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Research Report

Can artificial intelligence improve the effectiveness of government support policies?

KDI Policy Forum, No. 288

Provided in Cooperation with:

Korea Development Institute (KDI), Sejong

Suggested Citation: Kim, Minho; Han, Jaepil (2022) : Can artificial intelligence improve the effectiveness of government support policies?, KDI Policy Forum, No. 288, Korea Development Institute (KDI), Sejong,
<https://doi.org/10.22740/kdi.forum.e.2022.288>

This Version is available at:

<https://hdl.handle.net/10419/271128>

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KDI

Policy Forum

KDI Policy Forum

July 20, 2022 (No. 288 (2022-03), eng.)

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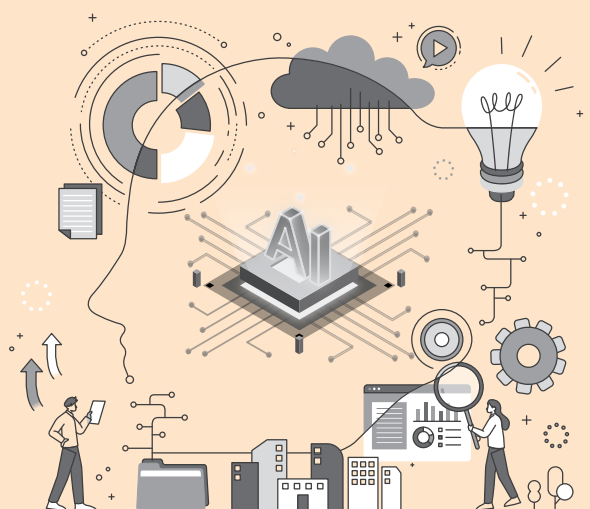
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Can Artificial Intelligence Improve the Effectiveness of Government Support Policies?

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* Based on Kim, Minho and Jaepil Han, *How to Build a Government System for Data-driven Decision Making*, Research Monograph 2020-07, Korea Development Institute, 2020 (in Korean).

Summary

- Despite high hopes for artificial intelligence (AI) to generate powerful innovations across the public sphere backed by its strong prediction skills, Korea has not fully brought the technologies into the public sector in tasks like identifying policy target groups and managing follow-up tasks in line with its policy objectives.
 - Recent cases of AI-applied public services in Korea show limited usage, mainly replacing simple repetitive tasks.
 - Few leading countries are trying to apply AI-based analysis to select promising policy target groups to effectively achieve policy goals and follow up on the performance of public projects.
 - While the existing management system for policy performance is mostly about ex-post assessment of project outcomes, the application of AI technologies signifies a shift to data-driven decision-making that uses ex-ante forecasts of policy effects.
- An analysis of AI-applied recipient selection of small and medium enterprise (SME) policy support programs demonstrated the efficiency of AI in predicting the performance of beneficiary firms after the program and AI's potential to significantly improve the effectiveness of public support by providing helpful information in screening out unfit SMEs.
 - Using firm-level data, this study applies machine learning to various public financing programs (subsidies or loans for SMEs) funded by the Ministry of SMEs and Startups and finds that AI helps predict the growth of recipient firms in the years following policy support.
 - The application of AI in identifying fitting recipients likely to achieve intended objectives may increase project effectiveness.
- In a KDI survey in 2020, respondents pointed out that what hinders transitioning into a system of AI-applied, data-driven policymaking in the public sector are: 1) incomplete standardization and linkage of policy information between governmental ministries and 2) lack of expertise in technology utilization in the public sector.
- By developing a strategy to propel a transition into data-driven policymaking in the public sector, coordinated national-level efforts must be made to heighten policy effectiveness across different public fields, including education, health care, public safety, national defense, and business support.
 - One way to adopt AI technologies in the public sector is by designing a policy to support technology adoption for competent public institutions. Support measures may cover system, data platform, security, organizational consulting, training, etc.
 - Detailed strategies are: 1) unifying existing data management systems into one single platform, 2) reorganizing the way government work gets done to enable efficient exchange of policy information, and 3) building a trust-based public-private partnership.
 - By examining the policy cycle from planning and implementation to evaluation, it is important to clarify areas for AI to contribute to policy decision-making. Also, the government needs step-by-step strategies toward data-driven policymaking, such as setting clear project objectives, selecting and sharing data, establishing system and security, and promoting operational transparency.

1

Introduction

- Despite the multifaceted potential of artificial intelligence (AI) as a tool for better policy efficiency, the application of AI technologies in Korea's public sector remains limited.
 - Comprehensive governance founded on openness, transparency, and public participation is gaining more global traction, paying particular attention to AI's immense potential to improve the efficiency of public policy among various intelligent information technologies.

- Depending on the scope of authority granted for decision-making in the policy process, the use of AI technologies can be divided into automation, augmentation, and autonomy.
 - Automation substitutes human labor for simple repetitive tasks and has fewer side effects from errors.
 - Augmentation utilizes AI diagnoses and projections in the policymaking process. Data-based policy planning and implementation can add practical value and promote policy improvement.
 - Autonomy automates policy decision-making with minimal human intervention, but it is hard to implement and poorly received.
 - In Korea, public services have adopted automation-oriented AI, which reduces errors, coupled with limited application of augmentation in which AI and humans collaborate to improve policy design and implementation process.
 - There is a growing use of AI to deal with repetitive tasks: AI Pedestrian Alert Service (Geumcheon-gu, Seoul-si), Smart Daily-life Service for Seniors Living Alone (Gimpo-si), and AI-based Consultation on Complaints (Military Manpower Administration).
 - However, there are only a handful of cases where the public sector uses AI to predict policy demand and effectiveness by applying machine learning to the government support program data, enabling the implementation of evidence-based policies.¹⁾
- The application of AI technologies in the policy process is emerging as a powerful tool that can enhance policy effectiveness by predicting policy impact. AI strengthens response capacity against uncertainty and policy evaluation within public organizations.
- Andini *et al.* (2022) show that using machine learning in selecting recipients for public credit guarantee funds can greatly improve the effectiveness of the public scheme by effectively identifying creditworthy firms in need of financing.
 - OECD (2019) points to the importance of a data-driven public sector for policy design, implementation, and evaluation, underlining the necessity of government-led systematic responses to uncertainty.
 - It also warns that although information technology can help governments respond more systematically, applying it without switching to effective data governance will only result in unnecessary data collection and inefficient processes.
- Active adoption of AI is conducive to advancing the data-driven policymaking process in the sense that AI improves policy effectiveness and gains legitimacy, both by increasing policy predictability.
- AI functions of monitoring, detection, and forecasting in predicting policy impact help improve the quality of policy in terms of policy predictability, transparency, and trust.
 - AI helps enhance policy transparency and trust by making data and policy processes traceable.
 - For the effective adoption of AI technologies, there should be widespread consensus on data-driven policy decision-making and good data governance across the public sector.
 - Innovations within the public sector are indispensable for reconfiguration of the policy process as well as rigorous data collection at each stage of policy implementation. Such innovations include standardization of policy information, cooperation in data sharing between government ministries, specialization of work activities, and seamless ICT support.
- This study presents strategies and ideas for transforming the public sector into a data-driven decision-making system to enhance the effectiveness of policies in various fields. We apply a machine learning method to Korean business support programs and provide a quantitative analysis of how the effectiveness of the programs can be improved.
- Government support program managers and authorities face a challenge in selecting policy targets with limited resources, which come from tax revenue, and the current process is at odds with one using data and analysis to sort out best-fit targets.
 - The AI-applied analysis of policy information can help select policy targets likely to effectively achieve the intended objectives. AI technologies are also applicable in the follow-up stage.

1 One exemplary case is the data-based administrative system of Namyangju-si (city). Big data analytics of traffic, preventive measures against infectious diseases, disaster preparedness, job support, and so on successfully improved policy predictability and reduced inefficiency.

2

Adopting AI to Government Policy

2 In May 2022, the Danish Agency for Digitisation changed its name to the Agency for Digital Government.

- The public sector is increasingly turning to AI. The main reasons for the shift include automating repetitive tasks, strengthening decision-making, and enhancing understanding of policymaking and public services delivery.
 - AI adoption is particularly active in areas where the benefits of automation are apparent, such as cost reduction and inefficiency elimination.
 - Sectors like healthcare, transportation, safety, and security have been leading the adoption of AI technologies, and cases of AI uptake are accumulating in other areas, such as policy efficiency improvement, decision-making, civil services, and regulations.
 - Viechnicki and Eggers (2017) find that using AI could save 2.2% to 27.9% of working hours in the US federal government.
 - The use of AI in tasks such as monitoring, detection, and prediction has contributed to improving the quality of public services.
 - The US State of Nevada selectively tested restaurants at high risk for food poisoning after conducting natural language processing on information from Twitter, enhancing the detection rate by 6%p compared to random inspection.
- Notwithstanding the underdeveloped adoption of AI augmentation in the public sector, few pioneering countries are trying to use AI analytics as a supplementary means to assist human decision-making.
 - Decision-making based on AI systems can reduce individual errors, avoid biases, and deliver information in real-time.
 - The Danish Agency for Digitisation²⁾ is implementing AI initiatives to decide policy targets for corporate subsidies and welfare allowances (e.g., assistance for seniors, severance pay, financial assistance for low-income families, subsidy for rental housing, etc.).
- Although Korea is seeing cases of AI adoption in the public sector, it is mainly to replace simple repetitive tasks. Full-scale AI adoption toward data-driven decision-making is still lagging.
 - With a growing budget for business and civil support programs, there comes an increasing demand for higher policy effectiveness and greater objectivity in the target selection process. However, subjective evaluation by experts still plays a determining role in selecting recipients and executing projects.
 - Introducing AI to the policy decision-making process means an active shift toward data-driven approaches, using AI-predicted data of policy effectiveness on policy planning and execution and so on.
 - So far, AI has been in limited use simply to check ex-post information on project outcomes and evaluations.

3

Exploring the Benefits of AI Adoption in Selecting Policy Targets for SME Support Policy

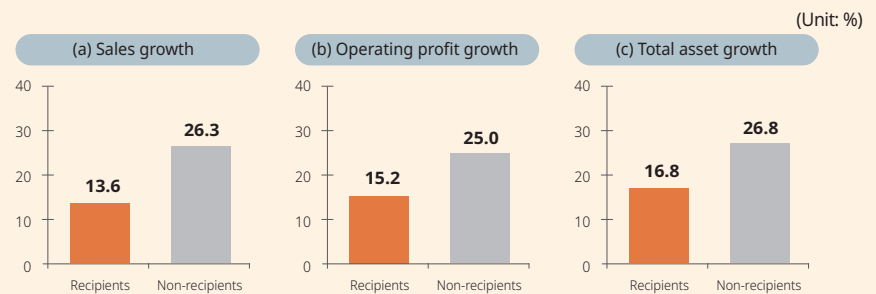
- This section illustrates the method and results of applying machine learning, a key AI component, to the target selection for SME support policy that has been the primary tool of Korea's industrial policy.
 - For analysis, we combined the records of direct financial support or loans to SMEs and the data on their balance sheets and characteristics.
 - Policy support records were extracted from the SME Integrated Management System (SIMS) for a period from 2010 to 2015 and firm-level data from the Korea Enterprise Data (KED) from 2010 to 2016.
 - The analysis is limited to firms (0~6 years of operation) qualified for the startup support program, which is the centerpiece of SME support projects. The results are in the below figure.³⁾

- Firms with growth potential but financially constrained are considered the program's desirable target, and one of the performance indicators includes their sales growth rate.
- Based on various characteristics and performance indicators of sample firms, the authors estimate a machine learning model applying a random forest methodology and use that model to predict their sales growth one year after receiving the support.
 - Firm-level data used in this analysis are total assets, sales, operating profit, number of workers, venture company status, type of business, years in operation, receipt of policy support, amount of support, etc.
 - Individual models were estimated for each year and two-digit industry to forecast the sales growth rate.

■ According to the results of the machine learning model estimated using company characteristics and performance indicators, the machine learning model is useful in predicting sales growth.

- In the analysis without applying the machine-learning model, the sales growth of firms receiving funds from the Ministry of SMEs and Startups stands at 13.6% on an average annual basis, much lower than 26.3% of non-recipients (Figure 1).
 - Recipient firms also exhibit slower growth rates in both operating profit and total assets.
- In the machine learning model analysis, depending on their predicted sales growth, SMEs are divided into two groups: the top 30% (with high growth expectations) and the bottom 70% (with low growth expectations). Then, the two groups are compared in terms of actual performance one year after receiving support. The result shows that the sales growth of the former is over ten times higher than that of the latter (Figure 2).
 - The top 30% is also found to perform much better than the bottom 70% in actual operating profit and total assets.

[Figure 1] Performance Indicators of 0-6 Year-old Startups (Recipients vs. Non-recipients)

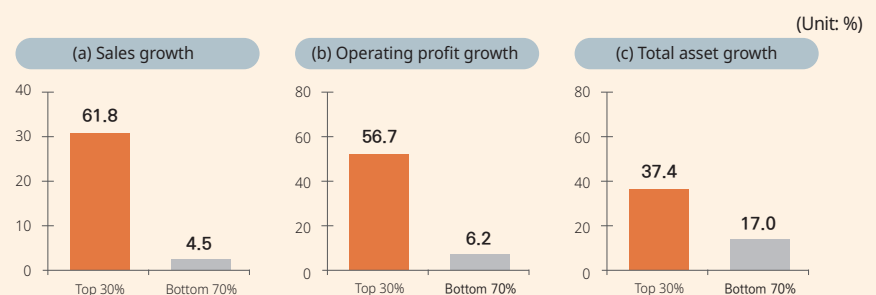


Note: 1) Samples are firms with 0-6 years of business operation.

2) Out of 467,414 firms, including those that remained operational for multiple years, about 37% (or 171,093 companies) are the recipients.

Source: Author's calculation using KED DB and SIMS DB.

[Figure 2] Actual Performance Indicators of Firms Divided Based on Machine Learning-predicted Sales Growth (Top 30% vs. Bottom 70%)



Note: 1) Samples are firms with 0-6 years of business operation.

2) Same as in Figure 1

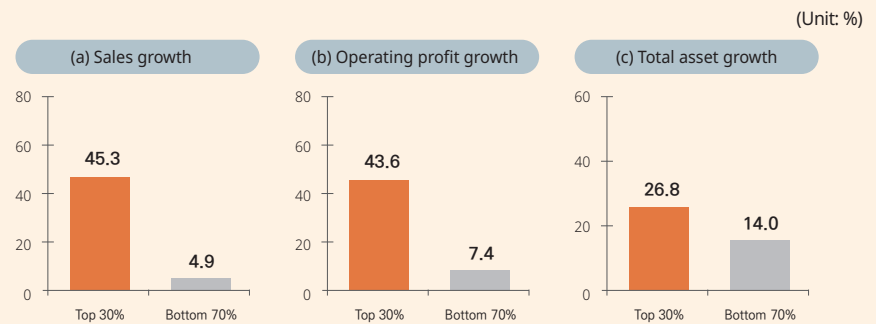
Source: Author's calculation using KED DB and SIMS DB.

3 The growth rate of firms varies greatly depending on their operation history. Refer to Kim and Han (2020) for results of the analysis of firms with seven and more years of business history.

■ Predictions on sales growth generated by the machine learning algorithm were applied to recipient firms, and the result confirms that using AI for selecting policy targets can enhance policy effectiveness.

- When limiting the analysis to recipient firms only, the real performance of the top 30% is higher than that of the bottom 70%, meaning that if the selection process adopted AI, the project's effectiveness could have been higher (Figure 3).
 - The current selection process is not using AI-predicted performance data, and the low sales growth of the recipients in Figure 1(a) is due to the poor performance of the firms that AI predicted to fall within the bottom 70%.
- Recipients show lower growth in both indicators for performance (growth in sales and operating profit) and investment (total asset growth), suggesting the current selection process may not be effective in identifying SMEs in need of financing to grow.

[Figure 3] Actual Performance Indicators of Recipient Firms (Top 30% vs. Bottom 70%)



Note: 1) Samples are firms with 0–6 years of business operation extracted from 2010–2016 data.
 2) The number of analyzed firms includes those that remained operational for multiple years. Of the top 30%, 36,671 companies are recipients, and 103,586 are non-recipients. The bottom 70% encompass 134,414 recipients and 192,686 non-recipients.

Source: Author's calculation using KED DB and SIMS DB.

- Rather than complete reliance on the technologies, AI-generated predictions in identifying suitable targets with higher success potential in the recipient selection is worth considering. There could be an additional review and selection process for those firms with lower predicted growth rates.
 - The new approach departs from the existing way in that the effectiveness of support programs is predicted with datasets on firms and individuals, and the selection process utilizes such predictions.
 - Target selection is commonly conducted in SME support services in R&D, export, and startup, as well as in an array of welfare programs such as energy vouchers and supporting COVID-affected individuals and businesses.

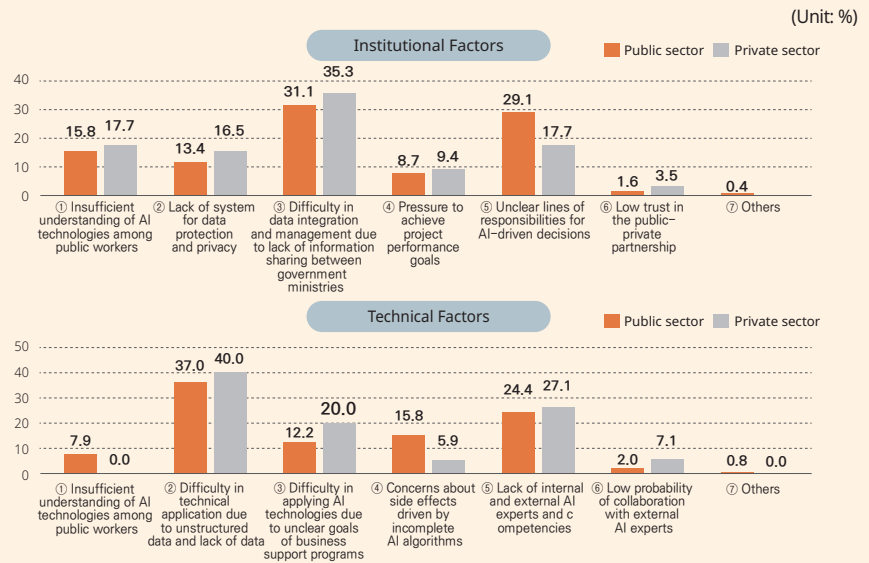
4

Obstacles to the Transition into AI-driven Policymaking

- It has been pointed out that factors that hinder the transition into an AI-based data-driven policy system in the public sector are: 1) incomplete standardization and linkage of policy information and 2) lack of expertise in technology utilization.
 - In 2020, KDI conducted an opinion survey⁴⁾ on adopting AI-driven systems in business support programs with participants from the public and private sectors. This survey found improved fairness and reliability in the selection process as positive aspects, but unstructured data and lack of information sharing between government ministries as obstacles.
 - Currently, each government ministry compiles and manages policy information on a project basis that a comprehensive analysis of datasets gathered across ministries is virtually impossible (Figure 4(a)).
 - There have been attempts to manage all government support projects under one integrated system. However, policy information was not clearly laid out, and only a small pool of persons could access the data, resulting in underutilization.
 - Issues like unstructured data (Figure 4(b)), the leading cause of higher cost for data pre-processing and lower data accuracy, stem from poor data governance across administrations.

4 The survey was conducted via email from Oct. 28 to Nov. 2 in 2020 on 339 employees in the public and private sectors. Project managers and researchers in the public sector took up 53.1% of the survey respondents and 41.3% from corporate leaders and executives in the private sector (KDI, 2020).

[Figure 4] Obstacles to AI Adoption to Public Service Policy



Source: KDI, "A Survey on the Perception and Actual Condition of Adopting AI to Government's Business Support Policy," 2020 (in Korean).

5

Policy Recommendations for Data-driven Policymaking

- A national strategy should coordinate the transformation into a government as a platform enabling data-driven policymaking in the public sector. Public services, such as education, health care, public safety, national defense, and business support, take up a substantial share of the government budget and are in dire need of improving policy effectiveness.
 - To enhance the effectiveness of government projects, the existing governance must switch to a data-driven decision-making process that predicts policy effects using AI technologies as early as in target selection.
 - It is necessary to move away from the ex-post evaluation of government projects based on their outcomes and build a practical policy feedback system.
 - In particular, a smooth adoption of AI technologies in policy decision-making requires moving toward data-friendly operations in public organizations, both technically and managerially.
 - The government needs a national strategy for building a system of data-driven policymaking in the public sector and should lay out specific policy tasks.
 - The action plan for the public sector included in the current National Strategy for Artificial Intelligence is confined to AI application in public services.⁵⁾
 - Each public field can introduce AI technologies by way of designing a policy to support competent public institutions with the provision of assistance, not only technically, such as system, data platform, and security, but also in terms of workplace innovation, such as consulting on organizational diagnosis and reconstructing, education, training, etc.
 - Each public institution should map out an institution-wide managerial strategy, which includes appointing a chief data officer in charge of data selection, analysis, and outcome, as well as providing training to employees.
- This study recommends detailed strategies to use AI to improve the effectiveness of support policy: 1) unifying the existing data management systems into a single platform, 2) reorganizing the government's operating system to enable efficient exchanges of policy information, and 3) building a trust-based public-private partnership.
 - Government ministries have separately managed project data under their purviews so far, but there should be standardized data management to better use scattered data when formulating new projects.

5 Refer to the statement jointly released by related ministries (Dec. 17, 2019).

- In lieu of digital portals that bring together dispersed data sources in one access point, new standards should lay out common formats and access and collection rights in using those datasets to facilitate analysis.
- It is necessary to set up an organization with policy coordination authority for government ministries to efficiently and effectively exchange policy information.
 - Such an organization, firmly founded in law, shall draw up inter-ministerial work standards related to production, collection, utilization, and analysis of policy information and swiftly coordinate data aggregation, linkage, and analysis as well as policy application.
 - This study suggests establishing an institution under the provisional name of Policy Impact Prediction Center with an exclusive mandate for data-driven policy analysis based on public project data produced and compiled by all ministries. Its operation should provide a framework for field experts to continue tracking policy effects.
- In addition, the public sector needs a system for the rapid adoption of new technologies through flexible public procurement while building trust-based public-private partnerships.
 - The public sector should fully utilize the private sector's capacity to make up for its shortfall of technical expertise.
 - Instead of short-term or one-time purchases of ready-made digital solutions, the government should build a pan-government AI system via mid-to-long-term procurement contracts to clarify pending problems and seek technical solutions focusing on problem-solving.
 - While encouraging the collaboration between private companies that partake in building the public sector system, the government must also have preemptive plans to cope with future demand for system integration and upgrades.

■ In the end, turning public institutions into data-driven policymaking bodies requires the following four steps.

- First of all, the design of public projects should facilitate quantitative measurements of project objectives and outcomes. This earliest stage should serve to build a system that can select, compile, and manage necessary data through monitoring the policy cycle of planning, implementation, and evaluation.
 - The workforce of the public sector should clearly understand the benefits of AI in policymaking.
- The second step is to create a platform where policy data can be effectively gathered, stored, utilized, and shared.
 - There should be an inter-ministerial data-sharing platform with transparent operating schemes founded on data timeliness, usability, and security.
- The third step is to analyze the data and extract meaningful information.
 - AI-generated predictions can be valuable information for identifying targets with high potential.
 - It is necessary to make policy decision-making more transparent by utilizing the latest technologies, such as Explainable AI (XAI), and also ensure flexibility by reflecting evaluation factors besides predicted information.
- The fourth step is to use the AI-analyzed data for better project planning and operation.
 - The actual performance data collected since the completion of support programs should be monitored and utilized in order to keep improving the effectiveness of public programs.

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