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Abstract

The surge in interest in artificial intelligence (AI) adoption in firms has necessitated an examination of the purported claims surrounding this technology. Despite the burgeoning interest, a theoretical explanation for these claims remains elusive. This study aims to validate the claims of AI's impact on innovation, research, and other areas of business management using fuzzy set Qualitative Comparative Analysis (fsQCA). By analyzing the discussion intensity about AI adoption on the relationship between Absorptive Capacity and firm performance, the findings of this study reveal that while the discussion about AI by managers

in their voluntary disclosures has a heightened impact on firm performance post-COVID compared to pre-COVID, the primary association with firm performance remains the non-discussion of AI. This study contributes to the existing body of knowledge by providing empirical evidence on the complex relationship between AI adoption, Absorptive Capacity, and firm performance. The findings of this study have significant implications for managers and policymakers seeking to leverage AI adoption for improved firm performance.

Introduction

The discussion about Artificial Intelligence (AI) has garnered significant attention in academic and business circles, with scholars and practitioners engaging in an ongoing debate about its potential impact on management and innovation processes (Haefner et al., 2021). Proponents of AI adoption argue that it has the potential to revolutionize the way firms think about design in their innovation processes (Verganti, Vendraminelli and Iansiti, 2020) and facilitate a transition towards a circular economy (Chauhan, Parida and Dhir, 2022). Moreover, AI is believed to enable firms to save time and effort in human resources (Chowdhury et al., 2023).

Despite these claims, the extent to which firms are actually investing in AI and whether these investments are associated with firm performance remains unclear. A critical examination of firms' voluntary disclosures, such as annual reports and websites, reveals that management is increasingly paying attention to adopting AI. However, the question of whether these disclosures reflect real investments in AI or merely claims is a topic that warrants further investigation.

This study seeks to address these knowledge gaps by examining the relationship between firms' voluntary disclosures about AI adoption and their subsequent performance. To achieve this, we draw upon the concept of absorptive capacity, which refers to a firm's ability to acquire, assimilate, transform, and exploit new and external knowledge (Zahra and George, 2002). We

argue that higher absorptive capacity is associated with higher firm performance, and that AI will accelerate this relationship.

Using the fsQCA method, we empirically investigate how firms' voluntary disclosures about AI adoption impact their performance, specifically before and after the COVID-19 discontinuity. We contend that these disclosures serve as "signals" by management about their firms' commitment to AI adoption. We then examine the quality measures of these signals to determine their impact on firm performance.

This study contributes to the existing literature by providing insights into the relationship between firms' voluntary disclosures about AI adoption and their performance. Our findings will inform management and policymakers about the potential benefits and challenges of AI adoption in firms.

The remainder of this study is organised as follows: In the next section, we review the literature relevant to this study, including absorptive capacity, artificial intelligence, voluntary disclosures, and discontinuities. We then present three propositions that examine these relationships. In the following section, we describe the data and methods used in the study. Finally, we discuss the findings and provide conclusions.

Literature review and propositions

Artificial intelligence (AI)

The impact of artificial intelligence (AI) on innovation performance in firms is significant, particularly in relation to knowledge creation, spillover, learning ability, and investments in research and development (R&D) and talent acquisition (Liu et al., 2020). The integration of AI in organisations gives rise to paradoxical tensions, including automation versus augmentation, based on human involvement, which increases the temporal scale and reveals the cyclical and interdependent nature of these choices (Raisch and Krakowski, 2021). Scholars

have ontologically explained AI through utilitarian and hedonic approaches, categorising it as mechanical, thinking, and feeling (Huang and Rust, 2021). AI's self-learning and connected nature enables it to overcome human information processing constraints and facilitate innovation generation, although scholars note the difficulty of replacing managers' judgment (Haefner et al., 2021). The diffusion of AI raises questions about its impact on innovation and design, whether it will lead to changes in objects and design processes, and how it will affect our understanding of innovation (Verganti, Vendraminelli and Iansiti, 2020). The adoption of AI in business education is also being reevaluated, with institutions needing to adapt to the cultural shift and develop new frameworks to handle AI-driven disruptions (Lim et al., 2023). While ethical concerns exist, AI has the potential to increase efficiencies, provide greater insight into business processes, and create competitive advantages for adopters (Munoko, Brown-Liburd and Vasarhelyi, 2020). Consultants suggest that AI can fundamentally accelerate the R&D process, creating new hypotheses and accelerating idea exploration (Anon, n.d.). Consultants suggest a positive correlation between AI adoption and EBIT (Earnings before interest and taxes) (Anon, n.d.). Conversely, some consultants argue that firms aim too low, place too many bets on AI, and fail to train employees in AI, which is not linked to financial goals (Anon, 2025). The linkage between AI adoption and financial performance improvements remains a topic of discussion, highlighting the need for further research.

Absorptive Capacity

Absorptive Capacity, a construct integral to the field of Knowledge Management, has garnered considerable attention due to its pivotal role in fostering competitive advantage through the acquisition and internalization of knowledge (Volberda, Foss and Lyles, 2010). Research has extensively utilized this construct to investigate inter-organizational learning, alliances, and acquisitions, innovation, entrepreneurship, and related phenomena (Acs et al., 2009; Lane and Lubatkin, 1998; Mowery, Oxley and Silverman, 1996; Zhou and Wu, 2010). The absorptive

capacities have been dichotomized into potential and realized absorptive capacities, where knowledge acquisition and assimilation are considered potential capacities, and knowledge transformation and exploitation are regarded as realized capacities (Jansen, Van Den Bosch and Volberda, 2005). Potential absorptive capacity encompasses efforts directed towards identifying and acquiring new external knowledge and assimilating knowledge obtained from external sources (Zahra and George, 2002). Realized absorptive capacity, which involves knowledge transformation and exploitation, entails deriving new insights and consequences from combining existing and newly acquired knowledge and incorporating transformed knowledge into organizational operations (Jansen, Van Den Bosch and Volberda, 2005). Research has demonstrated that a firm's internal capabilities are crucial for realizing its potential capabilities (Jansen, Van Den Bosch and Volberda, 2005). Notably, absorptive capacities can be viewed as dynamic capabilities that enhance a firm's innovation and financial performance (Cheng and Hung, 2022). The process of knowledge acquisition and assimilation is a deliberate and rational method that leads to the reorganization of knowledge within the organization, subsequently resulting in modifications of organizational routines (Hughes et al., 2018). Given the dual nature of absorptive capacities, which encompasses both external and internal aspects of a firm, numerous studies have employed absorptive capacity as either the primary variable, moderator, or mediator (Bhatti et al., 2025; Emre Yildiz et al., 2024; Friedmann, Lavie and Rademaker, 2024; Hassani and Arouss, 2024; Hong, Zhou and Gong, 2024). Research has shown that absorptive capacity can strengthen relationships such as TMT bricolage and unit-level performance (Chang et al., 2022), network breadth in open innovation and firm value (Liu, Lai and He, 2024), competitive advantage and responsible innovation (Memon, Ooi and Han, 2024). Conversely, in some instances, absorptive capacity has been found to negatively affect certain relationships (Knockaert, Spithoven and Clarysse, 2014; Najafi-Tavani et al., 2018).

Furthermore, the constructs of organizational routines and the four types of absorptive capacities have become a focal point for scholars investigating the role of AI adoption among firms. The empirical evidence suggests that absorptive capacity is a critical construct that warrants further investigation in the context of AI adoption among firms.

Discontinuities

Discontinuities introduce punctuation in organizational routines necessitating strategic foresight in technology and innovation management to detect exogenous changes, assess their expected consequences and develop a future course of action thereby enabling superior organizational performance (Mühlroth and Grottke, 2020). Scholars have extensively studied exogenous shocks from diverse perspectives including inflation crises debt crises stock market crashes war-like situations and sudden policy changes (Demers et al., 2021; Deng et al., 2020; Flammer and Ioannou, 2021; Zhou, Liu and Luo, 2022). Disruptive innovation as described by (Christensen, 2015) can originate from new technologies or inventions profoundly impacting existing business practices including decision-making structures. The COVID-19 pandemic precipitated a global crisis (Škare, Soriano and Porada-Rochoń, 2021) prompting firms to undergo adaptation, metamorphosis, evolution, and revolution (Meyer, Brooks and Goes, 1990) necessitating the integration of various strategies logic and structural forms to manage complex problems (Hitt, Arregle and Holmes Jr, 2020). Organizational hybridity incorporating diverse capabilities such as structural flexibility may facilitate effective resource and stakeholder management in the post-pandemic era (Hitt, Arregle and Holmes Jr, 2020, p.20). The deployment of knowledge whether tacit or codified represents a critical capability in this context. A Scopus search reveals a notable increase in discussions surrounding AI following the pandemic scholars debating its status as a technological disruption or general-purpose technology akin to the internet and electricity. Some organizations have indeed discussed AI

adoption prior to the pandemic highlighting the complex interplay between technological advancements and organizational responses.

Voluntary disclosures in firms

Voluntary corporate disclosure is a critical component of an efficient capital market, as firms disseminate information through regulated financial reports, including financial statements, footnotes, management discussion and analysis, and other regulatory filings (Healy and Palepu, 2001). The pertinent inquiry concerns the factors influencing management's disclosure choices. Specifically, when firms elect to share information about themselves, what they choose to divulge or conceal, and the timing of such disclosures. Firms are incentivized to share information as it enhances stock liquidity, reduces capital costs, and increases information intermediation (Healy and Palepu, 2001). Conversely, (Patten, 1991) posits that disclosures are more closely tied to public pressure than profitability. Nevertheless, recent studies indicate that non-financial disclosures have implications for a firm's financial aspects (Dhaliwal et al., 2011), and that firms with substantial economic resources tend to make more extensive disclosures, yielding net positive economic benefits (Qiu, Shaukat and Tharyan, 2016).

The 'signalling' associated with corporate social responsibility (CSR) investments suggests a future financial performance prospect. This 'signalling' is significant, as AI investments may also indicate a future financial performance prospect.

The textual analysis of voluntary disclosures is particularly relevant in management research due to the use of language as a business communication medium. Furthermore, these texts exhibit managerial decision-making behavior as managers must select when, how, and what to disclose. In most countries, public firms are mandated to regularly disclose information, providing scholars with an abundance of opportunities to work with the associated text.

The quality of this information is significant, as signals reduce information problems when they are costly to realize and imitate, and differences in signalling costs provide the basis for a selection process whereby receivers can use the signal to select a sender from among a more extensive set of signallers (Bergh et al., 2014). Moreover, better-written documents produce less ambiguity in valuation (Loughran and McDonald, 2014), and scholars can leverage tools such as FinBERT and the Loughran-McDonald Dictionary to assess the tone and other factors concerning the text that reflect qualitative attributes of the text (Huang, Wang and Yang, 2023; Loughran and McDonald, 2011, 2020, 2024). It is proposed that the established positive relationship between a firm's absorptive capacity and its performance will be affected further by AI adoption, and that AI adoption will be a sufficient or even necessary condition for the firm's financial performance.

Proposition 1: Along with the firm's Absorptive Capacity, AI adoption is necessary or sufficient for its financial performance.

Furthermore, I discussed the importance of voluntary disclosures by the firm. The information about the firm's AI adoption may be part of the voluntary disclosure made by the firm. However, the quality of these 'signals' about AI adoption will be either necessary or sufficient for the signal to be considered strong will explain the causal effect between AI adoption and the firm's financial performance more strongly.

Proposition 2: The signal quality of voluntary disclosures will be necessary or sufficient to explain the sufficiency or necessity of AI adoption and Absorptive capacity for a firm's financial performance.

The following proposition is exploratory in nature. The COVID-19 pandemic was a significant discontinuity in the business environment, after which the high interest in AI followed. Here, I

separate and attempt to explain the difference in causal configurations pre-COVID and post-COVID.

Proposition 3: The causal configurations concerning Absorptive Capacity, AI Adoption that explain financial performance will increase post-COVID than pre-COVID.

Accordingly, I advance three propositions regarding the relationships between Absorptive Capacity, AI adoption, and financial performance. This is depicted through a model in figure 1. The same is depicted in set theoretical format in Figure 2.

---- Figure 1 about here ----

---- Figure 2 about here ----

Data and Methodology

This study examines the data from Indian NIFTY Pharma Sectoral Index firms, comprising 19 prominent Indian pharmaceutical firms from 2018 to 2024, of which 15 have been selected based on availability of annual reports. The NIFTY Pharma Sectoral Index, designed by the National Stock Exchange, serves as a benchmark for the pharmaceutical sector in India. Pharmaceutical firms contribute approximately 1.7% to India's GDP, positioning them as a significant sector within the country's economy. This research focuses on pharmaceutical firms due to their high research and development intensity, distinct from the information technology sector, which is the focus of this research.

The selection of Indian pharmaceutical firms as the subject of analysis is informed by their sectoral significance. The pharmaceutical sector is a substantial contributor to India's economy, making it a suitable candidate for an analysis of AI adoption among pharmaceutical firms. In accordance with Listing Obligations and Disclosure Requirements (LODR) and the Securities and Exchange Board of India (SEBI) regulations, publicly listed firms in India submit their

annual reports. These reports are collected from the National Stock Exchange (with supplementary sources being the firm's website or the Bombay Stock Exchange, if necessary) in PDF format. The collected reports are subsequently converted into a suitable text format for further analysis.

The annual reports typically comprise various sections, including General Meeting Notice, Chairman's message, CEO's message, Business Model discussion, Firm Strategy Discussion, Management Discussion and Analysis, Governance Report, Corporate Social Responsibility report, Sustainability report, Auditor's report, Consolidated Financial Statements, and Standalone Financial Statements. The financial statement tables are excluded from the analysis, as they are not relevant to the content analysis.

The financial information (information from balance sheets, cash flows, profit and loss statements, shareholding, etc.) and identity information (firm age, etc.) about the firms have been retrieved from the Centre for Monitoring the Indian Economy (CMIE), which is a leading business information company.

The outcome variable is Return on Total Assets (RoTA), which measures the firm's financial performance based on its Asset base.

The condition variable “AI Discussion Intensity” is calculated using the Textrank algorithm (Mihalcea and Tarau, 2004) by measuring the ratio of AI-related keywords' importance to the entire text.

The absorptive capacity, specifically the condition variable, is quantified by comparing sentences from a scale devised by (Flatten et al., 2011) with each sentence in the annual report to identify congruent statements. A binary indicator (1/0) is assigned to each absorptive capacity type (acquire, assimilate, transform, exploit) based on the presence or absence of matching statements in the firm's annual report. For instance, Cipla Ltd's 2018 annual report

contains the statement: "We have various cross-functional committees to ensure robust delivery of business objectives and maintain growth momentum within the defined risk management framework. This has been embedded into the goal sheets of all MC members and has also been cascaded to all the leaders and their teams who have a significant amount of cross-functional overlap, to ensure that everyone is moving together in the same direction." This statement indicates the presence of assimilate capacity. The assimilate capacity is characterized by the following statements, as per (Flatten et al., 2011):

- In our company ideas and concepts are communicated cross-departmental.
- Our management emphasizes cross-departmental support to solve problems.
- In our company there is a quick information flow, e.g., if a business unit obtains important information, it communicates it promptly to all other business units or departments.
- Our management demands periodical cross-departmental meetings to interchange new developments, problems, and achievements.

Condition variables, namely Tone, Uncertainty, Litigious, Constraining, and Readability, are quantified via word-frequency-based measurements ascertained from the Loughran & McDonald Dictionary (Loughran and McDonald, 2011, 2014, 2020, 2024). A supplementary measure for a robustness check is the FinBERT model (Huang, Wang and Yang, 2023), employed to quantify Sentiment in texts as an alternative to the Loughran & McDonald Tone dictionary.

For the fsQCA analysis, fsQCA software version 4.1 (Ragin and Davey, 2023) hosted on the University of Irvine, California Sociology Department website is employed.

This analysis examines the pre-COVID and post-COVID dataset configurations yielded by the algorithm, revealing a notable emphasis on transformation and knowledge exploitation and high-quality disclosure signals in the complex and intermediate solutions.

---- Table 1 about here ----

This is consistent with the premise that Asset exploitation is a key determinant of financial performance. The post-COVID configurations exhibit a shift towards knowledge assimilation, accompanied by lower-quality signals and a negative tone, suggesting that firms must adapt to changing circumstances by assimilating new knowledge. The necessity of AI Intensity for financial performance is refuted by the observation that all causal configurations necessitate the absence of AI Intensity for the outcome RoTA. This finding contradicts the initial proposition that AI adoption is either necessary or sufficient for financial performance. The post-COVID parsimonious causal configuration suggests that the presence of AI_Intensity and Readability, along with the absence of Acquire capacity, causally influences financial outcomes. This configuration provides some insight into the relationship between AI adoption, signal quality, and financial performance. However, its theoretical validity is limited by the absence of Absorptive capacities, underscoring the complexities of the relationships.

Necessary condition analysis

The analysis reveals some causal inference between Artificial Intelligence intensity (AI_Intensity) and Return on Total Assets (RoTA) in the pre-COVID and post-COVID periods, as depicted in Table 2.

---- Table 2 about here ----

A comparative analysis of the consistency coefficients indicates a notable increase in the association between AI_Intensity and RoTA post-COVID, relative to the pre-COVID period (0.25 vs. 0.35). Conversely, the consistency coefficient for the absence of AI_Intensity exhibits

a decline post-COVID, from 0.82 to 0.72. These findings offer preliminary evidence in support of proposition 3. To ensure the robustness of the results, a supplementary analysis was conducted using FinBERT, a machine learning model, in lieu of the Loughran & McDonald dictionary for tone analysis. The outcomes of this analysis remained consistent with the initial findings. This result underscores the reliability of the methodological approach employed in this study.

Discussion and conclusion

This study investigates the voluntary disclosures of 15 top pharmaceutical firms in India to examine the claims regarding AI adoption in relation to absorptive capacity and financial performance. A comprehensive analysis is conducted to evaluate the propositions derived from the absorptive capacity model, which posits that AI adoption is either a necessary or sufficient condition for financial performance. The study also explores the relationship between the quality of signals and AI adoption, as proposed by the absorptive capacity model. The research aims to provide empirical evidence on the linkage between AI adoption and financial performance, as well as the impact of AI discussion on the relationship between absorptive capacity and firm financial performance. A mixed-methods research approach is employed, combining quantitative and qualitative data to analyze the voluntary disclosures of the firms. The study uses a dataset comprising firm-level data, including financial performance, absorptive capacity, and AI adoption, to examine the propositions and investigate the research questions. The study contributes to the literature on Absorptive capacity by providing empirical evidence on the linkage between AI adoption and financial performance, as well as the impact of AI discussion on the relationship between absorptive capacity and firm financial performance.

The findings of this study have several managerial implications, including the necessity for firms to weigh the benefits of hastened AI adoption against the importance of assessing their knowledge-absorbing capacity. Moreover, managers must be cautious during different types of disruptions, as highlighted by this study.

Notwithstanding its findings, this study has several limitations. Firstly, it explores plausible explanations for the additional causal effect of AI discussion on the relationship between absorptive capacity and firm financial performance, but a more valuable insight may be derived from firm-specific data, including the size of AI investments, product linkage, and measured benefits. Secondly, the propositions received limited support, which may be improved through the application of alternative theoretical frameworks. Thirdly, the measurements employed were limited, and future research could benefit from incorporating additional data sources, such as conference calls, social media, and official websites. Furthermore, a larger dataset could enable the use of a random effects regression model to provide additional empirical evidence. Finally, the analysis could be enhanced by incorporating additional dimensions, such as firm age, R&D intensity, export intensity, leverage, shareholding pattern, and by examining the data from multiple perspectives, including pre-COVID and post-COVID periods, high-quality versus low-quality signals, high AI intensity versus low AI intensity, and other relevant variables.

Appendix

Figure 1

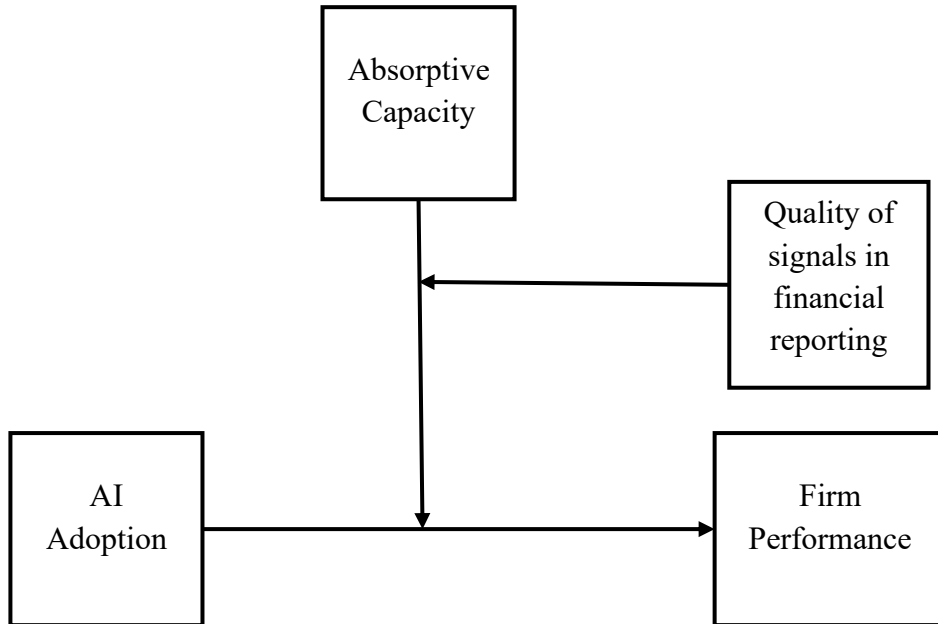


Figure 2

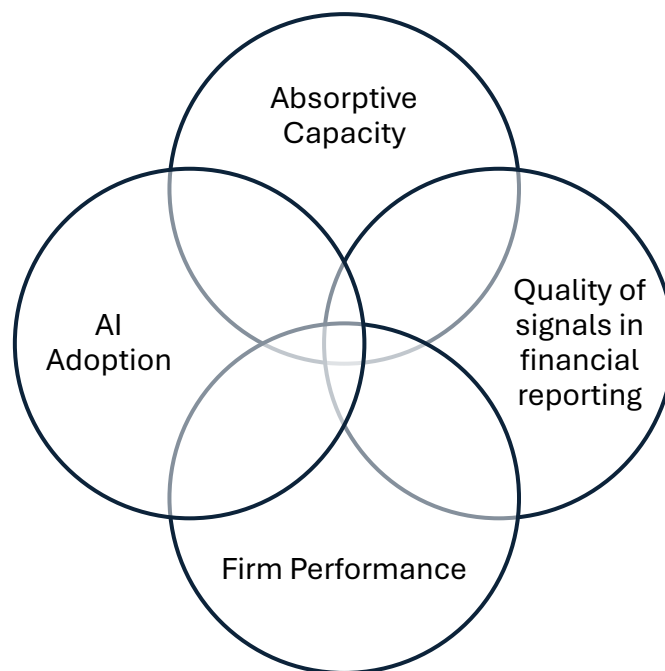


Table 1

Outcome: Return on Total Assets (RoTA)				
Pre-COVID				
		Raw coverage	Unique coverage	Consisten cy
Complex	~Acquire*~Assimilate*Transform*Exploit*tone*uncertainty*~Readability*~AI_Intensity	0.0652222	0.0652221	1
Parsimoni ous	Acquire*~Transform*tone	0.13166	0	0.988056
Intermedi ate	~Acquire*~Assimilate*Transform*Exploit*tone*uncertainty*~Readability*~AI_Intensity	0.0652222	0.0652221	1
Post-COVID				
		Raw coverage	Unique coverage	Consisten cy
Complex	~Acquire*Assimilate*~Exploit*~tone*uncertainty*~Readability*~AI_Intensity	0.095613	0.0323461	0.973656
Parsimoni ous	~Acquire*~Readability*~AI_Intensity	0.269522	0.116442	0.887793
Intermedi ate	~Acquire*Assimilate*~Exploit*~tone*uncertainty*~Readability*~AI_Intensity	0.095613	0.0323461	0.973656

Table 2

Pre-COVID			Post-COVID		
Condition	Consistency	Coverage	Condition	Consistency	Coverage
~AI_Intensity	0.823343	0.423435	~Exploit	0.824068	0.532292
~Exploit	0.707903	0.442962	~AI_Intensity	0.720485	0.650462
~tone	0.70575	0.518612	~tone	0.689568	0.775293
~Readability	0.654971	0.448412	Readability	0.675602	0.637339
uncertainty	0.638109	0.49938	uncertainty	0.655219	0.711357
~Acquire	0.625631	0.366224	~uncertainty	0.643388	0.686869
~uncertainty	0.618579	0.514613	tone	0.596605	0.616104
tone	0.612221	0.547121	~Assimilate	0.584821	0.524659
Readability	0.572346	0.561573	~Readability	0.578476	0.725141
~Assimilate	0.564611	0.365916	~Transform	0.551605	0.523969
Transform	0.555392	0.43819	~Acquire	0.545139	0.586872
~Transform	0.444608	0.366729	Acquire	0.454861	0.489682
Assimilate	0.435389	0.46475	Transform	0.448395	0.556987
Acquire	0.374369	0.485247	Assimilate	0.415179	0.558704
Exploit	0.292097	0.331282	AI_Intensity	0.359026	0.478619
AI_Intensity	0.255036	0.476353	Exploit	0.175932	0.568201
Outcome: Return on Total Assets (RoTA)					

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