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Association between Company's Medical Artificial Intelligence and Growth Opportunities

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ABSTRACT

The technological and industrial advancements in the field of medical artificial intelligence (AI) may be associated with the rapid growth of companies in this sector. The purpose of this study was to examine the relationship between the growth opportunities in the medical AI industry and companies engaged in one or more AI-related businesses. Secondary data analysis was performed using the 2021 artificial intelligence industry survey data collected from September 2021 to November 2021. In order to observe the relationship between the medical artificial intelligence industry and company growth opportunities, the medical artificial intelligence industry, company growth opportunities, difficulties, Artificial intelligence start year, Main business field, sales volume, listing status, corporate affiliated research institute, AI main business, Percentage of Data Utilization variables, Rao-Scott cross-test, and logistic regression analysis including covariates were performed. Among all companies, when the AI application industry included medical AI, the OR for the company growth opportunities was 1.80 (P-value 0.031, 95% CI 1.06-3.06). For the medical artificial intelligence industry, the OR was 2.28 (P-value 0.016, 95% CI 1.17-4.46). In artificial intelligence companies, medical artificial intelligence-related industries can play a role in enhancing the growth potential of companies. In order to improve the growth potential of artificial intelligence companies, there is a need to consider the implementation of medical artificial intelligence-related industries and implement support policies that consider the timing of the company's entry into the artificial intelligence industry. Therefore, the government needs to revise industry policies to actively establish laws, regulations, and policies, and further enable medical AI to perform a smooth role as a new growth engine.

1. Introduction

Amid the decline of the paradigm of global trade market liberalization and supply chain globalization, the 4th Industrial Revolution is opening a new era of digital globalization, in which the world is connected to the Internet (Kim, 2023). Particularly, AI is gaining attention as a next-generation growth driver capable of evolving the industrial ecosystem beyond solving structured problems (Cha, 2018). The proliferation of AI technology is rapidly expanding, impacting not only traditional sectors like manufacturing and finance but also socio-cultural domains (Yu, 2017). The field of healthcare and medicine is actively engaged in AI research and development (Kim et al., 2022). Leveraging the rapid technological advancements in medical AI, the focus is shifting towards Medical AI within Hospital Information Systems (HIS) (Shin, 2019). The medical AI market in South Korea is expected to reach $2.583 billion in 2026, with an annual growth rate of 45.2%, up from $275 million in 2020 (Foundation, 2021).

The growth of the medical AI industry encompasses both technological and industrial aspects. From a technological standpoint, the growth of the medical AI industry has been propelled by phenomena such as the disclosure and inflow of extensive complex medical data, a growing public demand for reduced healthcare costs, a surge in demand for emergency medical services due to imbalances in medical personnel and patients, increased inter-industrial partnerships, and strategic collaborations (Heo, 2022). These demands have driven technological advancements, stimulating AI technology innovation based on neuroscience and brain medicine (Lee et al., 2016). AI technology, aiming to mimic human cognitive functions, has rapidly advanced in understanding and processing large-scale data through algorithms (Apell et al., 2021). Notably, key technologies in the medical AI industry encompass AI, wearable devices, and telemedicine. A variety of technologies such as the Internet of Things (IoT), virtual/augmented reality, and robotics play pivotal roles in its growth (Ahn et al., 2022).

While the medical AI industry is growing from a technological perspective, it has also seen rapid growth from an industrial standpoint due to government support. Governmental support can be broadly categorized into policy and legal assistance. On the policy front, South Korea's Ministry of Science and ICT and Ministry of Health and Welfare have proposed plans to establish an AI new drug development platform, support five medical data-centric hospitals, and build AI basic legislation (ICT, 2017). Additionally, the government announced an AI national strategy, aiming to create economic effects of 455 trillion won through AI by 2030, targeting a top 10 ranking in global quality of life, fostering AI startups, securing AI-related technological competitiveness and infrastructure, and nurturing AI talent through education (Ministries, 2019). Legal support involves amendments to data-related laws like the Personal Information Protection Act, Credit Information Act, and Information and Communications Network Act. These amendments allow the utilization of pseudonymous information processed to prevent the identification of specific individuals, enabling the combination of scattered big data for private researchers (Lee et al., 2020).

AI technology in the medical field is continuously growing, which is directly linked to an increase in demand for medical services. As the demand for medical services increases due to

the increase of the population and the increase of the elderly population, the demand for medical technology is also increasing (Kim et al., 2020). Medical AI systems are leading medical innovations in various aspects such as diagnosis, treatment, and disease prevention (Kim, 2023). Through this, it is possible to improve the accuracy and speed of the patient treatment process and increase the efficiency of medical services (Hanbit et al., 2023). These innovations can provide an opportunity for companies to secure competitiveness and grow in the market. For these reasons, the medical artificial intelligence business is recognized as a field with high growth potential, and the development in the industrial and technical aspects of the medical artificial intelligence industry may be related to the rapid growth of companies in the field. The development of the medical AI industry from both an industrial and technological perspective may be associated with the rapid growth of companies in this field. However, research examining the correlation between the recent development of the medical AI industry and the potential growth of companies in this sector is scarce. Most existing studies focus on defining company growth and theoretical approaches (Gerber, Le Roux, & Van der Merwe, 2020; Jacobs et al., 2011; Meyer, Anzani, & Walsh, 2005), with very few studies focusing on domestic companies. Examining the relationship between medical AI and the growth potential of companies is vital for exploring policy support and enhancing competitiveness. Therefore, this study aimed to assess the status of domestic companies involved in medical AI-related businesses and understand the correlation between medical AI businesses and company growth opportunities among those engaging in medical AI-related activities. The goal is to provide foundational data for future prospects and policy support within the medical AI industry.

2. Methods

2.1 Study sample & design

This cross-sectional study conducted secondary data analysis using the 2021 Artificial Intelligence (AI) Industry Survey data. The AI Industry Survey is a statutory investigation aimed at producing fundamental statistics for establishing the AI industry ecosystem and formulating policies to activate the industry by examining AI-related sales status, AI workforce status, AI investment status, and policy demand (ICT, 2022). Since 2017, the Ministry of Science, ICT, and Future Planning has conducted surveys targeting businesses engaged in AI-related activities nationwide, transitioning from investigating individual businesses to enterprises in 2021. The survey was conducted through investigator visits to enterprises, structured online surveys, phone calls, and emails. A total of 1,365 enterprises were included as the overall survey subjects in 2021. Among them, three companies that responded that the corporate life cycle was in a 'declining phase' were excluded. No companies were missing responses to the covariate variables included in the study, and finally, 1,362 companies participated in this study. Table 1 shows the list of variables used in the study.

Table 1. Variable table

Variable type	Variables	Variables classification
Dependent variable	Company growth opportunities	Low growth opportunities
		High growth opportunities
Independent variable	Artificial intelligence application industry field	Industries including medical artificial intelligence
		etc
	Medical artificial intelligence industry field	Medical artificial intelligence industry
		etc
Control variable	Difficulties	Yes
		No
	Artificial intelligence start year	Since 2015
		Before 2014
	Main business field	AI HW & SW
		AI service
	Sales volume	Over 100 million
		Less than 100 million
	Listing status	Yes
		No
	Corporate affiliated research institute	Yes
		No
	AI main business	Yes
		No
	Percentage of Data Utilization	Private
		Public

2.2 Independent variables

The independent variable was determined using a multiple-response survey question: 'Please provide the application industry sectors and case examples of your company's leading AI products/services.' The variable was measured based on the responses to this question. If the AI application industry sector of the enterprise's main AI product/service fell within the healthcare or social welfare services, it was defined as Medical Artificial Intelligence (Medical AI). The AI industry sector variable was then reclassified as 'Including Medical AI Industry' if the enterprise's AI application industry sector encompassed Medical AI, otherwise categorized as 'etc'. Furthermore, the Medical AI industry sector variable was reclassified as 'Medical AI Industry' if the enterprise's AI application industry sector was solely associated with Medical AI, and as 'etc' if it did not include Medical AI.

2.3 Dependent variables

The dependent variable was the company growth opportunities, measured based on responses to the survey question: 'At which stage of the business life cycle is your company currently?' Responses indicating 'Introduction phase' or 'Early growth phase' were reclassified as 'Low growth opportunities,' while responses indicating 'High growth phase' or 'Maturity phase' were reclassified as 'High growth opportunities'.

2.4 Control variables

The control variables in this study consisted of difficulites, AI start year, main business field, sales volume, listing status, Corporate affiliated research institute, AI main business, and Percentage of Data Utilization. The difficulties are eight questions related to difficulties in operating an artificial intelligence business: data acquisition and quality issues, lack of AI manpower, excessive regulations, lack of AI infrastructure (computing), difficulties in attracting investment, difficulties in technology exchange and collaboration, narrowness of the domestic market, If the respondent responded that he or she agreed with at least one of the questions regarding uncertainty in technology development and commercialization, the difficulty was reclassified as 'yes'and the rest as 'No'. AI start year was reclassified into 'Since 2015' and 'Before 2014'. Main business field categories 'AI Software (AI SW),' 'AI Hardware (AI HW),' and 'AI Services' were regrouped into 'AI SW & HW' and 'AI Services'. Revenue scale was based on the total revenue scale of the company, categorized into 'Over 100 billion,' 'Between 10 billion and 100 billion,' 'Between 1 billion and 10 billion,' 'Less than 1 billion,' and 'No revenue,' then regrouped into 'Over 100 million' and 'Less than 100 million.' Listing status was categorized as 'Yes' if the company was listed on 'KOSDAQ,' 'KOSPI,' or 'KONEX'; otherwise, it was classified as 'No'. Corporate affiliated research institute was categorized as 'Yes' or 'No'. AI main business was classified as 'Yes' if AI accounted for over 50% of the total revenue or if over 50% of the overall R&D investment was in the AI sector; otherwise, it was classified as 'No'. Lastly, Percentage of Data Utilization was divided into 'Private' if the usage of public data for AI product/service development and provision was below 50%, and 'Public' if it exceeded 50%.

2.5 Analytical approach and statistics

The Rao-Scott Chi-Square test was used to compare the distribution differences of the dependent variable according to the independent variable. Logistic regression analysis, incorporating covariates, was conducted to investigate the association between the inclusion of medical AI industries and the growth opportunities of companies. We applied weights recommended by the AI Industry Survey. Statistical significance was set at $p < 0.05$, and associations were presented using odds ratios (OR), 95% confidence intervals (CI), and p-values. All statistical analyses were performed using SAS statistical software package version 9.4 (SAS Institute Inc., Cary, NC, USA).

3. Results

3.1 Sample characteristics

Table 2 shows the comparison of general characteristics among the subjects of the study. Among the total 1,362 companies, 395 (29.0%) were categorized as having high growth opportunities. Among the 229 companies (16.8%) included in the medical AI industries, 47 (20.7%) responded as having high growth opportunities. In the subset of 135 companies (9.9%) classified as part of the medical AI industries, 23 (17.1%) responded as having high growth opportunities. Notably, a higher proportion of companies categorized within the medical AI inclusion subset reported high growth opportunities compared to those specifically classified under the medical AI industries subset. Moreover, among the companies established since 2015 (833 companies, 80.7%), the majority (59.2%) reported low growth opportunities, whereas those established before 2014 (195 companies, 59.2%) reported high growth opportunities. Companies primarily involved in 'AI SW & HW' (393 companies, 29.2%) reported high growth opportunities, while those categorized under 'AI Services' (15 companies, 88.22%) reported low growth opportunities. Furthermore, among the listed companies (48 companies, 46.2%), a higher percentage reported high growth opportunities compared to unlisted companies (911 companies, 72.5%).

Table 2. Sample characteristics

Variables	All		Low growth opportunities		High growth opportunities		P-value*
	N	%	N	%	N	%	
Artificial intelligence application industry field							0.036
Industries including medical artificial intelligence	229	16.8	182	79.3	47	20.7	
etc	1,133	83.2	786	69.4	347	30.6	
Medical artificial intelligence industry field							0.024
Medical artificial intelligence industry	134	9.8	111	82.9	23	17.1	
etc	1,228	90.2	856	69.7	372	30.3	
Difficulties							0.942
Yes	79	5.8	55	70.5	23	29.5	
No	1,283	94.2	912	71.1	372	29.0	
Artificial intelligence start year							<.0001
Since 2015	1,032	75.8	833	80.7	199	19.3	
Before 2014	330	24.2	135	40.8	195	59.2	
Main business field							0.132
AI HW & SW	1,345	98.8	952	70.8	393	29.2	
AI service	17	1.2	15	88.2	2	11.8	

Table 2. Cont.

Variables	All		Low growth opportunities		High growth opportunities		P-value*
	N	%	N	%	N	%	
Sales volume							0.013
Over 100 million	944	69.3	642	68.1	301	31.9	
Less than 100 million	418	30.7	325	77.7	93	22.3	
Listing status							0.004
No	1,257	92.3	911	72.5	346	27.5	
Yes	105	7.7	56	53.8	48	46.2	
Corporate affiliated research institute							0.003
Yes	1,033	75.8	703	68.1	330	31.9	
No	329	24.2	264	80.3	65	19.7	
AI main business							0.380
Yes	1,150	84.4	809	70.4	341	29.6	
No	212	15.6	158	74.6	54	25.4	
Percentage of Data Utilization							0.396
Private	1,163	85.4	819	70.4	344	29.6	
Public	199	14.6	148	74.5	51	25.5	
All	1,362	100.0	967	71.0	395	29.0	

*Rao-Scott Chi-Square

3.2 Factors affecting a company's growth opportunities

Table 3 presents the analysis results aiming to understand the association between the medical AI industry and the growth opportunities of companies. The Odds Ratio for the company's growth opportunities concerning the 'Industries including medical AI' compared to the 'etc' was 1.80 (P-value 0.031, 95% CI 1.06-3.06). Moreover, in cases where the industry was specifically within the 'Medical AI Industries' compared to the 'etc,' the Odds Ratio for growth opportunities was 2.28 (P-value 0.016, 95% CI 1.17-4.46). Regarding the starting year of AI implementation, the Odds Ratios for growth opportunities for 'Since 2015' compared to 'Before 2014' were 5.48 (P-value <.0001, 95% CI 3.69-8.16) and 5.52 (P-value <.0001, 95% CI 3.71-8.21), respectively. When considering the listing status, the Odds Ratios for growth opportunities for 'Yes' compared to 'No' companies were 0.51 (P-value 0.045, 95% CI 0.26-0.98) and 0.51 (P-value 0.043, 95% CI 0.27-0.98), respectively. Additionally, for companies with 'No' Corporate affiliated research institute compared to those with 'Yes,' the Odds Ratios for growth opportunities were 0.59 (P-value 0.033, 95% CI 0.36-0.96) and 0.58 (P-value 0.027, 95% CI 0.36-0.94), respectively. Finally, concerning AI main business involvement, the Odds Ratios for growth opportunities for 'No' compared to 'Yes' were 0.54 (P-value 0.020, 95% CI 0.32-0.91) and 0.54 (P-value 0.020, 95% CI 0.32-0.91), respectively.

Table 3. Factors affecting a company's growth opportunities

Variables	Company growth opportunities							
	OR	95% CI		P-value	OR	95% CI		P-value
Artificial intelligence application industry field								
Industries including medical artificial intelligence	1.80	1.06	3.06	0.031				
etc	1.00							
Medical artificial intelligence industry field								
Medical artificial intelligence industry					2.28	1.17	4.46	0.016
etc					1.00			
Difficulties								
Yes	0.94	0.42	2.09	0.882	0.94	0.42	2.10	0.875
No	1.00				1.00			
Artificial intelligence start year								
Since 2015	5.48	3.69	8.16	<.0001	5.52	3.71	8.21	<.0001
Before 2014	1.00				1.00			
Main business field								
AI HW & SW	1.00				1.00			
AI service	2.84	0.66	12.15	0.159	2.81	0.66	12.03	0.164
Sales volume								
Over 100 million	0.86	0.56	1.30	0.466	0.89	0.58	1.35	0.576
Less than 100 million	1.00				1.00			
Listing status								
No	1.00				1.00			
Yes	0.51	0.26	0.98	0.045	0.51	0.27	0.98	0.043
Corporate affiliated research institute								
Yes	0.59	0.36	0.96	0.033	0.58	0.36	0.94	0.027
No	1.00				1.00			
AI main business								
Yes	0.54	0.32	0.91	0.020	0.54	0.32	0.91	0.020
No	1.00				1.00			
Percentage of Data Utilization								
Private	0.84	0.50	1.39	0.487	0.85	0.51	1.41	0.526
Public	1.00				1.00			

4. Discussion

Factors shaping a company's competitiveness can vary, and the impact of these factors on performance can also differ (Group, 1968). To establish and sustain competitiveness, elements like consumers, collaborations with external entities, market dynamics, and government support play pivotal roles (Atuahene-Gima et al., 2001). Particularly within AI-related enterprises, the medical AI industry can significantly bolster growth opportunities. Given the reality that the initial market formation and growth rate are heavily influenced by government policy direction, the relationship between companies and the government is vital in the corporate environment (Kim et al., 2022). For companies, governments serve as key entities providing new business opportunities and shaping competitive landscapes by formulating various regulations and benefits that can impact businesses (Hillman et al., 1999). The medical AI industry has experienced rapid growth through substantial support and investment based on government policies. In fact, the Ministry of Science and ICT (ICT, 2018) has propelled investment in areas such as medical imaging diagnosis and speech/language comprehension, supporting AI Small and Medium-sized Enterprises competitiveness through the AI R&D strategy for realizing I-Korea 4.0. Additionally, the Ministry of Health and Welfare (Welfare, 2021) has expanded investment in the four key areas of medical AI development — tackling critical illnesses, essential medical procedures, addressing the challenges of an aging society, and problem-solving AI development — to establish the foundation for growth within medical AI-related companies.

The government's support for promoting investment in technological innovation, seen as foundational for securing a company's competitiveness and long-term growth, has been acknowledged as a critical factor. Studies preceding this have focused on the effectiveness of government support and policies (David et al., 2000; Zúñiga-Vicente et al., 2014). Government-sponsored research and development initiatives have shown a positive effect on increasing a company's net investment (González et al., 2008; Lach, 2002), leading to heightened technological development, patenting, and infrastructure establishment (Lambe et al., 1997). In essence, government support stimulates companies' investment in technology development, fostering enhanced technological capabilities that, in turn, drive revenue expansion through technological competitiveness and quality improvements. This cycle further leads to the direct and indirect creation of high-quality job opportunities (Yoon et al., 2020). In the domain of medical AI-related enterprises, government backing can establish such a self-perpetuating structure, facilitating human and material growth within these companies. Moreover, unlike other conventional business sectors, AI-related ventures generally exhibit rapid dissemination and significant ripple effects (Hong et al., 2017), signifying a correlation between a company's growth opportunities and involvement in AI. Notably, within the AI realm, particularly in healthcare, the medical AI sector demands extensive resources in terms of time and research and development compared to other industries (Kim et al., 2022). This sector's resource-intensive nature, given its potential for high value creation through substantial added value (Ahn, 2021), accounts for the positive correlation between medical AI industries and a company's growth opportunities. However, despite the positive correlation between government policies on medical AI and a company's growth opportunities, the cumulative revenue of digital healthcare-related companies, including medical AI, as of 2020, totaled 1.35 trillion KRW, with over half earning less than 500 million KRW in revenue and employing

fewer than 30 people, indicating a relatively modest scale (Ministries, 2022). Despite ongoing government investment in medical AI policies, several issues persist within the medical AI industry.

The healthcare AI industry faces various challenges, including a constrained market environment, difficulties in utilizing data, regulatory constraints, and a shortage of skilled personnel (Ministries, 2022). Overcoming these hurdles necessitates essential government intervention. The government needs to act as a catalyst for market stimulation through support programs while exploring avenues to facilitate overseas expansion for domestic enterprises. Efforts should focus on enhancing data utility through supportive initiatives, improving regulations via amendments in healthcare laws and guidelines, fostering systematic talent development, and establishing institutional frameworks. Healthcare AI holds substantial value not only in micro healthcare domains but also on a macro level, contributing significantly to the nation's technological industry. Therefore, fostering the advancement of the healthcare AI sector and the growth of associated enterprises requires proactive governmental reconsideration of laws, systems, and policies. Establishing healthcare governance to enable healthcare AI as a significant driver of growth demands increased attention and resources dedicated to the proactive development of healthcare AI.

This study holds significance in verifying the correlation between medical AI and corporate growth opportunities, especially in the current critical period where activation of enterprises, particularly in emerging technological fields like medical AI, is crucial. According to the findings, when companies engage in medical AI-related ventures, a positive correlation with corporate growth emerges. These results may serve as foundational data for shaping industrial policies aimed at activating the necessity of AI in the medical domain and fostering enterprise growth, by exploring influential factors impacting the growth aspect of AI companies.

However, several limitations exist within this study. Given its cross-sectional nature focusing on AI companies, careful interpretation is necessary concerning the association between medical AI-related industries and corporate growth opportunities. Additionally, the growth stages, measured through self-reported surveys, may introduce respondent bias. Therefore, subsequent research should consider objective methods to measure corporate growth opportunities and reconfirm the association. Finally, for future studies, conducting longitudinal research encompassing all enterprises, including AI companies, to infer and evaluate the precise relationship between medical AI and corporate growth opportunities would lead to more reliable outcomes.

5. Conclusion

The study has revealed a strong correlation between enterprises in the medical AI industry and their growth opportunities. The results suggest a positive association between a company's growth and engagement in medical AI-related ventures. However, there are several challenges in the advancement of the medical AI industry and the growth of associated enterprises that require resolution at the governmental level. Therefore, it is imperative for the government to engage in proactive reevaluation of relevant industry policies, regulatory frameworks, and policies to facilitate the smooth operation of medical AI as a driver of new growth.

Conflicts of Interest

No author has any other conflict of interest to declare.

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