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Service Quality and Consumer Behavior in Saudi Arabia: Examining Transactions and Technological Integration within the Vision 2030 Framework

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ABSTRACT:
This paper investigates the role of digital transformation in enhancing sectoral quality and influencing consumer behavior in Saudi Arabia, framed within the nation's Vision 2030 initiative. Through a mixed-methods approach, combining quantitative data from the Saudi Arabian Monetary Agency (SAMA) and the General Authority for Statistics (GAStat) with qualitative insights, this study assesses digital adoption across various sectors and regions. The findings highlight the rapid expansion of e-commerce and digital transactions, revealing strong correlations between digital financial activities and broader economic indicators, such as consumer loans. This underscores the need for tailored digital strategies responsive to sectoral and regional dynamics. The analysis provides practical implications for policymakers and business leaders, emphasizing the importance of developing digital strategies to enhance economic diversification and service quality. The study concludes that digital transformation is critical for fostering resilience and sustainable economic growth in Saudi Arabia's evolving digital economy.

Keywords: Digital Transformation, Saudi Arabia, E-commerce Trends, Consumer Behavior, Financial Indicators, Quality Analysis

1. Introduction

In the ever-changing domains of finance and business, digital transformation has emerged as a catalyst capable of redefining operational paradigms. Typically characterized by the implementation of digital solutions, this process transforms conventional operational models to enhance the quality of services and products. Beyond technological advancements, digital transformation also signifies major cultural shifts within organizations. Globally, the pandemic underscored the importance of digital transformation for enhancing the sustainability and resilience of businesses. Consequently, the perpetuation of traditional practices becomes unsustainable due to continuous external challenges to the status quo. The ongoing shift towards digital solutions highlights an acceleration in technological adoption, driven by economic diversification strategies and continuous digital evolution. This shift presents an intriguing opportunity for research due

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to expected long-term changes in how businesses and public services will operate to achieve optimal results.

In this context, Saudi Arabia offers a compelling case study, elucidating the pervasive effects of global digital transformation on regional economies. Digital transformation is a cornerstone of Saudi Arabia's Vision 2030, driving sustainable development through diversified economic strategies and innovative technologies. Within the scope of Vision 2030, the country aims to reduce its dependency on oil and embrace a diversified economic profile (Salman, 2024). To this end, Saudi authorities and policymakers are modernizing key public sectors such as education, infrastructure, health, tourism, and others. Marking a deep commitment to digital transformation and innovation, this ambitious nationwide project extends beyond a limited set of medium-term objectives. Since its adoption in 2016, the Vision 2030 plan has guided Saudi Arabia's digital growth, leveraging innovative technologies across various sectors (Alasiri and Mohammed, 2022; Moreau and Aligishiev, 2024). Enabled by private sector innovations and government policies, the rapid development of digital infrastructure, e-governance solutions, and technology-driven ecosystems form the foundation for the country's economic diversification.

Regarding digital transformation, the concept of 'quality' may encompass various aspects, including service delivery efficiency, customer satisfaction, cybersecurity, and digital infrastructure resiliency (Afzal and Panagiotopoulos, 2024). Within the framework of this study and its alignment with Vision 2030, service quality is approached as a composite outcome reflecting the impact of digital transformation, particularly on operational effectiveness and user experience. Accordingly, transactional consistency in digital payment systems, the responsiveness of digital platforms as evidenced by growing adoption rates, and the degree of alignment between digital service availability and consumer engagement emerge as crucial indicators of sectoral quality improvements (Martínez-Peláez et al., 2023; Schiavone et al., 2023). This operationalization facilitates the investigation of how digital initiatives contribute to the robustness of services as well as rates of user adoption. The focus on these facets is integral to achieving the ambitious objectives outlined in Vision 2030. Therefore, a comprehensive examination of the quality-assuring strategies and practices enabling successful digital transformation is necessary.

The current study examines digital transformation in Saudi Arabia, with a specific focus on the quality-related dimensions of these initiatives. Given the complexities of the country's digital transformation process, there is a notable lack of research exploring the quality outcomes and challenges associated with these strategies (Alasiri and Mohammed, 2022; Alojail and Khan, 2023). This gap is particularly relevant given the unprecedented rate of digital adoption in Saudi Arabia as the Kingdom seeks long-term self-sufficiency. The research's primary objective is to assess the effectiveness of digital transformation initiatives in improving service quality and driving economic diversification. The main hypothesis suggests that successful digital transformation correlates directly with enhanced service quality and economic diversification. Additionally, the secondary hypothesis proposes that regional and sectoral variations in digital adoption significantly influence the overall effectiveness of these initiatives. Testing these hypotheses aims to elucidate the relationship between digital transformation processes and their quality outcomes,

providing a comprehensive view of the strengths and limitations of transformative innovations aligned with the strategic goals of Vision 2030.

The significance of this study extends beyond academic discourse, offering practical insights into Saudi Arabia's strategic approach to digital transformation. A thorough examination of the Kingdom's focus on quality outcomes provides lessons adaptable to other contexts. For instance, understanding the multifaceted nature of digital transformation can benefit other nations facing similar challenges. By critically analyzing how Saudi Arabia leverages digital technologies for economic diversification, we can evaluate its capacity to improve both private and public service quality. The study emphasizes the importance of context-tailored strategies, aligning with Vision 2030's goals (Alhassan and Soui, 2021). Through this lens, the paper contributes to the broader understanding of how digital transformation can drive economic growth and societal advancement. Lastly, the research offers valuable insights for policymakers, researchers, and other stakeholders involved in the evolving field of digital transformation. The paper proceeds with a detailed literature review, followed by methodology, results, and discussion sections, culminating in an informed conclusion.

2. Literature Review

2.1 Global Trends in Digital Transformation

The global shift toward digital transformation, catalyzed by both technological advancements and socioeconomic changes, has reshaped business models and public sector services. A synthesis of the academic literature covering various regions and industries strongly suggests that digital technologies emerge at the forefront of efforts to improve operational efficiency, customer engagement, and competitive advantage (Hanelt et al., 2021). From a global perspective, leading organizations are increasingly integrating digital solutions into their operational processes. Most prominent examples of such efforts include the adoption of artificial intelligence, cloud computing, and the Internet of Things to attain optimal quality outcomes (Nadkami and Prügl, 2021; Yang et al., 2024). Wen et al. (2022) also emphasize that for international corporations digital transformation is already more of a strategic priority than a passing gimmick. Driven by the need for agility, innovation, and resilience in unpredictable economic environments, small and medium-sized companies are also actively exploring options to access and implement technologies novelties (Kraus et al., 2022). The observed trends are not limited only to wealthy developed countries as certain solutions have already shown their effectiveness in developing economies.

As a principal element of digital transformation, quality improvement is receiving heightened attention in academic discourses. According to multiple sectoral studies, the integration of digital solutions results in markedly positive outcomes in regard to service quality, operational errors, and customer satisfaction (Alasiri and Mohammed, 2022; Stroganov et al., 2021; Thekkoote, 2022). The healthcare sector is a prominent example of digital transformation being indispensable for achieving significant advancements in patient care and medical research. Specifically, Kraus et al. (2021) and Dal Mas et al. (2023) provide a contextualized overview of technologies that helped to revolutionize patient care in recent decades. Among the advancements allowing to make healthcare more personalized and efficient are telemedicine, electronic health records, AI-based

diagnostics, and many others. From another standpoint, the financial sector became almost unimaginable without such fintech innovations as digital banking (Barroso and Laborda, 2022). While the latter helps to enhance security, streamline processes, and improve customer experience, there are multiple industry-wide solutions that have positive effects on a corporate level. One of the central areas where the outcomes of digitalization are apparent almost immediately, the retail sector and e-commerce will be explored in detail in the following sections.

2.2 Digital Transformation in the Saudi Arabian Context

Saudi Arabia's Vision 2030 has led to significant advancements in e-government services, improving transparency, citizen engagement, and service delivery efficiency. Notable initiatives include online health services, education platforms, and digital identification systems that align with global trends in public sector digital governance (Alojail and Khan, 2023; Fardoust and Nabli, 2022). In turn, public and private entities operating in the country are embracing foreign experiences and investing into local solutions at a rapid pace. As further explained by Alhubaishy and Aljuhany (2021), Saudi Arabia has a unique socio-economic landscape due to its young population, high internet penetration, and government-led digital initiatives. The ground for digital innovation is also being prepared by investments incentivizing transformations of entire industries (Alshahrani et al., 2022). Nevertheless, scholarly sources report multiple challenges to the pervasive digitization of developing countries like Saudi Arabia (Moser-Plautz and Schmidthuber, 2023). While digital literacy among key stakeholders remains insufficient, there are also concerns regarding data privacy and regulatory frameworks.

To ensure the country's preparedness in the constantly evolving digital landscape, the literature points to the importance of carefully exploring local context. Namely, the authors clarify that the Saudi digital landscape's uniqueness precipitates the need for research focusing on regional challenges and opportunities (Alojail and Khan, 2023). The importance of understanding the nuanced subject is evidenced by the current lack of sectoral and city-specific studies of digital transformation in Saudi Arabia. Similarly, the current knowledge base pertaining to quality outcomes in e-commerce and retail sectors remains inadequate (Alomar et al., 2023). Although the country's bold adoption of digital technologies in government services and the private sector is commendable, these developments should be further contextualized in regard to customer satisfaction. In their studies, Hasan et al. (2024) and Zygiaris and Maamari (2023) suggest that e-government services in Saudi Arabia have significantly improved public service efficiency and transparency. Overall, several of the mentioned authors provide results supporting the practicality of introducing new technologies in the private sector but the integration of these solutions should be accomplished in accordance with cultural norms and values.

2.3 Sectoral Insights and Variations in Digital Adoption

Although the targeted search for cross-industry insight in the literature reveals the multifaceted impact of digital transformation, the data on quality outcomes in most sectors is insufficient. The global trends in healthcare are also frequently observed in Saudi Arabia as local stakeholders are actively implementing telemedicine and digital health records (Abdulaziz et al., 2023; Akinwale and AboAlsamh, 2023). The enhanced accessibility and

quality of patient care are often assumed or inferred but rarely directly studied in the scholarly literature. In the case of the Saudi finance sector, the emergence of fintech innovations and their effects on customer satisfaction mirrors observations from studies conducted in other countries. Additionally, digital banking services providing private and corporate customers with innovative financial solutions are being increasingly discussed in a positive light (Yıldırım, and Erdil, 2024). Digital technologies have reshaped public sector transparency in Saudi Arabia, enabling more accountable governance through data-driven decision-making and real-time access to government services for citizens. These advancements mirror global trends in digital governance, where efficiency, data security, and public trust are critical outcomes.

In the spheres of retail and e-commerce, Saudi Arabia is experiencing significant shifts. As noted by Abuali et al. (2024), the growth in these sectors is mainly associated with digital transformation initiatives and the consumer behaviors paradigms. Another study highlights the role of socioeconomic disruptors, such as pandemics, in popularizing digital transactions among both younger and older populations (Mahroum, 2021). Increasingly tech-oriented and digitally connected, the young demographic is embracing online shopping at an unprecedented rate, a phenomenon that catalyzes the expansion of e-commerce platforms. Based on one study, the described trend expands beyond the retail segment to further influence the broader economic patterns in the country (Al Tayyar et al., 2021). Continuously exposed to factors such as increased internet penetration and the proliferation of mobile devices, the older generation appears to be mostly receptive to the new status quo (Gull et al., 2023). On the other hand, the government is actively developing supportive policies aimed at e-commerce marketplaces and retail conglomerates to accommodate for the growth in online retail (Abuali et al., 2024). With businesses increasingly relying on digital solutions for marketing, supply chain management, and customer service, the area presents unique research opportunities. The latter is indicated by the fact that despite its growth, the sector is still prone to challenges that ultimately impact quality outcomes. Inherently related to logistics, payment security, and consumer satisfaction, most of these challenges should be carefully assessed and researched to fully realize the potential of e-commerce in Saudi Arabia.

2.4 Theoretical and Practical Implications of Digital Transformation

The cross-industry examination of the literature reveals that while Saudi Arabia is aligned with global digital transformation trends, there are unique local contexts due to the socio-cultural and economic landscapes of the Middle Eastern state. The review shows that certain sectors, such as healthcare and finance, receive considerable coverage in scholarly studies. Nevertheless, the quality element remains under-researched due to the lack of a cohesive framework and universal metrics. In this context, it is important to note that digital transformation is often praised in comparison to conventional methods, regardless of its practical significance (Thekkoote, 2022). To better understand the region's experience regarding digital transformation and quality, the subject should be assessed from multiple perspectives. Recent global trends in digital governance highlight the importance of public sector modernization, transparency, and data-driven policymaking. Saudi Arabia's Vision 2030 reflects similar objectives with its focus on e-government and digital services. As few studies provide an integrated framework for evaluating quality

outcomes across sectors, this gap underscores the need for standardized performance indicators, such as transaction success rates in finance, platform uptime in e-commerce, or patient throughput in healthcare (Aldaarmi, 2024; Al-Kahtani et al., 2022). For this reason, the current study interprets quality through context-sensitive proxies that include transaction volumes, sectoral growth rates, and correlations with broader financial variables.

As can be determined from the literature review balancing global and Saudi perspectives, there are several knowledge gaps and opportunities for further research requiring further attention. Specifically, the literature review provides a broad outline of the topic while helping to identify areas of further optimization. Judging from the relative lack of studies investigating quality outcomes of digital transformation in Saudi Arabia, it is possible to identify specific research opportunities in the rapidly evolving digital landscape. Such opportunities include a sectoral and nationwide analysis that would specifically assess the situation in retail and e-commerce, as well as other sectors. By contrasting local findings with international experiences, it would be possible to address the research gaps. As such, the literature review provides a justification for the current study with the originally chosen objectives and goals. The review not only establishes a strong foundation for the research, but also helps to situate it within the global and Saudi-specific contexts. The insights indicate that a cross-industry analysis could be crucial in furthering our understanding of the multifaceted nature of digital transformation and its implications for quality improvement. In regard to identifying and addressing the challenges and opportunities of digital transformation in Saudi Arabia, this review will form the foundation for the analytical sections of the paper.

3. Methodology

This research incorporated a mixed-methods approach, integrating quantitative data analysis with qualitative insights to thoroughly explore and assess the impact of digital transformation on quality in Saudi Arabia. Driven by the rich data obtained from the Saudi Arabian Monetary Agency (SAMA) and General Authority for Statistics (GAStat), the scholarly investigation primarily targeted reports on MADA card transactions and SADAD system payments as the main area of interest. While MADA is a type of a national debit card issued by Saudi banks, SADAD is a payment system integrated with banks and commercial entities (Ali and Salameh, 2023). With the further incorporation of sector-specific and city-specific reports, the analysis provided a holistic perspective on Saudi Arabia's digital economy. Overall, the inclusion of these datasets was integral for achieving an in-depth understanding of digital transformation's impact by assessing consumer behavior, transaction patterns, and sector-specific trends.

3.1 Data Collection and Selection Rationale

Sourced from the SAMA and GAStat databases, our datasets encompassed an extensive range of variables to comprehensively represent the digital economy in Saudi Arabia. The primary datasets included MADA cards transactional and sales data, accounting for both Point of Sale (PoS) and E-commerce transactions, with values represented in numbers of transactions and thousand Riyals, respectively. The decision to

include the number of transactions allowed us to capture the dynamic volumes of studied economic activities. Additionally, the collection of sector-specific data involved transactions and sales for the following sectors: Furniture, Hotels, Transportation, Restaurants, Health, Clothing and Footwear, Recreation and Culture, Beverage and Food, Electronic Devices, Goods and Services, Construction Materials, Jewelry, Telecommunication, Education, Public Utilities, and Others. Segmented into transactions and sales (in thousand Riyals), each sector's data provided perspectives on both volume and economic value. To further reflect regional variations within Saudi Arabia, the datasets included transactions and sales data across major cities like Jeddah, Riyadh, Dammam, Makkah, AL-Madinah, and others. City-specific data were similarly divided into transactions and sales (in thousand Riyals), as well as total terminal count to capture the extent of digital payment networks. To understand the financial background underlying digital transactions, the data collection included broader economic indicators, such as total consumer loans, total credit card loans, SADAD system payments volume, and SADAD system payments value.

Table 1: Summary of data sources and analysis methods in the study

Data Source	Dataset Description	Analysis Method
Saudi Arabian Monetary Agency (SAMA)	MADA card transactions and sales data (PoS and E-commerce), SADAD system payments value and volume, total credit card and consumer loans	Descriptive Statistics, Spearman Correlation, OLS Regression, Time-series Forecasting
General Authority for Statistics (GAStat)	Sector-specific transactions and sales, City-specific transactions and sales	ANOVA Testing
Secondary Sources (incl. literature review)	Qualitative insights for contextual and theoretical understanding	Qualitative Analysis

The study examines long-term trends in digital transaction patterns from 2019 to 2023, aligning with Saudi Arabia's broader digital economy transformation. The sample sizes for all datasets were decided based on the data availability and relevance to the research objectives. In light of the findings from the literature review, this approach provided an opportunity to explore Saudi Arabia's digital economy, including the country's various sectors, regions, and economic indicators.

3.2 Data Analysis Methods

After employing descriptive statistics to determine baseline transaction patterns, the first step of the study involved inferential analysis. Due to its suitability for non-normal distribution data, Spearman correlation analysis was specifically chosen to examine the relationships between digital transaction metrics, like MADA Cards PoS and E-commerce Sales, and financial variables, including consumer loans and credit card loans (Makowski et al., 2020). Additionally, Ordinary Least Squares (OLS) regression analysis was utilized to identify predictors of credit card loans, thereby assessing how consumer confidence and

engagement in digital transactions correlate with borrowing patterns. Preliminary diagnostic checks indicated no major violations of linear regression assumptions, and the model's overall significance and fit were evaluated using the R^2, F-statistic, and p-values. This analysis was crucial in understanding the interplay between consumer behavior and financial trends in the digital economy.

For the purposes of further studying the differential impacts of digital transformation on quality in Saudi Arabia, the methodology extended to a comprehensive deseasonalized trend analysis. In combination with Spearman correlation analysis and OLS regression, this approach offered a glimpse into the complex patterns and interdependencies between digital transactions and broader economic indicators (Skinner, 2020). Moreover, time-series forecasting was incorporated to predict future trends in PoS and E-commerce transactions. The choice to include a forecasting method was justified by the need to evaluate the prospective growth trajectories and emerging trends within the digital economy of Saudi Arabia. In turn, the results could be helpful for locating potential areas for strategic focus and future investment.

As a part of the comparative analysis of Saudi cities and sectors, the data for sixteen sectors and fourteen cities for the covered period were subjected to ANOVA tests. This step of the data analysis process was particularly significant, as it could facilitate an understanding of how digital transformation manifests differently across various geographical regions and sectors. On the other hand, the inclusion of a regional and sectoral breakdown was justified by the need to identify specific growth patterns as well as the average annual growth rates in various sectors. Apart from offering an outlook on apparent challenges, this analysis proved critical for determining which sectors are prone to experience significant growth or decline due to digital transformation and other factors.

3.3 Justification of Methodological Choices

The mixed-methods approach delineated above provided a balanced perspective, combining the objectivity of quantitative data with the depth of qualitative insights. Acknowledging the absence of unified national metrics for digital service quality assessment, we operationalized quality indirectly through sector-specific transaction patterns and financial indicators. Specifically, growth in e-commerce transactions was interpreted as a proxy for improved digital service engagement, while correlations with consumer loans indicated growing trust and system functionality. While these proxies are indirect, they align with approaches in established literature on digital performance indicators in emerging economies. Overall, the entire methodology and specific analytical methods align with the research objectives, each offering a unique perspective on digital transformation trends and quality in Saudi Arabia's retail and E-commerce. Throughout the data analysis stage, methodological rigor was maintained by adhering to the best practices of data selection, informed use of statistical techniques, and consideration of external factors. All of the methodological choices were reviewed for their potential to offer valuable insights for targeted policy and strategy development in Saudi Arabia and other countries facing similar circumstances. The statistical analyses listed above were conducted using advanced data analysis software such as SPSS and R. The choice was justified by their robust analytical capabilities that could enable comprehensive data manipulation, analysis, and visualization.

4. Results

4.1 Descriptive Analysis and Preliminary Trends

The foundational stage of the data analysis involved descriptive statistics, providing crucial insights into digital financial operations by Saudi Arabian consumers. The analyses of key variables, including MADA Cards PoS Sales and Transactions, uncovered a noteworthy consistency which reflects steadiness and robustness of PoS transactions in the country. In contrast, MADA Cards E-commerce metrics displayed comparatively lower means and medians, a sign of relatively low but growing presence of online transactions in the broader digital economy. No outliers or evident points of interest were noted during this preliminary phase that establishes a baseline for the consequent analysis of digital transaction patterns and its effect on quality. Figure 1 provides a visual depiction of the observed fluctuations and trends of the evolving digital transaction landscape in Saudi Arabia during the study period.

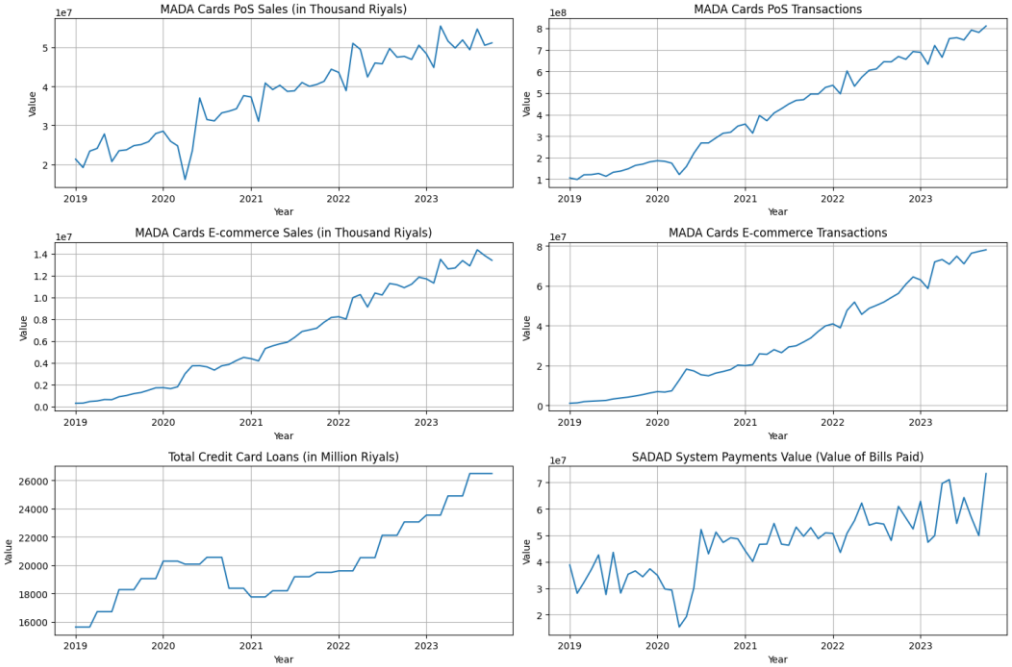

Figure 1. Time series analysis of digital transactions, credit loans, and SADAD payments value in Saudi Arabia (adapted by Author based on the SAMA dataset)

A key aspect of our analysis pertains to the pronounced variability in transaction patterns, as can be seen by high standard deviations in both PoS and E-commerce metrics. Reflective of a diverse range of consumer behaviors, this variability likely connects to the following factors: seasonal trends; market dynamics; and changing consumer preferences. This finding is further evident on the deseasonalized trend analysis and should be recognized due to its role for a broader context. Using these results for context will enable further consideration of sectors and regions requiring in-depth investigation.

Table 2. Descriptive statistics of digital transaction metrics in Saudi Arabia (adapted by Author based on the SAMA dataset)

Metric	Mean	Median	Standard Deviation	Skewness	Kurtosis	Interquartile Range
MADA Cards PoS Sales	37669699.90	39027599.00	10711095.58	-0.21	-1.19	19457532.50
MADA Cards PoS Transactions	418156308.21	417249244.50	227637081.35	0.10	-1.38	446192167.75
MADA Cards E-commerce Sales	6480477.55	5815044.00	4496255.24	0.20	-1.35	8678916.75
MADA Cards E-commerce Transactions	32436366.17	27163972.50	24907340.02	0.41	-1.15	43144390.75
Total Credit Card Loans	20314.36	19604.00	2822.58	0.67	-0.11	3819.75
SADAD System Payments Value	46477279.81	48365484.50	12131161.54	-0.24	0.17	15947813.25

Our preliminary trend analysis can yield valuable findings regarding the changing dynamics of digital transactions. Accordingly, we observed significant fluctuations in MADA Cards PoS sales and transactions in the timeframe coinciding with the onset of the pandemic. The several-months-long downward trend was followed by a period of gradual recovery. Similar observations, albeit less pronounced, were recorded for other variables. Figure 2 provides a visual representation of deseasonalized trends in MADA Cards PoS and e-commerce sales and transactions. Aligning with the scholarly evidence, these observations offer a preliminary perspective on the broader economic ramifications of the pandemic.

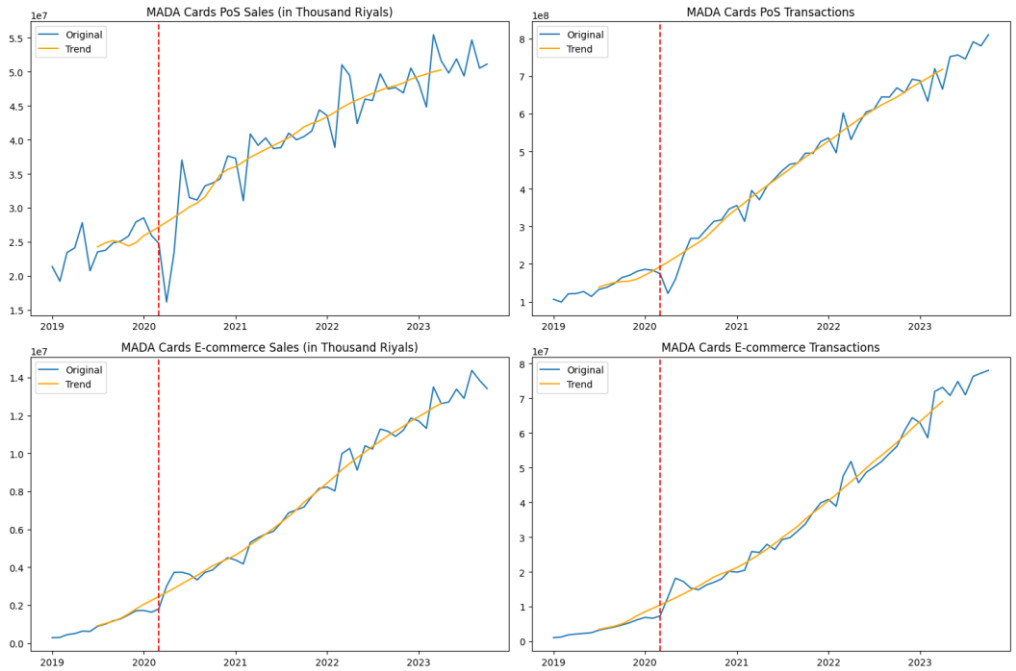

Figure 2. Deseasonalized trends in MADA Cards PoS sales and transactions with the demarcation line identifying the first COVID-19 case in Saudi Arabia (adapted by Author based on the SAMA dataset)

Offering a high-level overview, the results of descriptive statistics form the foundation for the subsequent detailed analyses. Based on the initial results, it is possible to delineate a preliminary picture of digital transactions in Saudi Arabia. This overview suggests a dynamic and evolving economic situation that responds to consumer behaviors and shifting preferences in an expected manner.

4.2 Cross-Industry Analysis

The comparative analysis of digital transaction patterns across sixteen cities in Saudi Arabia reveals significant discrepancies, with the onset of COVID-19 being an outlier. Notably, several major cities including Riyadh, Jeddah, and Dammam exhibited notable changes in sales patterns post-COVID-19. While certain locales showed an increase in digital sales due to an expected shift to online transactions during the pandemic, others did not exhibit this behavior. To visually depict these cross-city variations in digital transaction patterns, Figure 3 presents a corresponding grouped violin plot. The noted variation can be explained by the non-uniform adoption of digital payment systems as well as the different severity of the pandemic-related economic crises across the country. Fundamentally, the disparities may reflect varying levels of digital infrastructure maturity, different digital literacy and educational attainment rates, challenges pertaining to consumer access and purchasing power, and other economic as well as cultural factors shaping technology acceptance. In all cases, the evidence suggests that the onset of the pandemic emerged as a defining milestone precipitating the rise of digital transactions across various regions. A more in-depth investigation of potential confounding factors,

such as economic conditions and consumer preferences, is warranted. The highlighted results are also indicative of the need for specific digital strategies that consider requirements and capabilities of each region.

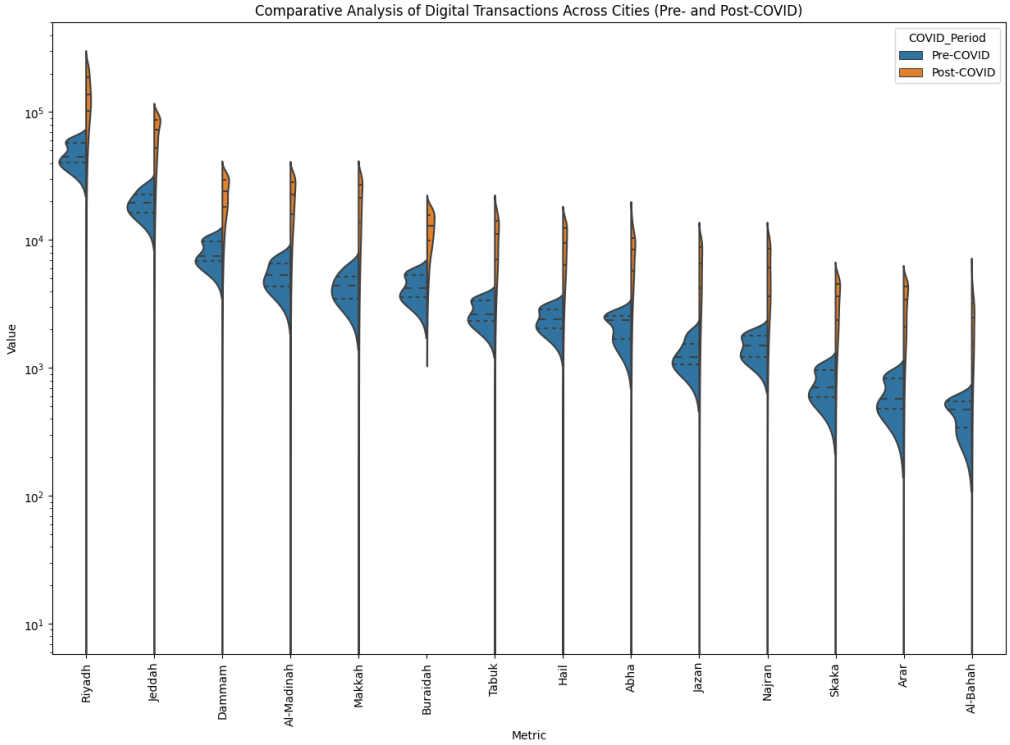

Figure 3. Grouped violin plot of comparative analysis of digital transactions across Saudi Arabian cities pre- and post-COVID-19 (adapted by Author based on the SAMA dataset)

In the post-COVID-19 period, the data shows a steady increase in the distribution of sales values for most metrics, an observation consistent with city-specific trends. The ANOVA results highlight the statistical significance of the changes in digital sales patterns pre- and post-COVID-19. These results are summarized in Table 3. Apart from suggesting an increasing variability in digital transaction patterns, these changes likely reflect the evolving consumer behavior in response to the pandemic and the differential impact of COVID-19 that has been covered in previous studies (Alessa et al., 2021; Alflayyeh et al., 2020). The widening distribution of sales values in the post-COVID-19 timeframe points to a potential long-term shift in consumer purchasing habits. When considered together with the adoption of digital technologies and quality outcomes, these implications call for new digital marketing and retail strategies. A further investigation of regional variations in response to specific policies and measures is needed to better understand how global experiences can be used in Saudi Arabia's context. Furthermore, the mentioned variability is indicative of potential market opportunities in regions that showed increased digital sales throughout the post-pandemic period.

Table 3. City-specific ANOVA results comparing digital sales pre- and post-COVID-19 in Saudi Arabian cities (adapted by the Author based on the SAMA dataset)

City	Sum of Square	Degree of Freedom	F-value	P-value	Interpretation
Riyadh	2.253302e+14	1.0	30.7711	8.185794e-07	Significant
Jeddah	5.036152e+13	1.0	37.30516	1.014539e-07	Significant
Dammam	6.486594e+12	1.0	42.576232	2.101315e-08	Significant
Al-Madinah	4.566261e+12	1.0	37.505527	9.539806e-08	Significant
Makkah	4.345478e+12	1.0	17.405397	0.000106	Significant
Buraidah	1.602522e+12	1.0	58.732864	2.769741e-10	Significant
Tabuk	1.172597e+12	1.0	47.645996	5.012523e-09	Significant
Hail	9.969574e+11	1.0	62.897833	1.004926e-10	Significant
Abha	7.176792e+11	1.0	33.16526	3.737571e-07	Significant
Jazan	5.456203e+11	1.0	56.991808	4.279521e-10	Significant
Najran	4.281921e+11	1.0	51.910145	1.587043e-09	Significant
Skaka	2.095123e+11	1.0	80.313693	2.079043e-12	Significant
Arar	1.276041e+11	1.0	95.34506	1.076714e-13	Significant
Al-Bahah	9.374384e+10	1.0	29.719627	0.000001	Significant

4.3 Sector-Specific Analysis

The study's sector-specific analysis of average annual growth rates across 16 sectors revealed pronounced variations that signify a non-uniform impact of digital transformation. Whereas certain areas like Education and Clothing and Footwear displayed consistently high growth rates, other sectors demonstrated a markedly slower growth. For high-performing areas, the data is indicative of substantial growth and adaptability to digital platforms as conveniently visualized in Figure 4. Conversely, the Healthcare industry has a considerably slower post-COVID-19 growth due to potential challenges in digital adoption or varying market demands. These contrasting trends point to the importance of individualized sector-specific digital strategies accounting for unique sectoral dynamics and consumer behaviors.

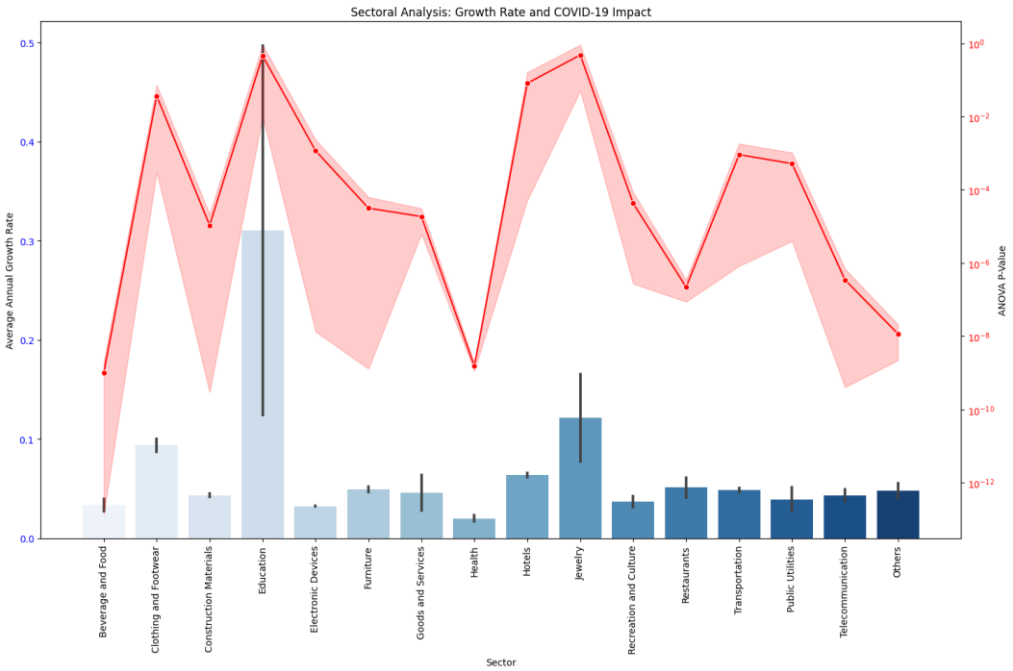

Figure 4. Sectoral analysis of growth rates and COVID-19 impact (adapted by Author based on the SAMA dataset)

The ANOVA P-Value analysis of sectoral data provides crucial insights into the pandemic's differential impact across Saudi Arabia's sectors. Specifically, digital transactions in Beverage and Food and Construction Materials sectors were significantly affected by COVID-19, as can be seen from the corresponding low p-values. From another perspective, the sales dynamics in Education and Jewelry industries are tied to higher p-values as an indicator of a less pronounced impact of the pandemic. The described variation in temporal impact necessitates resilience planning and agile adaptation strategies that would help to mitigate external disruptions like a pandemic. To further elucidate the discussed sector-specific impacts of the pandemic, Table 4 presents a detailed overview of the average annual growth rates for transactions and sales, along with the ANOVA p-values.

Table 4. Sector-specific ANOVA results comparing digital sales and transactions in Saudi Arabian sectors (adapted by Author based on the SAMA dataset)

Sector	Average Annual Growth Rate for Transactions	Average Annual Growth Rate for Sales	ANOVA P-Value
Beverage and Food	0.039481	0.027212	2.024087e-09
Clothing and Footwear	0.087419	0.100202	3.006062e-04

Construction Materials	0.041686	0.045216	2.950939e-10
Education	0.124265	0.496520	1.009809e-02
Electronic Devices	0.032551	0.032053	1.338305e-08
Furniture	0.046883	0.052000	1.286876e-09
Goods and Services	0.063813	0.027988	6.156976e-06
Healthcare	0.022955	0.017137	1.121807e-09
Hotels	0.061362	0.065925	5.131917e-05
Jewelry	0.077159	0.165809	5.033331e-02
Recreation and Culture	0.042253	0.031172	2.709658e-07
Restaurants	0.060785	0.041308	3.504654e-07
Transportation	0.046667	0.050817	8.237051e-07
Public Utilities	0.051399	0.027018	3.957290e-06
Telecommunication	0.049129	0.037042	6.932008e-07
Others	0.055266	0.040587	2.110982e-08

In regard to sectoral trends and digital adoption, the analysis supports the notion that high growth rates in certain sectors are likely attributed to increased digital adoption and evolving consumer behaviors. However, the comparatively slower growth observed in sectors such as healthcare (Table 4) post-COVID-19 suggests that beyond pandemic-related disruptions (Hesham et al., 2021), there may be underlying factors contributing to more reserved or complex digital integration. Since these could include aspects of digital resistance, regulatory complexities, or specific operational challenges inherent to the sector, the exploration of the barriers to digital transformation in such contexts presents a compelling area for future research. Overall, the presented findings show that digital transformation, together with external challenges like COVID-19, continuously shape sector-specific trends and quality outcomes. Although certain sectors promptly incorporate digital platforms in daily operations, others require strategic interventions to enhance digital integration and the resulting service quality. As such, both continuous monitoring and agile response mechanisms are needed to exploit the potential of digital transformation across diverse sectors and regions in Saudi Arabia.

4.4 Financial Implications of Digital Transactions

Our extended analysis of the data uncovered additional insights into Saudi Arabia's digital transformation. Namely, the results show that main digital transaction metrics strongly correlated with credit card loan volumes. For example, a strong correlation ($r = 0.96$) was observed between MADA Cards E-commerce and PoS sales. This correlation is potentially indicative of a symbiotic relationship across digital and physical platforms, as success in one type of transaction is coupled with success in another. The relationships between MADA Cards E-commerce sales and Total Consumer Loans ($r = 0.94$), and between MADA Cards PoS sales and Total Consumer Loans ($r = 0.91$), indicate that consumers involved in digital purchases are increasingly reliant on loans. Validating the observed relationships, the results of the OLS regression analysis are presented in Table 5. The model explains 77.4% of the variance in total credit card loans ($R^2 = 0.774$), with statistically significant coefficients for MADA E-commerce Sales ($p < 0.001$) and PoS Sales ($p = 0.001$). In contrast, the SADAD system payments variable did not exhibit statistical significance ($p = 0.456$), suggesting a weaker or indirect connection to consumer borrowing behavior. These findings reinforce the association between digital transaction volumes and evolving trends in consumer credit utilization. To represent the strength of these correlations, Figure 5 depicts a scatter plot visualization showing the interconnectedness of digital transactions and consumer credit behavior.

Table 5. OLS Regression Results for Total Credit Card Loans in Saudi Arabia (adapted by Author based on the SAMA dataset)

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Intercept	21,360.00	1,344.70	15.88	<0.001
MADA E-commerce Sales	0.0010	0.0001	7.39	<0.001
MADA PoS Sales	-0.0002	0.00007	-3.47	0.001
SADAD Payments Value	0.000021	0.00002	0.75	0.456
Note. $R^2 = 0.774$; Adjusted $R^2 = 0.762$; $F(3, 54) = 61.71$; Prob > F < 0.001; Observations = 58.				

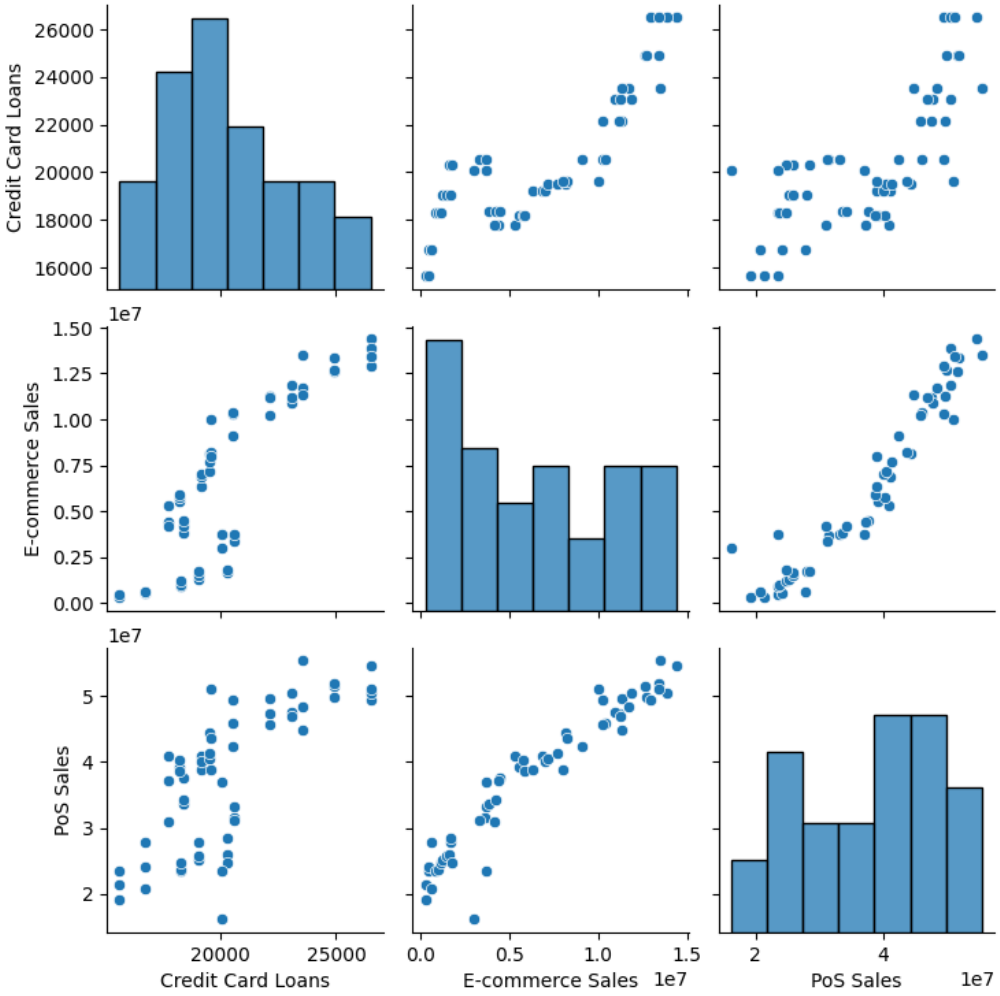

Figure 5. Scatter plot matrix showing Spearman correlation for digital transaction metrics and consumer loans in Saudi Arabia (adapted by the Author based on the SAMA dataset)

These results support the initial assessment of digital transaction data having a strong predictive value for financial forecasting. As can be seen in time-series forecasts on Figure 6, a sustained upward trend is expected for both MADA Cards PoS and E-commerce Transactions over the next 12 months. This suggests a continued shift towards a digital-centric economy in Saudi Arabia. As for SADAD system payments value and volume, they did not appear to have any significant correlation with other targeted variables. Resulting from the complex combination of data analysis methods, the findings emphasize the interconnectedness between digital transactions and financial activities that indirectly point to the quality of financial services. The correlations and trends outlined above illustrate consumer behavior in the wake of Saudi Arabia's digital transformation and quality improvements across various sectors.

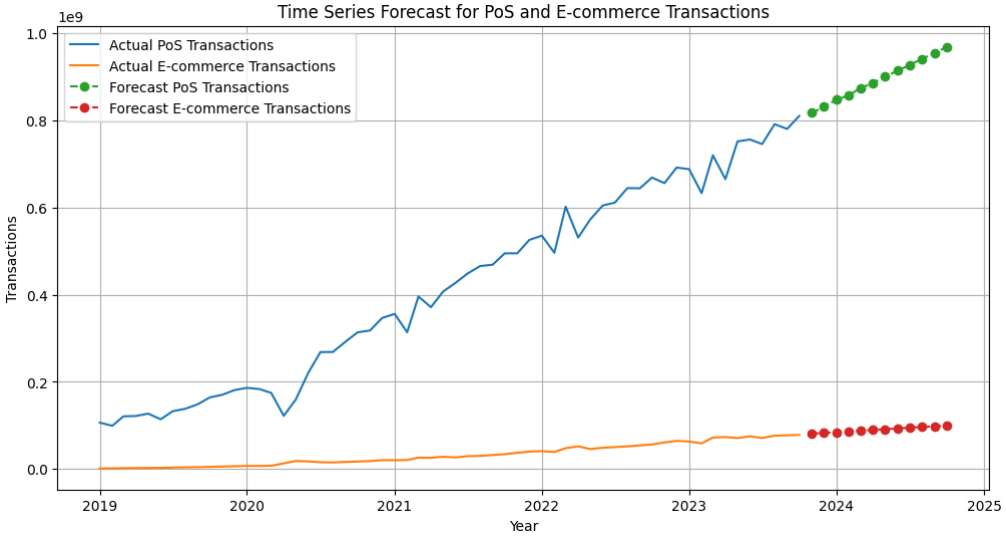

Figure 6. Time-series forecast for PoS and E-commerce transactions (adapted by Author based on the SAMA dataset)

5. Discussion

In this chapter of the study, we integrate the principal findings within the broader context of digital transformation in Saudi Arabia; a particular focus is placed on the latter's impact on sectoral quality and consumer behavior in the past five years. Resulting from a mix of quantitative data and qualitative reviews, the analysis elucidates a complex and multifaceted subject. Throughout the studied timeframe, we observed a prominent shift towards e-commerce and online transactions that became particularly pronounced in the aftermath of the COVID-19 pandemic. Our observations align with the theoretical perspectives highlighting increased digital resilience in times of crisis (Albliwi and Alsolami, 2021; Hesham et al., 2021). Most of the identified trends are also characterized by correlations between digital transactions and relevant financial indicators, such as consumer and credit card loans. This finding is reflective of a rapidly evolving Saudi economic landscape as digital platforms are becoming increasingly pertinent to both commercial and personal use cases (Jan et al., 2021). When compared to global leaders in digital governance, such as Estonia and Singapore, Saudi Arabia's digital transformation showcases promising progress in public sector efficiency, though challenges remain in terms of digital literacy and policy implementation.

The analysis of digital transaction patterns across Saudi Arabia is invaluable for improving the understanding of the nuanced impacts of digital transformation at both sectoral and regional levels. In this context, the observed regional variations in major Saudi Arabian cities reveal the involvement of specific economic conditions, consumer preferences, as well as the state of digital infrastructure development. Further contextualized through structural and sociocultural lenses, variations in digital engagement across Saudi cities may be linked to disparities in technological infrastructure, consumer education, and regional economic development. While urbanized Riyadh and Jeddah

benefit from digital penetration rates, institutional investment, and exposure to globalized service ecosystems, secondary cities may face structural obstacles due to limited access to high-speed connectivity, lower digital literacy, and more traditional consumer habits. These findings align with prior findings on digital transformation heterogeneity in emerging economies and underscore the importance of regionally adaptive strategies under Vision 2030 (Alomar et al., 2023; Gull et al., 2023). There is a need for further investigations into these dynamics through regionally disaggregated qualitative studies and policy evaluation frameworks.

Consistent with the observations of Salem and Now (2020) and Shishah and Alhelaly (2021), our results also highlight the pandemic's role as a catalyst that ultimately accelerated digital adoption in Saudi Arabia. The data echoes similar trends observed during this period in other countries (Fu and Mishra, 2022; Mansour, 2022). From another standpoint, the observed variability in digital transaction patterns can be at least partially explained by an array of factors affecting consumer behaviors including, but not limited to, seasonal trends and market dynamics. The scholarly literature mirrors these conclusions as sector-specific heterogeneity appears to be one of the features associated with digital adoption (Cirera et al., 2022; Hyytinen et al., 2022). A deeper examination of digital resistance in underperforming sectors reveals potential constraints, such as regulatory rigidity, data security, and institutional inertia that resists operational restructuring. In the case of healthcare, professionals may exhibit lower technological adoption due to risk aversion, workload concerns, or lack of digital training (Akinwale and AboAlsamh, 2023). These forms of resistance underscore the need for qualitative investigations that examine structural, behavioral, and policy-level barriers to transformation. As noted by Klein and Todesco (2021), the economic impacts of digital transformation emerge as one of the crucial elements needed for a country's economic resilience. When assessed through the lens of Saudi Arabia's Vision 2030, our findings highlight the strategic importance of developing balanced digital capabilities that account for the unique conditions in different regions and sectors. In the Saudi context, balance entails recognizing the uneven readiness of sectors and regions to adopt advanced technologies. It also involves harmonizing national-level policies with the institutional realities of service providers by ensuring that goals and execution plans remain feasible. Without mechanisms to implement actionable frameworks at subnational levels, digital reforms risk becoming aspirational rather than transformative.

The correlations observed between digital transaction activities and consumer and credit card loans provide the context necessary to enhance scholarly interpretation of consumer behavior in Saudi Arabia's digital economy. According to our results, there is a trend towards increased reliance on credit for online purchases. This is a significant development, partially supported by the existing literature (Cruz-Cárdenas et al., 2021), that adds a new layer to complex consumer behaviors in digital marketplaces. Specifically, the finding demonstrates that credit facilities play a central role in facilitating e-commerce growth. While digital economy studies mention similar broad conclusions (Dolfen et al., 2023), this aspect opens an opportunity for new investigations into the interplay between consumer credit behavior and digital transaction trends. These insights regarding the notion of consumer choices in digital environments being approached in the context of credit usage can be especially relevant to the development of policies and strategies.

Accordingly, Saudi policymakers and business leaders are recommended to rely on the obtained data when developing solutions to enhance digital integration and service quality as a part of the country's Vision 2030. All of the mentioned considerations are integral for the development of a successful national economic strategy fostering the economy's long-term growth.

5.1 Practical Implications for Policy and Business Strategies

In regard to practical implications for policy-making and business strategy development, our findings underscore the importance of robust digital infrastructure and progressive regulatory frameworks capable of supporting Saudi Arabia's growing digital economy. In the context of Vision 2030, the government's role is to create and sustain an economic framework conducive to digital transactions leading to positive quality outcomes. For the private sector, the main priority should be adapting their strategies to accommodate for the growing reliance on online transactions. Complex measures extending beyond cosmetic improvements to digital platforms should be considered. For example, retail and e-commerce companies are recommended to harmonize financial services with consumer preferences and digital behaviors. Notably, the study's insights into sector-specific trends in digital transformation provide a foundation for designing such strategies. As high growth rates in certain sectors signify promising areas for investment and development, future digital solutions can be streamlined for these industries. Conversely, historically modest growth in healthcare and other spheres can become the basis for digital adoption strategies. The array of city-specific and sectoral results is critical for businesses and policymakers seeking to effectively allocate resources to maximize the impact of digital transformation on quality and efficiency.

Achieving such objectives in practice requires a tiered approach. First, institutional readiness must be assessed and strengthened through digital skills training, legacy system audits, and adaptive governance structures. Policymakers should also focus on expanding digital literacy initiatives and ensuring robust cybersecurity frameworks across all digital platforms to sustain the progress made under Vision 2030. Second, fostering synergies between public and private sectors is essential for innovation diffusion, funding mobilization, and service interoperability. In addition, integrating AI and blockchain technologies can further enhance service delivery and operational transparency. Third, implementation must be accompanied by comprehensive evaluation systems, reliant on key performance indicators tailored to each sector, to monitor outcomes. Only through such alignment can Vision 2030's digital ambitions shape into broad-based socio-economic transformation.

5.2 Limitations and Future Research

Although the study's scope comprehensively addresses the researched subject, there are limitations that must be acknowledged for an informed consideration of its contributions and implications. Namely, the reliance on transactional data from MADA cards and SADAD system payments, as well as other incorporated variables, may not be sufficient to capture the entirety of Saudi Arabia's digital economy. While the existing data from the SAMA is robust, it does not account for other methods of digital transaction that are becoming more prevalent in the country. As the study emphasizes quantitative data

with a limited inclusion of qualitative insights, the revealed trends and correlations are not sufficiently explored in regard to their qualitative aspects. For example, the chosen study design omits consumer attitudes, cultural influences, and other qualitative impacts of digital transformation on service quality. Another major limitation is the study's focus on Saudi Arabia. Despite the research being increasingly relevant to the country's context and offering insights into this particular region, this choice potentially limits the generalizability of the findings to other geographical and socio-economic contexts.

In the given context, future studies are recommended to address these limitations and expand the understanding of digital transformation through multiple lenses. Specifically, the chosen area or interest would benefit from qualitative studies exploring consumer experiences in digital transactions via comprehensive surveys. Complementing the quantitative findings of the current research, such scientific endeavors could offer a more holistic perspective on digital transformation's quality outcomes. On the other hand, it is also recommended to expand the scope of research to include a wider variety of new and emerging digital transaction methods. To address generalizability limitations, scholars can consider conducting comparative studies involving other regions characterized by distinct socio-economic characteristics. The investigation of sectors that were not covered in this research, such as the petrochemical industry and public services, could provide further information about the impacts of digital transformation across different areas of Saudi Arabia's economy. In addition to addressing the current study's limitations, such prospective research opportunities are likely to introduce major contributions to the scholarly knowledge of digital transformation and its quality implications.

6. Conclusion

The research has systematically explored the complexities surrounding digital transformation and its impact on quality in Saudi Arabia. The study highlights Saudi Arabia's commitment to digital leadership through Vision 2030, positioning the Kingdom as a model for sectoral digital integration and economic resilience. Judging from the pronounced correlations between digital sales and financial indicators, there is a significant interdependence between digital economic activities and the broader financial landscape. Furthermore, the analysis demonstrated varying impacts and growth rates across different sectors, an observation indicative of the multifaceted nature of digital transformation. Regional analyses revealed strong differential impacts of digital transformation across Saudi Arabian cities, emphasizing the importance of carefully tailored strategies. Although the selected quantitative investigations are robust, additional insights into customer satisfaction and other indicators of quality outcomes are needed for a more complete understanding of digital transformation in Saudi Arabia. Particularly, future research should operationalize customer satisfaction through measurable indicators such as transaction speed, platform accessibility, user interface clarity, perceived trust, and responsiveness of digital services. In addition to reflecting the functional quality of digital platforms, these metrics serve as early signals of user confidence and system reliability. The adoption of standardized digital service benchmarks could further institutionalize quality assurance and inform sector-specific performance evaluations in the Saudi context.

In the chosen framework, this research makes a substantial contribution to the academic discourse on digital transformation and quality in Saudi Arabia's rapidly developing economic landscape. The results showcase the significance of digital transformation initiatives in promoting a country's economic resilience and adaptability to global disruptions. Furthermore, the uniform adoption of digital solutions in retail and e-commerce can enhance the quality of services and products across various sectors and regions. As evidenced in the discussion chapter, the findings are critical for policymakers and businesses seeking to formulate future strategies. Such strategies leveraging digital innovation can potentially optimize business operations, address consumer demands, and promote economic growth. By considering digital transformation in combination with financial variables and quality outcomes, the research provides a fresh perspective on consumer behavior in the digital age. The resulting guidance and recommendations can help to develop more effective and customer-centric digital solutions. Considering that all sectors and regions deserve equal attention when it comes to quality improvements, both regional and sector-specific analyses enrich the existing scholarly knowledge of the situation in Saudi Arabia.

As a result, this study not only expands the academic understanding of digital transformation but also provides important practical implications for the ongoing digital transformation of Saudi Arabia's economy. As the Middle Eastern state realizes the objectives stated in Vision 2030, the study's contributions are imperative for guiding digital initiatives towards greater economic diversification, improved quality of life, and sustained economic growth. This foundation can be eventually used by future research to conduct a deeper exploration of the qualitative aspects of digital transformation. Similarly, the analysis can be extended to other countries and industries. In addition to making valuable contributions to the academic literature, this scientific study serves as a guiding framework for policymakers and other stakeholders aiming to achieve optimal quality outcomes throughout their digital transformation journey.

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