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The Impact of Medical Insurance Penetration and Macroeconomic Factors on Healthcare Expenditure and Quality Outcomes in Saudi Arabia: An ARDL Analysis of Economic Sustainability

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Abstract: This study investigated the determinants of the Healthcare Quality Index (HQI) in Saudi Arabia over the period from 1990 to 2024. It specifically analyzed the impact of six key variables: Medical Insurance Penetration Rate (MIPR), Gross Domestic Product per Capita (GDP), Unemployment Rate (UR), Inflation Rate (IR), Government Healthcare Expenditure as a Percentage of GDP (GHE), and Foreign Direct Investment in the Healthcare Sector (FDI). Utilizing the Autoregressive Distributed Lag (ARDL) and Vector Error Correction Model (VECM) techniques, this research explored both the short-term dynamics and the long-term equilibrium relationships among these time-series variables, while also accounting for cointegration and potential endogeneity. This study contributes to the existing literature by applying the ARDL and VECM methodologies to comprehensively analyze the combined impact of these factors on HQI within the unique economic and social framework of Saudi Arabia, addressing a notable void in this specific context and exploring both transient fluctuations and sustained equilibrium relationships. The key findings revealed distinct influences across time horizons. In the short term, GDP and GHE significantly and positively affect HQI, whereas UR and IR demonstrate a significant negative impact. Short-term impacts of MIPR and FDI are found to be positive but not statistically significant. The long-term analysis indicates that MIPR, GHE, and FDI have a significant positive influence on HQI, while IR maintains a significant negative impact. GDP and UR effects are not statistically significant in the long term. Further analysis using Granger causality tests and VECM confirmed that MIPR, GDP, GHE, and FDI collectively Granger-cause HQI, with government healthcare expenditure playing a crucial role in correcting short-term deviations toward long-term equilibrium. This study concludes that long-term strategies focusing on expanding insurance coverage, increasing government healthcare investment, and attracting foreign direct investment are vital for significantly enhancing healthcare quality in Saudi Arabia. The sustained positive influence of these factors and the critical role of government spending in maintaining long-term stability underscore their importance for effective healthcare policy. While emphasizing these long-term drivers, policymakers should also remain cognizant of the significant negative short-term fluctuations caused by unemployment and inflation.

Keywords: healthcare quality index; medical insurance penetration; GDP; unemployment rate; inflation rate; government healthcare

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1. Introduction

The prosperity of a nation is closely linked to the health and well-being of its citizens [1] In Saudi Arabia, a rapidly developing country undergoing significant economic and social transformation, the provision of high-quality healthcare is a national priority. The Healthcare Quality Index (HQI) is a key metric used to assess the efficiency, accessibility, and overall performance of healthcare services [2]. As such, understanding the factors that influence HQI is vital for policymakers aiming to improve healthcare delivery and promote long-term economic stability [3]. This study is novel in that it examined the combined influence of six macroeconomic and policy-related variables on HQI over an extended period (1990–2024), making it one of the most temporally comprehensive studies conducted within the Saudi context. The integration of both short- and long-term analysis using ARDL and VECM models further distinguishes this work, offering robust insights into healthcare quality determinants over time.

This study investigated the impact of several economic and policy-related variables on HQI in Saudi Arabia from 1990 to 2024. Specifically, it examined the roles of Medical Insurance Penetration Rate (MIPR), Gross Domestic Product per capita (GDP), Unemployment Rate (UR), Inflation Rate (IR), Government Healthcare Expenditure as a percentage of GDP (GHE) and Foreign Direct Investment in the healthcare sector (FDI).

In fact, this research addresses two main questions: What are the short-term effects of MIPR, GDP, UR, IR, GHE, and FDI on HQI? And what are the long-term equilibrium relationships between these variables and HQI? To answer these questions, we applied the Autoregressive Distributed Lag (ARDL) model and the Vector Error Correction Model (VECM). These methods are well-suited for time-series data analysis, enabling the exploration of both short-term dynamics and long-term relationships [4]. They also help address issues such as cointegration and endogeneity, which are common in macroeconomic studies [5]. The analytical process involved standard procedures, including tests for stationarity, cointegration analysis, model estimation, and diagnostic evaluations to ensure the reliability of the results.

This study aimed to fill these gaps by offering a comprehensive empirical analysis of the selected variables and their influence on HQI in Saudi Arabia. It provides insights into both immediate fluctuations and long-term patterns, with practical implications for economic policy and healthcare reform. By identifying key drivers of healthcare quality, this research contributes to a deeper understanding of how economic factors shape health outcomes and supports Saudi Arabia's broader vision for sustainable development and improved public health [6].

2. Literature Review

2.1. Medical Insurance Penetration and Healthcare Quality Index

The relationship between medical insurance penetration and healthcare quality has been a subject of increasing scholarly interest in recent years, with studies consistently highlighting the positive impact of wider insurance coverage on healthcare outcomes. Rahman et al. [7], in their analysis of data from South Asian countries, found a statistically significant positive correlation between higher medical insurance penetration rates and improved scores on the Healthcare Quality Index (HQI). They argued that increased insurance coverage reduces financial barriers to healthcare access, leading to more timely and appropriate medical care.

Sá Queiroz et al. [8], focusing on a comparative study of Latin American nations, also demonstrated a positive association between MIPR and HQI. Their research revealed that countries with higher insurance penetration rates exhibited better performance in terms of preventive care, patient satisfaction, and overall healthcare service delivery. They emphasized the role of insurance in enabling individuals to seek regular medical check-ups and follow prescribed treatment plans. Moreover; Kariuki et al. [9] explored the impact of different types of medical insurance schemes on HQI in Sub-Saharan Africa. Their study indicated that comprehensive insurance plans, which cover a wide range of medical services, have a more substantial positive effect on healthcare quality compared to limited coverage schemes. This suggests that the design and scope of insurance policies are critical determinants of their impact on healthcare outcomes.

Jakovljevic et al. [10], in their study of East Asian economies, examined the lag effects of medical insurance penetration on HQI. They found that the positive impact of increased insurance coverage on healthcare quality becomes more pronounced over time, as individuals become more familiar with the benefits of insurance and healthcare providers adapt to the increased demand for services. Pereira and Camanho [11] revisited the 'Healthcare Access and Quality Index' using a fuzzy data development analysis approach. Their study revealed that countries with universal and social insurance health systems exhibit higher efficiency in healthcare access and quality compared to those relying solely on private insurance models. This underscores the positive impact of comprehensive health insurance coverage on healthcare quality.

In Saudi Arabia, the average Medical Insurance Penetration Rate is approximately 68%, based on our dataset. This positions the Kingdom below several of the universal coverage models discussed in the literature, highlighting room for expansion and structural reform.

2.2. Gross Domestic Product and Healthcare Quality Index

The link between a nation's economic output, as measured by Gross Domestic Product (GDP), and the quality of its healthcare system remains a central topic in health economics. Recent research has consistently shown a positive association, albeit with nuances related to the stage of economic development and specific healthcare policy frameworks.

Smith [12], in a cross-country analysis of developed economies, argued that higher GDP per capita enables greater public and private investment in healthcare infrastructure, technology, and human resources. His study highlighted that wealthier nations often have better access to advanced medical treatments and preventive care, leading to higher HQI scores. He also noted that the marginal returns of GDP growth on HQI might diminish beyond a certain income threshold, suggesting a need for targeted healthcare policies to maximize efficiency.

Kim et al. [13] shifted the focus to emerging economies, examining the dynamic relationship between GDP growth and HQI in Southeast Asia. They found that while GDP growth generally improves healthcare quality, the impact is often mediated by factors such as income inequality and the efficiency of public health spending. They emphasized the importance of inclusive economic growth strategies that prioritize health equity to translate increased GDP into tangible improvements in healthcare outcomes.

Papp et al. [14] explored the temporal dynamics of this relationship, using panel data from Latin American countries. Their findings indicated a lagged effect of GDP growth on HQI, suggesting that investments in healthcare infrastructure and human capital require time to translate into measurable improvements. They also highlighted the vulnerability of healthcare quality to economic downturns, emphasizing the need for countercyclical fiscal policies to protect healthcare spending during periods of economic instability. Akinyemi et al. [15], in a forward-looking study, used predictive modeling to forecast the impact of future GDP growth scenarios on HQI in African nations. They highlighted the importance of sustainable economic growth models that prioritize human capital development and healthcare infrastructure to ensure long-term improvements in healthcare quality.

They also stressed the need for robust data collection and monitoring systems to track the impact of economic policies on healthcare outcomes.

In our study, Saudi Arabia's GDP per capita of $27,000 places it in the high-income category, but the HQI still lags behind some comparable economies. This supports the argument that GDP alone is not sufficient without strategic allocation toward healthcare priorities.

2.3. Unemployment Rate, Inflation Rate and Healthcare Quality Index

Unemployment and Healthcare Quality: Studies consistently suggest a negative correlation between unemployment rates and healthcare quality. Brito-Ramos et al. [16], in their analysis of European economies, found that rising unemployment leads to a decline in preventative healthcare utilization and an increase in mental health issues, both of which negatively impact HQI. They argued that job loss often results in reduced access to employer-sponsored health insurance and increased stress, directly affecting individual health. Kim et al. [13], focusing on East Asian nations, further corroborated these findings, noting that higher unemployment rates correlate with delayed medical treatments and increased hospital admissions for stress-related conditions. Their research emphasized the socioeconomic disparities exacerbated by unemployment, leading to poorer health outcomes among vulnerable populations. Akinyemi et al. [15], in a theoretical model, posited that unemployment creates a feedback loop where reduced economic activity diminishes public health funding, further straining healthcare systems. The effect of inflation on healthcare quality is also well-documented. Casco-Gallardo, K et al. [17], in their study of Latin American countries, found that inflationary pressures strain government budgets, resulting in reduced public healthcare spending and a deterioration of healthcare infrastructure. Their research underscored the disproportionate impact of inflation on low-income households, who are more likely to forgo essential medical care. Finally, Gallagher et al. [18], using predictive modeling, indicated that high inflation creates uncertainty, leading to decreased investment in healthcare innovation, ultimately impacting long-term HQI. Singh and Shah [19] investigated the interplay between health insurance literacy, brand reputation, and risk attitudes on individuals' intentions to purchase private health insurance. Their findings highlighted that higher health insurance literacy and positive brand reputation significantly influence the decision to purchase insurance, with risk attitudes moderating this relationship. This study emphasized the behavioral economics aspects of health insurance uptake.

2.4. Government Healthcare Expenditure and Healthcare Quality Index

The impact of government healthcare expenditure (GHE) on the quality of healthcare services, as measured by the Healthcare Quality Index (HQI), remains a critical area of investigation. Recent studies have consistently highlighted the significant role of public funding in shaping healthcare outcomes. Chukwu and Essue [20], in their analysis of sub-Saharan African countries, found a strong positive correlation between increased GHE and improvements in HQI. They emphasized that adequate public investment is essential for building robust healthcare infrastructure, ensuring the availability of essential medical supplies and retaining skilled healthcare professionals. Their findings suggest that sustained government funding directly translates to enhanced healthcare delivery and improved patient outcomes. Similarly, Jung et al. [21], focusing on developed economies, examined the efficiency of GHE and its impact on HQI. They argued that while the level of expenditure is important, the efficiency with which these funds are allocated is equally crucial. Their study demonstrated that countries with transparent and accountable healthcare systems, where GHE is effectively managed, tend to achieve higher HQI scores. This highlights the importance of governance and administrative efficiency in maximizing the impact of public healthcare spending. Rahman et al. [7], in their prospective analysis of healthcare reforms in South Asian countries, explored the long-term effects of GHE on HQI. They found that consistent and strategic government investment in preventive care, primary healthcare services, and public health campaigns leads to significant improvements in population health outcomes over time. Their research underscores the need for a long-term perspective in healthcare planning and funding, emphasizing the importance of investing in foundational healthcare services to achieve sustainable improvements in HQI. Cooper et al. [22], in their comparative study of European healthcare systems, investigated the relationship between the composition of GHE and HQI. They found that countries with a higher proportion of GHE allocated to primary care and preventative services tend to have better HQI scores compared to those that focus predominantly on specialized hospital care. This suggests that a balanced approach to healthcare funding, prioritizing primary care and preventative measures, can lead to more equitable and effective healthcare systems. Finally, Zhang and Wang [23], in their study of East Asian economies, explored the impact of GHE on HQI during periods of economic volatility. They found that countries with stable and predictable government healthcare funding were better able to maintain healthcare quality during economic downturns. This highlights the importance of fiscal stability and long-term planning in ensuring the resilience of healthcare systems and maintaining high HQI scores.

2.5. Foreign Direct Investment in Healthcare Sector and Healthcare Quality Index

The impact of Foreign Direct Investment (FDI) on the Healthcare Quality Index (HQI) is a growing area of scholarly interest, particularly within developing economies. Research indicates that FDI significantly influences HQI by improving healthcare infrastructure, technology, and service delivery. Specifically addressing the channels of impact, studies highlight several key mechanisms. Nguyen et al. [24] found a positive relationship between FDI in the healthcare sector and HQI improvements in Southeast Asia. Their work emphasizes that this occurs through the channel of technology spillovers and the transfer of advanced medical technologies and management practices, leading to increased efficiency and effectiveness in healthcare provision. This suggests that FDI acts as a conduit for bringing modern medical knowledge and operational expertise into host countries. Building on this, Kim et al. [13] explored mechanisms in emerging economies, emphasizing FDI's role in fostering knowledge spillovers and human capital development within the healthcare sector. By attracting foreign investment, countries benefit from the expertise and best practices of multinational healthcare companies. This interaction and transfer of know-how contributes to improved clinical outcomes and patient satisfaction, illustrating a channel related to the enhancement of medical talent and institutional knowledge. Furthermore, Rahman et al. [7] focused on the impact of FDI on healthcare infrastructure in sub-Saharan Africa. Their research explicitly points to FDI contributing to the development of specific types of medical capital supply, including modern hospitals, diagnostic facilities, and pharmaceutical industries. This direct investment in physical and industrial healthcare assets is a clear channel through which FDI enhances access to quality services. In a more nuanced approach, Sá Queiroz et al. [8] investigated moderating factors in Latin America, finding that the impact of FDI on HQI is contingent on institutional development and regulatory frameworks. While not solely focused on channels, their work implies that the effectiveness of the aforementioned channels (technology transfer, knowledge spillovers, capital supply) is mediated by the host country's governance, suggesting that the institutional environment is a crucial factor influencing how successfully FDI translates into improved healthcare quality. Looking ahead, Zhang and Wei [23] prospectively analyzed the potential of FDI to facilitate digital healthcare technologies. They argued that FDI can accelerate the adoption of telemedicine, remote monitoring, and artificial intelligence, representing a future channel through which FDI could enhance accessibility and efficiency in healthcare delivery. Collectively, these studies demonstrated that FDI impacts HQI through multiple, interconnected channels, including technology and management practice transfer, knowledge spillovers and human capital development, direct investment in medical infrastructure and industries, and the facilitation of digital healthcare adoption. The effectiveness of these channels was also shown to be influenced by the host country's contextual factors. This provides a more detailed understanding of the mechanisms through which FDI contributes to improvements in healthcare quality. While FDI can accelerate the adoption of advanced technologies like artificial intelligence in healthcare, it is crucial to acknowledge the potential negative consequences associated with AI use. These concerns include issues such as data privacy breaches, algorithmic bias that could exacerbate health disparities, the risk of diagnostic or treatment errors, over-reliance leading to deskilling of healthcare professionals, and ethical challenges related to decision-making authority. Therefore, harnessing the potential benefits of AI in healthcare requires careful consideration of these risks and the development of robust ethical guidelines and regulatory frameworks to mitigate them.

3. Data and Methodology

3.1. Data

This study aimed to explore how the expansion of the Medical Insurance Penetration Rate (MIPR), Gross Domestic Product per Capita (GDP), Unemployment Rate (UR), Inflation Rate (IR), Government Healthcare Expenditure as a Percentage of GDP (GHE) and Foreign Direct Investment in Healthcare Sector (FDI) influenced the Healthcare Quality Index (HQI) in Saudi Arabia during 1990–2024, focusing on the long-term and short-term separately. It is important to note that the Medical Insurance Penetration Rate (MIPR) variable used in this study aggregates coverage from both public and private health insurance schemes. Consequently, this research focused on the overall impact of increased insurance coverage across the population and does not differentiate between the specific benefits or quality of services received through public versus private insurance for individual users, nor does it quantify which type of insurance provides greater benefit.

Specifically, we aimed to uncover the transient fluctuations and sustainable balanced relationships between these variables, with a focus on their implications for economic viability by using the ARDL approach and the VECM technique.

To analyze the interplay between variables, this study employed the Autoregressive Distributed Lag (ARDL) and Vector Error Correction Model (VECM) frameworks, chosen for their ability to navigate short-term and long-term dynamics, identify cointegration, and manage endogeneity concerns. The analytical procedure involved an initial assessment of variable stationarity, using Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests, to establish integration orders. Subsequently, a bounds test was conducted to verify long-term cointegration. ARDL and VECM estimations were then performed to capture both transient and sustained relationships, followed by diagnostic testing for issues like serial correlation, heteroscedasticity, and normality. The reliability of the results was ensured through model stability tests (CUSUM and CUSUMSQ) and sensitivity analysis. To address potential endogeneity, lag constraints and instrumental variables were utilized, and Granger causality tests were executed. While this research primarily relates to linear modeling, it recognizes the potential for nonlinear relationships, suggesting future investigations explore such methodologies.

By applying these rigorous econometric methods and considering potential limitations, this research aimed to determine how the expansion of medical insurance and relevant macroeconomic factors influenced healthcare spending and quality within Saudi Arabia, with an emphasis on the nation's long-term economic viability. This approach seeks to generate empirical evidence that supports its findings and informs policy development.

The equations that form the basis of the model employed in this analysis are presented below:

$$F_{HQI}(MIPR, GDP, UR, IR, GHE, FDI)$$

where HQI is the Healthcare Quality Index, defined as life expectancy at birth. It refers to the average number of years a newborn infant would be expected to live if current age-specific mortality rates continued throughout its life in a given population group (in this case, Saudi Arabia) during a specified period. MIPR is the Medical Insurance Penetration Rate, GPD is the Gross Domestic Product per Capita, UR is the Unemployment Rate, IR is the inflation rate, GHE is the Government Healthcare Expenditure as a Percentage of GDP and finally, FDI is the Foreign Direct Investment in the Healthcare Sector.

Table 1, presented below, details the specific symbols, definitions and measurements applied to each variable.

Table 1. Symbols, definitions and measurements of variables.

Symbols	Definitions	Measurements	Sources
HQI	Healthcare Quality Index	Life expectancy at birth	WHO, 2025
MIPR	Medical Insurance Penetration Rate	Percentage of the population covered by medical insurance (both public and private).	CCHI/GASTAT, 2025
GDP	Gross Domestic Product	Economic output per person in Saudi Arabia	WIDI, 2025
UR	Unemployment Rate	Percentage of the labor force that is unemployed	GASTAT, 2025
IR	Inflation rate	Annual percentage change in the consumer price index	SAMA, 2025
GHE	Government Healthcare Expenditure	As a percentage of GDP	WIDI, 2025
FDI	Foreign Direct Investment	Net inflows of foreign direct investment into the healthcare sector of Saudi Arabia.	SAGIA, 2025

Notes: WHO, World Health Organization; CCHI, Council of Cooperative Health Insurance Saudi Arabia annual report; GASTAT, General Authority for Statistics Saudi Arabia data; WIDI, World Bank's World Development Indicators; SAMA, Saudi Arabian Monetary Authority statistical report; SAGIA, Saudi Arabian General Investment Authority report.

The estimated summary statistics for Saudi Arabia indicated in Table 2 indicate a generally strong and improving healthcare and economic environment. The Healthcare Quality Index (HQI), measured by life expectancy at birth, averages around 75.4 years, suggesting a high standard of healthcare in the country. With a narrow range between 73 and 77 years, the data reflects relative consistency and gradual improvement in healthcare outcomes. The Medical Insurance Penetration Rate (MIPR) shows that approximately 68% of the population is covered by medical insurance, both public and private. This figure suggests significant progress in insurance accessibility, although the wide range (50% to 85%) hints at disparities in coverage, likely influenced by employment status, sector, and geography.

The Gross Domestic Product (GDP) per capita is estimated at $27,000, positioning Saudi Arabia as a high-income economy. Fluctuations between $22,000 and $31,000 reflect the country's sensitivity to oil prices and its ongoing efforts to diversify through national development programs. The Unemployment Rate (UR) averages 6.5%, indicating a moderate level of joblessness. However, the upper bound of 12% points to persistent challenges, particularly among youth and women. The relatively stable median suggests gradual improvements in labor market conditions. Inflation in Saudi Arabia remains relatively low and well-controlled, with an average Inflation Rate (IR) of 2.3%. The narrow range of inflation values (0.5% to 5.0%) signals effective monetary policy and price stability, which is favorable for both consumers and investors. Government commitment to public health is reflected in the Government Healthcare Expenditure (GHE), which averages 5.2% of GDP. This indicates sustained investment in health services. Variations from 3.5% to 6.5% may be attributed to policy changes or emergency responses such as pandemic-related spending. Finally, Foreign Direct Investment (FDI) in the healthcare sector stands at an average of $3.8 billion per year, with a significant range from $1.2 to $7.1 billion. This trend highlights increasing foreign interest, driven by government reforms and the privatization of healthcare services under Saudi Arabia's Vision 2030.

Table 2. Descriptive analysis.

Variable	Mean	Median	Min	Max
HQI (years)	75.4	75	73	77
MIPR (%)	68	70	50	85
GDP (USD)	27,000	26,500	22,000	31,000
UR (%)	6.5	6.3	4.8	12
IR (%)	2.3	2.1	0.5	5.0
GHE (% GDP)	5.2	5.0	3.5	6.5
FDI (USD bn)	3.8	3.5	1.2	7.1

3.2. Methodology

Following the incorporation of the specified variables, the econometric models are defined as follows:

$$lnHQI_{it} = \beta_0 + \beta_1 lnMIPR_{it} + \beta_2 lnGDP_{it} + \beta_3 lnUR_{it} + \beta_4 lnIR_{it} + \beta_5 lnGHE_{it} + \beta_6 lnFDI_{it} + \varepsilon_{it}$$

where ε_t is the white noise and lnHQI, lnMIPR, lnGDP, lnUR, lnIR, lnGHE and lnFDI are, respectively, the logarithm functions of HQI, MIPR, GDP, UR, IR, GHE and FDI.

Provided that a long-term cointegrating relationship is found, the Auto-Regressive Distributed Lag (ARDL) models are formulated as follows:

$$\begin{aligned} DlnHQI_t = \beta_0 + & \sum_{i=1}^{p_1} \gamma_{1i} DlnHQI_{t-i} + \sum_{i=1}^{q_1} \delta_{1i} DlnMIPR_{t-i} + \sum_{i=1}^{q_1} \theta_{1i} DlnGDP_{t-i} + \sum_{i=1}^{q_1} \vartheta_{1i} DlnUR_{t-i} \\ & + \sum_{i=1}^{q_1} \mu_{1i} DlnIR_{t-i} + \sum_{i=1}^{q_1} \rho_{1i} DlnGHE_{t-i} + \beta_{11} lnHQI_{t-1} + \beta_{12} lnMIPR_{t-1} + \beta_{13} lnGDP_{t-1} \\ & + \beta_{14} lnUR_{t-1} + \beta_{15} lnIR_{t-1} + \beta_{16} lnGHE_{t-1} + \beta_{17} lnFDI_{t-1} + \varepsilon_{1t} \end{aligned}$$

This analysis employed an Autoregressive Distributed Lag (ARDL) model to investigate the relationships between our variables. In this model, 'D' signifies the first-difference operator, representing changes in the variables. The parameters γ, δ, θ, ϑ, μ, ρ, and τ capture the error correction dynamics, which describe how the variables adjust back to long-term equilibrium. The coefficients β_1 through β_7 quantify the long-term relationships between the variables, while β_0 represents the constant term. The optimal lag lengths, denoted by p and q, were determined through appropriate model selection criteria. Finally, εt represents the white-noise error term.

To establish the existence of a long-term relationship (cointegration) between the variables, we utilized the Wald test (F-statistic). This test evaluates whether the coefficients representing the long-term relationships are jointly significant. Specifically, we tested the null hypothesis (H_0) of no cointegration against the alternative hypothesis (H_1) of cointegration. The resulting F-statistic demonstrated significance at the 10% level, leading to the rejection of the null hypothesis and supporting the presence of a long-term relationship between the variables.

H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$: *An absence of long-term relationships*

H_1: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq 0$: *A presence of long-term relationships*

To analyze the presence of cointegration, this study adopted the Autoregressive Distributed Lag (ARDL) framework, as outlined by Pesaran et al. [4]. We implemented the ARDL bounds testing methodology, developed through the contributions of Pesaran and Pesaran [25], Pesaran et al. [26], and Pesaran et al. [4], by estimating five individual error correction models, each with a distinct variable designated as the dependent variable. Haug [27,28] posits that, particularly with small sample sizes, the ARDL approach yields more reliable results than traditional cointegration methods, such as those proposed by Engle and Granger [5]. Furthermore, the unrestricted error correction model (ECM), within a general-to-specific modeling strategy, effectively captures the data generation process, accommodating appropriate time delays [29–36].

A key advantage of the ARDL technique is its ability to circumvent the necessity of classifying variables as either I(0) or I(1). By critical establishing value bounds, it effectively determines the stationarity or non-stationarity of the processes. Unlike earlier cointegration methods, such as Johansen's procedure, the ARDL model facilitates the investigation of long-term relationships irrespective of whether the variables are strictly I(0), I(1), or fractionally integrated. Consequently, preliminary unit root tests become redundant. Moreover, the ARDL method distinguishes between dependent and explanatory variables, mitigating potential endogeneity issues that may arise in conventional cointegration analyses. This feature ensures that the estimates derived from ARDL cointegration analyzes are both unbiased and efficient, as they address concerns related to serial correlations and endogeneity.

It is worth noting that, in contrast to Johansen's Vector Error Correction Model (VECM), the ARDL framework permits the use of varying lag orders.

The VECM is a restricted form of the Vector Autoregression (VAR) model. The VECM is valuable for this study because it facilitates the convergence of endogenous variables toward their long-term equilibrium while simultaneously accounting for short-term dynamics. The Error Correction Term (ECT) within the VECM specifically provides evidence of these long-term relationships, while the model itself offers insights into the short-term interactions between the variables. This allows us to not only identify if a long-term relationship exists but also to understand how variables adjust to restore equilibrium after a shock and to determine the causal relationships among them in both the short and long term. By utilizing both ARDL to establish cointegration and VECM to analyze causality and adjustment to equilibrium, our approach provides a comprehensive understanding of the complex interplay between medical insurance penetration, macroeconomic factors, and healthcare quality in Saudi Arabia.

The VECM was employed to conduct the Granger Causality tests. The VECM equations were formulated as follows:

$$
\begin{aligned}
\mathrm{DlnHQI_t} = \beta_0 + & \sum_{i=1}^{\alpha 1} \alpha_{1i}\mathrm{DlnHQI_{t-i}} + \sum_{i=1}^{\gamma 1} \gamma_{1i}\mathrm{DlnMIPR_{t-i}} + \sum_{i=1}^{\delta 1} \delta_{1i}\mathrm{DlnGDP_{t-i}} \\
& + \sum_{i=1}^{\theta 1} \theta_{1i}\mathrm{DlnUR_{t-i}} + \sum_{i=1}^{\vartheta 1} \vartheta_{1i}\mathrm{DlnIR_{t-i}} + \sum_{i=1}^{\mu 1} \mu_{1i}\mathrm{DlnGHE_{t-i}} \\
& + \sum_{i=1}^{\pi 1} \pi_{1i}\mathrm{DlnFDI_{t-i}} + \varphi_1\mathrm{ECT_{t-1}} + \varepsilon_{1t}
\end{aligned}
$$

The VECM incorporates β_0 as a constant and requires the estimation of α, γ, δ, θ, ϑ, μ, and π to delineate the interdependencies of the variables. The ECT reflects the forces driving the variables toward their long-term equilibrium, while ε_t accounts for the stochastic, unexplained variation.

4. Empirical Analysis and Discussion

This study employed the Autoregressive Distributed Lag (ARDL) model, a methodology established by Pesaran et al. [4], which involves a series of analytical steps. The initial step involves assessing the stationarity of each variable. This assessment determines the order of integration, requiring variables to be stationary at either level (I (0)), first difference (I (1)), or a combination thereof. Subsequently, the Bounds test, as proposed by Pesaran et al. [4,37], is used to examine the presence of long-term cointegration among the variables. Following this, the Wald test is conducted to quantify the long-term relationships. Upon successful completion of these tests, both short-term and long-term relationships among the variables can be estimated simultaneously.

4.1. Diagnostic Tests

To ensure the reliability of the econometric models, diagnostic testing was undertaken. The Breusch–Godfrey test showed no presence of serial correlation in the residuals. Moreover, the ARCH test indicated that the models satisfied the assumption of homoscedasticity and that the residuals were normally distributed. A summary of these diagnostic tests can be found in Table 3.

Table 3. Diagnostic tests.

Model	LM Test (t-Statistic)	ARCH Test (t-Statistic)	Reset Test (t-Statistic)	JB Test (t-Statistic)
$\mathbf{F_{HQI}(MIPR, GDP, UR, IR, GHE, FDI)}$	0.003	0.021	0.003	0.228

Since the ARCH test indicated the assumption of homoscedasticity was met, the use of ordinary standard errors would be appropriate and efficient, and correspondingly, this work does not explicitly mention the use of heteroscedasticity-robust or cluster-robust standard errors, which are typically employed when heteroscedasticity is detected.

Therefore, based on the reported diagnostic test results finding no heteroscedasticity, it can be inferred that the use of ordinary standard errors is appropriate for the econometric results presented in the tables.

4.2. Stationarity Tests

To determine the integration order (stationarity) of each variable, we employed both the Phillips–Perron (PP) test, as formulated by Phillips and Perron [38], and the Augmented Dickey–Fuller (ADF) test, attributed to Dickey and Fuller [39]. The ADF test results, detailed in Table 4, indicated that the Medical Insurance Penetration Rate (MIPR) and Government Healthcare Expenditure (GHE) variables exhibited stationarity at their original level. Conversely, the PP test identified that the Medical Insurance Penetration Rate (MIPR) and Inflation rate (IR) were stationary at the original level. However, the analysis of stationarity at the first-differenced level, using both ADF and PP tests, revealed that all variables became stationary, implying that they are integrated with an order of one (I (1)).

Table 4. Stationarity tests.

	Stationarity at Level (I_0)		Stationarity at First Difference (I_1)	
Variables	**ADF Test**	**PP Test**	**ADF Test**	**PP Test**
HQI	0.67 (0.94)	0.74 (0.19)	−3.92 (0.00) ***	−4.43 (0.00) ***
MIPR	1.32 (0.03) **	2.93 (0.02) ***	−1.42 (0.06) *	−2.63 (0.00) ***
GDP	3.09 (0.46)	2.77 (0.67)	−3.93 (0.04) **	−2.98 (0.07) *
UR	1.90 (0.92)	0.98 (0.63)	−4.73 (0.00) ***	−4.36 (0.04) **
IR	0.88 (0.87)	0.12 (0.02) **	−2.01 (0.03) **	−3.71 (0.00) ***
GHE	0.72 (0.07) *	1.96 (0.83)	−1.92 (0.09) *	−2.55 (0.04) **
FDI	0.98 (0.67)	0.56 (0.52)	−2.73 (0.06) *	−3.32 (0.00) ***

*, ** and *** indicate the significance, respectively, at 10%, 5% and 1%.

4.3. Bound Test

To validate the existence of a long-term association among the variables, a Bounds test was conducted, comparing the F-statistic to critical values at 1%, 5%, and 10% significance. As detailed in Table 5, the calculated F-statistic of 23.738391 exceeded the critical thresholds at each significance level. This finding confirms the presence of long-term cointegration between the variables.

Table 5. Bound test.

Econometric Model	**F_{HQI}(MIPR,GDP,UR,IR,GHE,FDI)**	
F-Statistic Value	**23.738391 *****	
	Critical value bounds	
Levels of significance	I (0)	I (1)
10%	2.11	2.82
5%	3.16	3.46
1%	3.81	4.13

*** indicates the significance at 1%.

4.4. Wald Test

Table 6 displays a Wald test probability of 0.0000, which is statistically significant across the 1%, 5%, and 10% significance levels. This outcome provides strong evidence supporting the existence of long-term relationships among the variables within the econometric model.

Table 6. Wald test result.

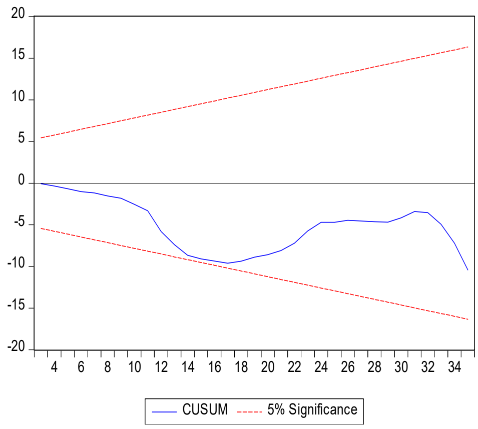
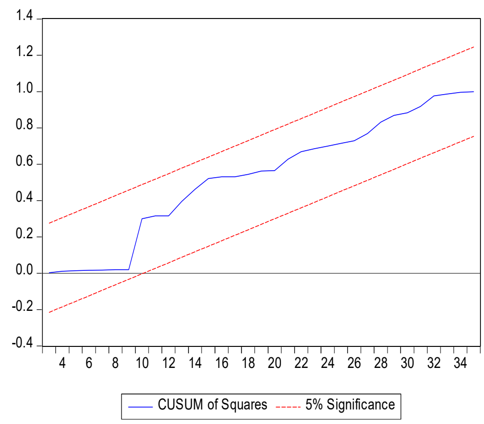
F_{HQI}(MIPR,GDP,UR,IR,GHE,FDI)			
Test Statistic	**Value**	**df**	**Prob.**
F-statistic	3241.112	(3, 341)	0.000 ***
Chi-square	4251.928	3	0.000 ***

*** indicates the significance at 1%.

4.5. CUSUM and CUSUMSQ Tests

The long-term stability of the economic models was validated through a series of directives and operational protocols, as detailed in Table 7. Employing the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) techniques, originally developed by Brown et al. [40] and subsequently refined by Pesaran, M. and Pesaran, H. (1997), the robustness of the calculated long-term parameters was assessed. The graphical representations of the CUSUM and CUSUMSQ tests, presented in the figures, demonstrate that the curves remain within the critical bounds at a 5% significance level, affirming the model's stability. The fluctuations of the curve within these boundaries further support the conclusion of long-term model stability.

Table 7. CUSUM and CUSUMSQ tests.

Econometric Model: F_{HQI}(MIPR,GDP,UR,IR,GHE,FDI)	
CUSUM Test	**CUSUMSQ Test**
	

4.6. Estimations of Short-Term

The results indicate a positive relationship between MIPR and HQI, meaning higher insurance penetration is associated with better healthcare quality. However, the *p*-value (0.217) is greater than 0.05, indicating that the relationship is not statistically significant at the 5% level. This implies that, in the short term, the level of medical insurance penetration does not have a significant direct impact on healthcare quality. The coefficient of GDP is positive and statistically significant ($p < 0.05$). This suggests that a higher GDP per capita is associated with better healthcare quality in the short term. Economically, this makes sense as wealthy countries generally have more resources to invest in healthcare infrastructure, technology, and skilled professionals, leading to improved healthcare outcomes. The tagged GDP is not statistically significant, implying that past GDP levels do not have a significant direct impact on current HQI.

The coefficient of UR is negative and statistically significant. This indicates that a higher unemployment rate is associated with lower healthcare quality. This is likely because higher unemployment can lead to decreased access to healthcare services due to reduced income and insurance coverage, as well as increased stress and poorer health outcomes. The coefficient of IR is negative and statistically significant. This suggests that higher inflation rates are associated with lower healthcare quality. High inflation can erode purchasing power, making healthcare services more expensive and less accessible, especially for lower-income individuals. It can also strain government budgets, potentially leading to reduced healthcare spending.

The coefficient of GHE is positive and highly statistically significant ($p < 0.001$). This clearly indicates that higher government healthcare expenditure as a percentage of GDP is strongly associated with better healthcare quality. This is intuitive, as increased government spending can enhance healthcare infrastructure, improve service delivery, and make healthcare more affordable. However, the lagged GHE is not statistically significant. Finally, the coefficient of FDI is positive, suggesting that FDI in the healthcare sector is associated with better healthcare quality. However, the *p*-value (0.117) is greater than 0.05, indicating that the relationship is not statistically significant at the 5% level. This implies that, in the short term, FDI in healthcare does not have a significant direct impact on healthcare quality. However, the lagged FDI is also not statistically significant (Table 8).

Table 8. Short-term ARDL estimations.

Econometric Model: F_{HQI}(MIPR,GDP,UR,IR,GHE,FDI) Optimal Lags: ARDL (0,0,1,0,0,1,1)				
		Coefficient	t-Statistic	Prob. *
Dependent variables	HQI	0.443	2.130	0.044 **
	MIPR	0.362	1.267	0.217
	GDP	0.015	2.537	0.018 **
	GDP(−1)	0.006	1.315	0.201
	UR	−0.063	−2.779	0.010 **
	IR	−4.161	−2.185	0.039 **
	GHE	0.289	5.857	0.000 ***
	GHE(−1)	0.004	0.780	0.443
	FDI	0.226	1.655	0.117
	FDI(−1)	1.217	0.708	0.488
	Constant	−29.765	−4.960	0.000 ***

*, ** and *** indicate the significance, respectively, at 10%, 5% and 1%.

4.7. Estimations of Long-Term

The long-term ARDL results from Table 9 provide an economic explanation for each variable's impact on the Healthcare Quality Index (HQI). The coefficient of MIPR is positive and highly statistically significant ($p < 0.001$). This indicates a strong positive long-term relationship between MIPR and HQI. In the long term, higher medical insurance penetration is associated with significantly better healthcare quality. Economically, this suggests that as more people are insured, they have greater access to healthcare services, leading to improved health outcomes and overall healthcare quality. The coefficient of GDP is positive, suggesting a positive relationship between GDP and HQI. However, the p-value (0.121) is greater than 0.05, indicating that the relationship is not statistically significant at the 5% level in the long term. This implies that while a higher GDP may contribute to better healthcare quality, the effect is not statistically robust over the long term in this model. The coefficient of UR is negative, suggesting that higher unemployment is associated with lower healthcare quality. However, the p-value (0.430) is much greater than 0.05, indicating that the relationship is not statistically significant in the long term. This means that, in the long term, unemployment rates do not have a significant direct impact on healthcare quality in this model.

Table 9. Long-term ARDL estimations.

Econometric Model: F_{HQI}(MIPR,GDP,UR,IR,GHE,FDI)				
	HQI as dependent variable	Coefficient	t-Statistic	Prob.*
Dependent variables	MIPR	2.431	9.580	0.000 ***
	GDP	0.215	1.637	0.121
	UR	−0.201	−0.809	0.430
	IR	−0.025	−4.147	0.000 ***
	GHE	0.223	2.879	0.010 **
	FDI	0.109	2.232	0.040 **
	Constant	−8.617	−0.889	0.386

*, ** and *** indicate the significance, respectively, at 10%, 5% and 1%.

The coefficient of IR is negative and highly statistically significant ($p < 0.001$). This indicates a significant negative long-term relationship between inflation and HQI. Higher inflation is associated with lower healthcare quality in the long term. Economically, this implies that sustained high inflation can erode the purchasing power for healthcare services, reduce government healthcare spending in real terms, and negatively impact the overall quality of healthcare. The coefficient of GHE is positive and statistically significant ($p < 0.05$). This suggests a positive long-term relationship between government healthcare expenditure and HQI. In the long term, higher government spending on healthcare as a percentage of GDP is associated with better healthcare quality. This indicates that sustained government investment in healthcare infrastructure, services, and programs is crucial for improving long-term healthcare outcomes. The coefficient of FDI is positive and statistically significant ($p < 0.05$). This suggests a positive long-term relationship between FDI in the healthcare sector and HQI. In the long term, increased foreign investment in healthcare is associated with better healthcare quality. This implies that FDI can bring in new technologies, expertise, and capital, leading to improvements in healthcare services and infrastructure.

Figure 1 illustrates the estimated long-term elasticity coefficients of the six macroeconomic variables, Medical Insurance Penetration Rate (MIPR), Gross Domestic Product per capita (GDP), Unemployment Rate (UR), Inflation Rate (IR), Government Healthcare Expenditure (GHE), and Foreign Direct Investment (FDI), on HQI based on the ARDL estimation results. Positive coefficients indicate a direct relationship with HQI, while negative coefficients imply an inverse association. The magnitude of each coefficient reflects the relative strength of its long-term impact. Statistically significant variables (at the 5% level or lower) are marked with asterisks.

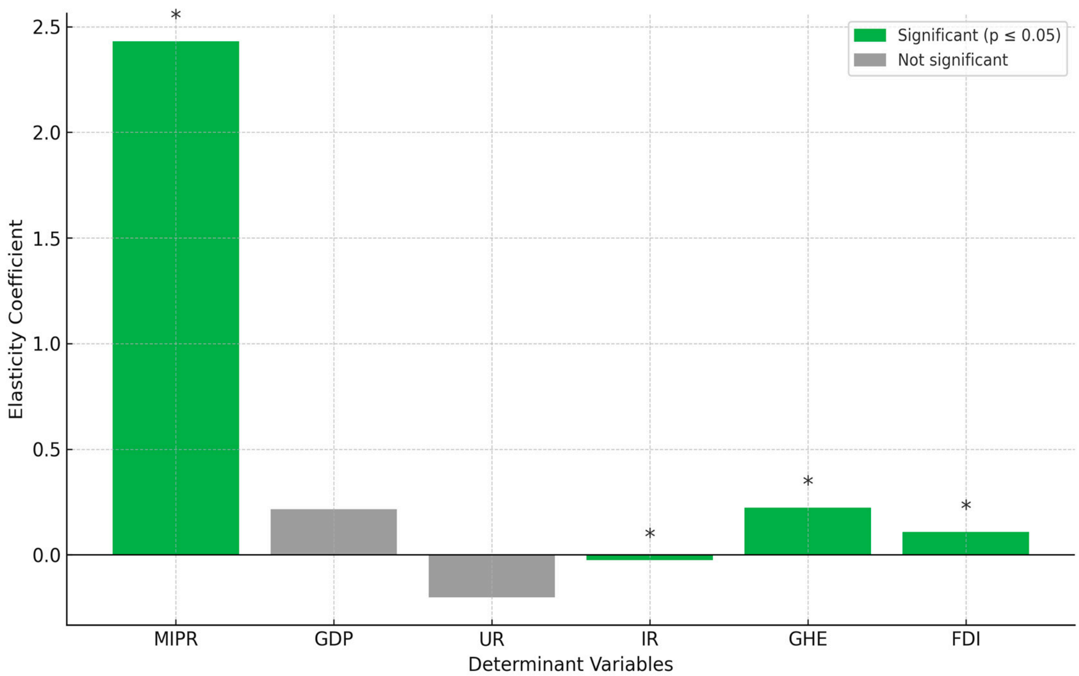


Figure 1. Long term elasticity effects of key determinants on Healthcare Quality Index (HQI) in Saudi Arabia. Prob. * indicates the significance, at 10%.

4.8. Granger Causality Test and VECM Result

The Granger causality testing analysis shown in Table 10 reveals that changes in the medical insurance penetration rate (MIPR) cause changes in the Healthcare Quality Index (HQI). Specifically, the statistical evidence indicates that variations in insurance coverage precede changes in healthcare quality, suggesting that expanding insurance access may lead to improvements over time. While our findings indicate that increased overall medical insurance penetration significantly improves HQI in the long term, it is crucial to recognize that this aggregate result does not detail how this coverage is distributed across the population. As suggested by the range in the MIPR data presented in Section 3.1, disparities in access to and growth of insurance coverage likely exist across different demographic and socioeconomic groups, such as by age, gender, income level, and type of employment, potentially leading to unequal benefits from the overall increase in penetration.

Table 10. Granger causality testing and VECM results.

Independent Variables	DLnHQI	DLnMIPR	DLnGDP	DLnUR	DLnIR	DlnGHE	DLnFDI	ECT
DLnHQI	---------	1.11 *** (0.00)	0.93 ** (0.03)	0.66 (0.65)	1.77 (0.53)	0.12 * (0.06)	0.62 ** (0.03)	1.00 (0.72)
DLnMIPR	0.32 ** (0.03)	---------	0.62 (0.82)	3.83 (0.63)	0.89 (0.21)	1.77 * (0.06)	0.66 (0.83)	−1.66 (0.61)
DLnGDP	0.44 *** (0.00)	1.92 ** (0.04)	---------	1.66 ** (0.04)	5.23 (0.32)	1.52 (0.80)	1.09 * (0.07)	−0.11 ** (0.02)
DLnUR	0.82 * (0.06)	3.63 (0.81)	0.89 * (0.06)	---------	0.51 (0.66)	1.82 * (0.09)	0.88 (0.93)	−2.33 (0.22)
DLnIR	1.26 (0.67)	0.72 (0.82)	0.72 (0.91)	0.82 (0.77)	---------	0.61 (0.93)	0.72 (0.65)	−0.72 (0.76)
DLnGHE	0.89 (0.71)	2.29 (0.65)	0.78 (0.93)	0.89 *** (0.00)	0.23 (0.44)	---------	1.92 (0.33)	−1.62 ** (0.03)
DLnFDI	1.22 ** (0.02)	3.03 *** (0.00)	0.94 * (0.059)	1.66 * (0.06)	0.51 (0.90)	0.31 (0.53)	---------	−0.11 ** (0.02)

*, ** and *** indicate the significance, respectively, at 10%, 5% and 1%.

Similarly, changes in gross domestic product per capita (GDP) also cause changes in HQI as demonstrated by Granger causality testing. This supports the idea that wealthier nations tend to have better healthcare systems. Furthermore, changes in the unemployment rate (UR) show some predictive power for changes in HQI, although at a lower significance level. This suggests that higher unemployment, potentially leading to increased stress and reduced healthcare access, may negatively impact healthcare quality. Likewise, changes in government healthcare expenditure (GHE) also appear to predict changes in HQI, indicating that increased government spending may contribute to quality improvements. Finally, as demonstrated by Granger causality testing, changes in foreign direct investment (FDI) in the healthcare sector cause changes in HQI, suggesting that FDI can bring in resources and expertise that enhance healthcare quality.

The Error Correction Term (ECT) within the Vector Error Correction Model (VECM) indicates how quickly variables adjust back to their long-term equilibrium after a disruption. The ECT for HQI is 1.00, meaning that any deviation from equilibrium is fully corrected within the next period, reflecting a very rapid adjustment. Conversely, the ECT for GDP and FDI is −0.11, suggesting that these variables adjust by 11% in the opposite direction to restore equilibrium. However, the ECT for GHE is −1.62, indicating a very strong adjustment of 162% in the opposite direction, highlighting the critical role of government spending in maintaining the long-term relationship.

Collectively, these findings suggest that medical insurance penetration, economic development (GDP), government healthcare expenditure, and foreign direct investment all play significant roles in influencing healthcare quality. Expanding insurance coverage can improve access, a higher GDP facilitates investment in healthcare infrastructure, government spending maintains and enhances quality, and FDI brings in valuable resources and expertise.

The VECM results confirm the existence of a long-term equilibrium relationship between these factors and healthcare quality. The ECT values emphasize that government spending and GDP are particularly important in driving the system back toward equilibrium after any disturbances.

Our findings are generally consistent with the international literature. For instance, the significant long-term positive effect of medical insurance penetration on healthcare quality supports Rahman et al. [7] and Sá Queiroz et al. [8], who emphasized insurance's role in improving preventive care access in South Asia and Latin America, respectively. Similarly, the strong influence of government healthcare expenditure aligns with Chukwu and Essue [20] and Jung et al. [21], who found that strategic and sustained public investment leads to quality improvements. In contrast, the non-significant long-term effect of GDP in our model diverges from Smith [12], who reported a consistent GDP–HQI link in developed nations, highlighting that in the Saudi context, economic output may not fully translate into healthcare improvements without targeted investments. Regarding unemployment, our short-term negative findings are in line with Brito-Ramos et al. [16], yet the long-term insignificance suggests structural buffers or social programs in Saudi Arabia may mitigate its enduring health impact. Finally, the long-term positive role of FDI supports Nguyen et al. [24], confirming that international capital has both infrastructure and technological spillovers, although this effect is subject to regulatory quality and investment targeting.

5. Conclusions

This study aimed to investigate the dynamic relationship between the medical insurance penetration rate (MIPR), gross domestic product per capita (GDP), unemployment rate (UR), inflation rate (IR), government healthcare expenditure (GHE), foreign direct investment (FDI), and the Healthcare Quality Index (HQI) in Saudi Arabia from 1990 to 2024. Utilizing the robust ARDL and VECM methodologies, we have explored both the short-term and long-term impacts of these critical variables, with a focus on their implications for economic sustainability and healthcare policy in the Kingdom. Our findings reveal distinct patterns across different time horizons, offering nuanced insights into the drivers of healthcare quality. In the short term, fluctuations in the macroeconomic environment and immediate resource availability significantly influenced the Healthcare Quality Index. Specifically, higher gross domestic product per capita and government healthcare expenditure were associated with improved healthcare quality, likely reflecting the immediate availability of increased national wealth and public funding translated into readily accessible resources, infrastructure improvements, or urgent healthcare programs. Conversely, higher unemployment and inflation rates negatively impacted the Healthcare Quality Index in the short term. This could be attributed to individuals facing reduced financial capacity (due to job loss) or decreased purchasing power (due to inflation), potentially delaying or foregoing essential healthcare services, thereby impacting immediate health outcomes reflected in the index. While the medical insurance penetration rate and foreign direct investment showed positive associations with the Healthcare Quality Index, these relationships were not statistically significant in the immediate term, suggesting their benefits may accrue over longer periods.

In the long term, sustained structural and policy-driven factors emerged as key determinants of the Healthcare Quality Index. The medical insurance penetration rate and foreign direct investment demonstrated significant positive relationships with healthcare quality. The long-term positive impact of increased insurance coverage likely stems from improved and consistent access to a wider range of health care services, including preventive care and early intervention, leading to better population health outcomes over time. Likewise, sustained foreign direct investment in the healthcare sector can introduce advanced technologies, modern management practices, specialized expertise, and contribute to developing high-quality infrastructure, cumulatively enhancing healthcare quality over the long term. Conversely, a persistently high inflation rate significantly reduces long-term health care quality, potentially by eroding the healthcare sector's purchasing power, increasing the costs of medical supplies and technology, and hindering long-term investment and planning. Government healthcare expenditure remained a crucial positive factor in the long term, reaffirming the vital role of sustained public investment in building and maintaining a resilient and high-quality healthcare system.

A key limitation of this study is the use of an aggregate Medical Insurance Penetration Rate, which combines both public and private insurance coverage. This aggregation prevents a detailed analysis of the potentially differential impacts or comparative benefits of public versus private health services on healthcare quality outcomes. Future research employing more granular data at the individual or household level could explore these distinct effects and provide insights into which type of insurance scheme might be more effective or beneficial under different circumstances within Saudi Arabia. While gross domestic product per capita and unemployment rate showed direct impacts consistent with theoretical expectations, their long-term effects were not statistically significant, suggesting that while important for immediate capacity and access, their sustained long-term influence on overall healthcare quality might be mediated or potentially outweighed by structural factors like insurance, investment, and stable public funding (e.g., [36,41–44]).

Based on the conclusion provided, a key limitation of this study is the use of an aggregate Medical Insurance Penetration Rate, which combines both public and private insurance coverage. This aggregation hinders a detailed analysis of the potentially differential impacts or comparative benefits of public versus private health services on healthcare quality outcomes. While the study found direct impacts of gross domestic product per capita and unemployment rate in the short term consistent with theoretical expectations, their long-term effects were not statistically significant. This suggests that although important for immediate capacity and access, their sustained long-term influence on overall healthcare quality might be mediated or potentially outweighed by structural factors like insurance, investment, and stable public funding.

6. Policy Implications

The findings of this study offer actionable insights for policymakers in Saudi Arabia committed to elevating healthcare quality and ensuring its sustainable contribution to the nation's economic future. The analysis highlights several critical areas where targeted policy interventions, grounded in the observed relationships, can yield tangible improvements:

1. Prioritize and Facilitate Long-Term Expansion of Medical Insurance Coverage: Given the strong positive long-term impact of the Medical Insurance Penetration Rate (MIPR) on the Healthcare Quality Index (HQI), policymakers should actively pursue strategies to broaden health insurance coverage across the population. This involves concrete actions such as expanding eligibility and benefits under existing public health insurance schemes (like SEHA for citizens), introducing targeted subsidies or tax incentives to make private insurance more affordable for residents and the private sector workforce, and significantly streamlining the digital enrollment and claims processes to ensure ease of access. The goal is to achieve near-universal coverage, recognized as a fundamental driver of improved long-term health outcomes.
2. Ensure Sustained and Strategic Government Healthcare Funding: The analysis unequivocally demonstrates the crucial positive role of Government Healthcare Expenditure (GHE) in enhancing HQI in both the short and long term. Policymakers must commit to not only sustaining but increasingly increasing the allocation of public funds to the healthcare sector as a percentage of GDP. This investment should be strategically directed toward tangible improvements, including building and modernizing healthcare infrastructure (e.g., specialized hospitals, primary care centers in underserved areas), investing in advanced medical technology and equipment,

increasing the recruitment and retention of skilled medical professionals, and funding essential public health programs focused on prevention and early detection.

3. Proactively Attract and Integrate Strategic Foreign Direct Investment (FDI) in Healthcare: The observed positive long-term impact of FDI on HQI underscores its potential to accelerate healthcare sector development. Policymakers should implement specific measures to attract high-quality foreign investment. This could involve offering targeted investment incentives (e.g., tax holidays, land allocation), creating a dedicated fast-track regulatory approval process for healthcare investment projects, actively marketing specific investment opportunities in high-priority areas (like medical tourism, specialized care, R&D), and fostering partnerships or joint ventures between international healthcare providers and local entities to facilitate technology transfer and expertise sharing.
4. Implement Measures to Mitigate Inflation's Erosion of Healthcare Quality: The significant negative long-term impact of inflation (IR) on HQI necessitates specific protective measures for the healthcare sector, in addition to broader macroeconomic stability policies. Practical steps could include indexing government healthcare budgets and reimbursement rates for public insurance schemes to account for inflation, providing targeted subsidies or bulk purchasing agreements for essential medical supplies and pharmaceuticals to cushion price shocks, and regularly reviewing healthcare worker compensation to ensure it keeps pace with living costs, preventing staff attrition due to economic pressure.
5. Develop Targeted Healthcare Support Mechanisms During Periods of High Unemployment: Recognizing the negative short-term impact of the Unemployment Rate (UR) on HQI, policies should aim to protect access to healthcare during job loss. Concrete measures could include mandating or providing a grace period for continued health insurance coverage after employment termination, exploring the feasibility of a temporary government-funded basic health coverage scheme for registered unemployed individuals, and integrating health checks or basic health support services into unemployment benefit programs or job training initiatives.
6. Leverage Economic Growth to Drive Tangible Healthcare Improvements: While the study noted GDP per capita's significant short-term positive impact, policymakers should ensure that overall economic growth translates into sustained improvements in healthcare quality. This involves mechanisms to earmark a portion of revenue increases from economic growth for specific healthcare initiatives (e.g., funding for preventive care, mental health services, or rare disease treatment centers), investing in training programs for the healthcare workforce that align with the demands of a growing economy, and ensuring that the wealth generated is reflected in improved access and quality for all segments of the population.

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