological innovation is using domestic policies to promote firms’ continuous investment in research and development (R&D).

Regulations

Regulations are legal rules set by governments or supernational organizations that mandate companies to follow, which aim to execute certain standards and protect market environment. By stimulating firms to quickly respond to new regulations and

influencing their incentives to invest into innovative areas, regulations largely influence technological innovation.

Two main theories were raised to explain regulations' impact on innovation. The first one is known as Porter Hypothesis, which posits that "properly crafted" regulations can trigger innovation offsets. Strict regulations can not only push firms to innovate to meet current standards, but also have a substitution effect in R&Ds of upstream innovation as investment in downstream industries decreases (Porter and Van der Linde 98; Chakraborty and Chatterjee 944). One case study focused on the United Kingdom (UK) firms provides evidence for Porter Hypothesis. In the study, the UK environmental regulations are "becoming stringent", with firms facing "increasing costs of energy or waste disposal" under the regulation. This creates an incentive for companies like SUPR Co. to adopt energy-waste-saving technologies and redesign production process in order to avoid significant cost generated by handling toxic substances that are not allowed under the regulation (Ramanathan et al. 15).

On the contrary, another theory states that regulations are burdens on firms because complying to them generates additional costs, which in turn discourages firms' resource input in the R&Ds, impeding innovative performance (Aghion et al. 2894; Jaffe and Palmer 610). For instance, under strict environmental regulation, corporations including RAIL Co. and CHXIN Co. complained that compliance on these regulations has high administrative and financial costs so that these firms have to reduce their production. It is even more unpractical for them to continue to invest in technology innovation fields (Ramanathan et al. 15-16). Furthermore, regulations

impose heavier burden on small and medium enterprises (SMEs), emerging innovative force that could promote technology development and economic growth (Qian and Chen 328), for these immature companies need to spend much time and money on how to comply complex rules, making them even less competitive in the market (Nasir and Kechema 42).

Sanctions

Sanctions impede technological innovation in the targeted countries by negatively influencing cooperation. Cross-border mergers and acquisition (M&A)-a process where a company from one country merges with or acquire a company with another country, is an important branch of international economic cooperation. By providing crucial strategic assets including cutting-edge knowledge and complementary resources to emerging economy firms (EEFs) in a speedy way, these cross-border M&As lead to efficient cross-fertilization of ideas and new knowledge combination, promoting targeted firms' innovation and technology capability (Hong et al. 8).

However, an empirical study on sanctions' impact shows that they have "adverse and sizable effects on M&As" (Nguyen et al. 79). Lacking necessary knowledge and resources from cooperative platform upheld by cross-border M&As, it would be formidable for the EEFs to create innovative technology product, and thus hinder local technology development.

Sanctions also influence targeted countries' technological innovation by limiting or cutting off access to technology input. By incorporating foreign capital goods and technology tools which cannot be obtained otherwise into production process via

trade, firms' technology adoption and productivity can be promoted, and may be more innovative than those only have access to domestic markets (Almeida et al. 702). This process can be severely restricted by sanctions. For example, the United States' sanctions against Iran in early 2010 prohibited the exportation of technology and services from the United States to Iran. Facing severe financial risks of doing business under this sanctioned environment, Iran companies still had no access to basic information and communication technology in around 2016, largely hindering technology innovation related to information sectors. What's worse, citizens' ability to acquire information and freely communicate was also constrained (Mehta 765-766).

Although sanctions are intended to restrict targeted countries' technology development, they can have opposite effects that even accelerate innovation. Sanctions intensify the uncertainty of targeted countries' external economic environment and stimulate them to become more self-relying as proaction to challenges. This process can effectively catalysts technology innovation as demonstrated in the case of the United States' sanctions on Chinese technology industry. The United States imposed sanctions on China advanced semiconductor, originally intending to constrain China's semiconductor-related industries including chips and artificial intelligence application (Sutter). Nevertheless, it in fact helped drive China's semiconductor innovation by stimulating the country to seek technology self-reliance. From 2020 (pre-sanctions) to 2024 (post-sanctions), China's semiconductor self-sufficiency increased by 10% and its global market share of

matured chips increased by 18%, demonstrating distinct technology innovation in these fields (Lo 103942).

As can be seen above, whether sanctions impede or accelerate targeted countries' technological innovation is uncertain. The real impact of sanctions can be influenced by sanctioned country's research capability. A study shows that lagging countries are more likely to suffer from sanctions because of their lack of research capability and reliance on technology inputs, just like the case of Iran. On the contrary, countries with relatively high research capability such as China develop innovative technology to increase self-reliance under sanctions, which instead accelerates domestic innovation (Lo 103942).

Conclusion and Proposal

Regulations can spur innovation because firms have incentives to cut down costs of violating regulations by developing new technology to meet governments' criteria, but they can also inhibit innovation, for the costs of complying regulations can be too high for some companies that their investment in innovation becomes a secondary activity. Secondly, sanctions may impede targeted countries' technological innovation by reducing international cooperation and limiting access to technology input that are crucial for production and cannot be obtained domestically. Nonetheless, sanctions may unintentionally accelerate technological innovation of the countries with strong research capability by stimulating them to seek self-reliance as a response to external uncertainty.

The conclusions above suggest that external policies such as sanctions do not have a decisive role on targeted country's technological innovation, and it is still possible to mitigate the negative impact from external political measures and promote technology innovation through appropriate domestic stimulus like well-designed regulations. Therefore, cultivating domestic innovation through strategic subsidies may be one method in response to unstable factors for technological innovation. Governments may provide sector-specific financial support to stimulate investment in R&Ds and enhance firms' research capabilities. In this way, countries may have the incentives and ability to seek self-sufficient technologies under sanctions and maintain R&D investment even when facing regulation costs, which may contribute to an acceleration in technological innovation in today's uncertain political and economic world.

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