

Nuclear phase-out policy and innovation ecosystem

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1. Introduction

Innovation policy determines the innovation ecosystem, and the coherency of the policy has been considered an important factor. Fluctuations in innovation policy could undermine the actors' tendencies to pursue long-term R&D strategies.

The importance of coherency is pronounced in the nuclear power plant industry, which shows a high complexity in the industry structure. Nuclear power plants are comprised of complex subsystems (e.g., nuclear steam supply system, turbine generator system, etc.), and the subsystems are highly technology-intensive and interrelated with each other [1]. Therefore, a radical change in the institutional environment surrounding the nuclear industry may bring about irreversible impacts on the industry ecosystem.

In this paper, we investigate the case of "Nuclear phase-out" in South Korea. A sudden regime change from the Park Geun-hye administration to the Moon Jae-in administration in 2017 due to domestic political issues led to an abrupt change in the energy policy. It seeks to substitute nuclear power energy with renewable energy and eventually achieve a "Nuclear phase-out."

By analyzing research papers and patents produced by Korean organizations, we show how radical policy change affects the innovation ecosystem of the nuclear industry. We examine how the policy change influences innovation outcomes in the related area. Further, the study delves into the underlying mechanisms of the change in innovation outcomes, focusing primarily on the talent outflow and core technology transfer following the policy change.

2. Research Background

The nuclear industry itself has the critical issue of maintaining legitimacy, and thus the industry is vulnerable to political or social arguments. The nuclear energy industry has a unique trait in that the biggest challenge the industry faces is not only the technical or cost-efficiency-related ones but also maintaining legitimacy [2]. The industry went through fluctuations in its legitimacy affected by the conflicting views between the proponents and the antagonists of nuclear energy, along with the accidents of the Fukushima and Chernobyl nuclear power plants [3,4].

The susceptibility to political and social arguments can result in radical policy changes. The subsequent case in South Korea demonstrates such a case, and it provides an adequate context for investigating the effects of radical policy change on the nuclear industry.

Due to political issues, the former Park Geun-hye administration could not complete its full term. And the following Moon Jae-in administration announced the nuclear phase-out at the beginning of its term.

The Moon administration declared a 'Nuclear Phase-out', suggesting renewable energy as a substitute for nuclear power energy. The new policy features a decoupling: while pursuing the nuclear phase-out domestically, the overseas export of nuclear technology is promoted.

The experts in the nuclear industry apprehended that the policy is too radical as it cancels out the previous plans of constructing the new nuclear power plants, and it does not allow the extension of the operation periods of the existing power plants.

Other than the radicalness of the plan itself, the change of administration itself was also unexpected. Therefore, the actors in the nuclear power plant field would have perceived the new policy as more radical and abrupt. Considering the overall background, the case of the nuclear phase-out policy would be a suitable context to investigate the effects of radical policy change.

3. Research Framework

This study delves into the effects of the policy with a multi-level approach.

First, we take a macro-level approach, focusing on the organizational- and national-level innovation achievements and exploring whether the policy change brought about the quality and quantity of innovation outcomes.

The effects of the Nuclear phase-out policy on the quality of the innovative outcomes could be dual-sided. The policy change might have demoralized the inventors, thus deteriorating the quality of innovation outcomes. Alternatively, the inventors have strived to keep high-quality outcomes based on their faith or mission to contribute to the public.

The impacts of the policy change in the area of research could also be twofold: The inventors may become isomorphic in the research field, pursuing the research topics which ensure the technology demands

regardless of the policy change. On the other hand, the inventors could extend the research area, seeking interdisciplinary research and searching for other technological fields to which they can link their nuclear expertise.

Potential heterogeneity in the effects of the policy is also examined by the organization types (i.e., private sector, public research institute, university).

We also take a micro-level approach to shed light on the underlying mechanism of the quality changes in the innovation outcomes subsequent to the policy change. Considering that human resource is one of the key factors for ensuring a high-quality innovation ecosystem, it is crucial to examine whether the radical policy change leads to talent outflows. Whether the inventors move abroad due to the pessimistic prospect in the domestic ecosystem or they choose to stay but extend their research field into other technological areas are investigated. More detailed investigations which consider the characteristics of inventors are also conducted.

4. Method

We use data on research papers and the patents that are published by organizations within the South Korean nuclear energy R&D ecosystem. Patents and journal publications are well-established ways to capture the innovation outcomes of R&D activities.

The study takes a difference-in-differences approach as an identification strategy, and the approach has the advantage that it absorbs the effects of unobservable factors which may confound the identification.

Moreover, the study employs coarsened exact matching to improve the balance between the treatment and control groups. The approach alleviates the model dependence and causal estimation error.

5. Expected Results

The results will reveal the overall impact of the nuclear phase-out policy on the innovation ecosystem. Based on the results, we may be able to find that the magnitude and significance of the impacts differ depending on the characteristics of individuals, organizations, or research fields.

6. Expected Contribution

The findings will provide concrete policy implications that would be conducive to setting up the orientation of nuclear energy policy which aims to restore and develop the innovation ecosystems of the nuclear energy field. The research findings could give clues to the policy makers on where and how to allocate resources to restore the ecosystem in an efficient and effective way.

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