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The effect of health system governance on economic growth in Morocco: A VAR modeling approach

L'effet de la gouvernance du système de santé sur la croissance économique au Maroc : Une approche selon la modélisation VAR

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Abstract

This study explores the impact of health system governance on economic growth in Morocco, using an econometric approach and VAR modeling. It highlights the importance of effective health system governance for economic development, particularly through improved human capital and productivity. The results show that, in the short run, economic growth depends mainly on its own shocks, while the impact of health governance becomes significant in the long run. Impulse response functions reveal a delayed effect of improved governance on growth, with an initial negative GDP response followed by a rebound in the medium term. The study recommends structural reforms in the health sector, such as optimizing public spending, managing health infrastructure, and integrating digital technologies, to maximize the economic impact of health governance.

Keywords: health system governance; economic growth; principal component analysis; VAR model.

Résumé

Cette étude explore l'impact de la gouvernance du système de santé sur la croissance économique au Maroc, en utilisant une approche économétrique et la modélisation VAR. Elle met en évidence l'importance d'une gouvernance efficace du système de santé pour le développement économique, en particulier à travers l'amélioration du capital humain et de la productivité. Les résultats montrent que, à court terme, la croissance économique dépend principalement de ses propres chocs, tandis que l'impact de la gouvernance sanitaire devient significatif à long terme. Les fonctions de réponse impulsionnelle révèlent un effet différé de l'amélioration de la gouvernance sur la croissance, avec une réponse initiale négative du PIB suivie d'un rebond à moyen terme. L'étude recommande des réformes structurelles dans le secteur de la santé, telles que l'optimisation des dépenses publiques, la gestion des infrastructures sanitaires et l'intégration des technologies numériques, pour maximiser l'impact économique de la gouvernance sanitaire.

Mots clés : gouvernance du système de santé ; croissance économique ; analyse de la composante principale ; Modèle VAR.

Introduction

Health economics is an applied field of study that provides a systematic and rigorous examination of the problems encountered in promoting health for all. By applying the economic theories of consumer, producer, and social choice, health economics aims to understand the decision-making behavior of individuals, health care providers, public and private organizations, and governments.

Health system governance, that is, the way a country organizes, regulates and controls its health care, is a determining factor in a nation's economic performance. Indeed, the quality of health governance directly influences the health of the population, which in turn is a key driver of economic growth. Many countries around the world are facing increasingly complex challenges in managing their health systems, whether it is access to care, efficiency of spending or management. Chronic diseases. These governance issues are not only a challenge for public health, but also for economic development, because an unhealthy population can hamper productivity, innovation.

Understanding the effect of health system governance on economic growth is of critical importance to policy makers, economists, and public health experts. It helps to better direct health investments, improve economic planning, and design public health policies that support both individual well-being and economic development goals. Effective governance can prevent costly health crises, improve access to care, and reduce social inequalities.

From a theoretical perspective, the interaction between health governance and economic growth can be explained by several economic models and concepts. For example, human capital theory posits that health is a key factor in economic development, as a healthier population is more productive and more capable of innovating. Other theories, such as health system efficiency theory, suggest that optimal management of resources in the health sector can reduce economic costs, improve a country's competitiveness, and support stable economic growth. In addition, endogenous growth models highlight the importance of the quality of institutions, including health system governance, in stimulating sustained growth.

The governance of the health system in Morocco has undergone significant reforms in recent years, although challenges persist in terms of efficiency, accessibility, and financing. The Moroccan health system is based on a combination of public and private services, but it suffers from significant disparities between urban and rural areas, with inequalities in access to care. The Moroccan government has undertaken ambitious reforms to improve the governance of the sector, including through the expansion of medical coverage and the launch

of the National Social Security Fund to broaden access to care, as well as the implementation of strategies to modernize health infrastructure. However, problems of management, transparency, coordination between public and private actors, and financing remain major obstacles. Effective implementation of reforms, strengthening local governance of health facilities, and combating corruption are crucial elements to ensure that the Moroccan health system can meet the needs of the population in an equitable and sustainable manner.

This work examines the impact of health system governance on economic growth in Morocco, drawing on empirical data and economic theories, and highlights the mechanisms through which effective governance can promote sustainable and equitable economic development. The central problem of the study is therefore: How does the governance of the health system in Morocco influence economic growth, and what mechanisms can effective governance use to promote sustainable and equitable economic development?

In order to conduct our study well, section 1 reviews the literature with emphasis on the main theories. Section 2 describes the state of the Moroccan health system. While section 3 will discuss the data and the empirical technique of the study. The discussion of the results is presented in section 4. The last section is a conclusion.

1. Review of theoretical literature and development of hypotheses

The theoretical literature highlights the fundamental impact of the health system on economic growth through several mechanisms. One of the most influential approaches is based on endogenous growth theory (Lucas, 1988; Romer, 1990), which emphasizes the role of human capital in economic development. A well-performing health system improves the quality and productivity of the workforce by reducing absenteeism, extending working life, and enhancing individuals' cognitive abilities (Grossman, 1972).

Another relevant theoretical framework is that of positive externalities of health. When a population benefits from a good general state of health, productivity gains are not limited to the individuals concerned, but are diffused throughout the economy. This dynamic is particularly highlighted by development models based on human capital, where health is a key factor in the accumulation of skills and know-how (Becker, 1964; Barro, 1996).

Health system governance also plays a crucial role in its impact on economic growth. Effective regulation, optimal allocation of resources, and rigorous management of health expenditures help maximize benefits by avoiding waste and inefficiencies (Acemoglu & Robinson, 2012). Some institutionalist currents emphasize the importance of the quality of health institutions in strengthening the productive capacities of a nation (North, 1990).

Finally, some analyses draw on multi-sector growth models to show that the health sector can act as an economic engine in its own right. By stimulating biomedical innovation, creating jobs and promoting the development of the pharmaceutical industry and medical technologies, a dynamic health system contributes directly to economic growth (Hall & Jones, 2007).

Overall, the theoretical literature converges on the idea that health is both a factor of individual productivity and a pillar of long-term economic development. Effective investment in the health system not only improves social well-being, but also sustainably strengthens a country's economic performance (Bloom, Canning & Sevilla, 2004).

The objective of this study is to analyze the impact of health system governance on economic growth in Morocco using a VAR model. This analysis is based on a set of empirical hypotheses that guide the research and allow the interpretation of the results obtained.

1. Main hypothesis

• H1: Improving the governance of the health system (measured by the Health System Governance Index - IGSS) has a positive and significant impact on economic growth (GDP) in Morocco.

This hypothesis assumes that a better governed health system contributes to a healthier population, which improves labor productivity and, therefore, stimulates economic growth.

2. Secondary hypotheses

• H2: The effects of health system governance on economic growth are dynamic and manifest themselves through interactions between the variables of the VAR model.

• H3: The impact of the health system on economic growth varies according to the time horizon (short, medium and long term).

• H4: Improving the IGSS reduces economic uncertainty and promotes a climate conducive to investment.

3. Methodological hypotheses

• H5: The time series used in the model are stationary in first difference.

• H6: The VAR model is stable, that is to say that the eigenvalues associated with the coefficients remain in the unit circle.

• H7: Model errors do not exhibit autocorrelation, heteroscedasticity or normality bias, thus ensuring reliable and robust estimates.

These hypotheses are empirically tested through VAR model estimation, diagnostic tests, and analysis of shock response functions and variance decomposition.

2. State of play of the governance of the health system in Morocco

The health system in Morocco, as in many developing countries, has gone through several phases of reforms and improvements over the decades. While the progress made in recent years is notable, significant challenges remain, particularly with regard to access to care, equity between different regions and the quality of services. This overview of the health system in Morocco examines its evolution, the main current challenges and the reforms undertaken to improve the health and social situation of the population.

Morocco has initiated a series of significant reforms in the health sector since the 1960s. However, it was from the 2000s that significant structural changes were put in place to strengthen health coverage and improve the living conditions of citizens.

In the 1990s and 2000s, the government introduced several strategies to combat communicable diseases (such as tuberculosis and malaria) and to promote maternal and child health. An important milestone during this period was the adoption of the National Health Strategy in 2002, which served as a framework for future reforms. The strategy emphasized the importance of decentralization and regional management of health facilities.

In 2012, the Medical Assistance Scheme (RAMED) was introduced, aiming to provide free medical coverage to the most vulnerable populations, such as those living below the poverty line. This program has helped extend health coverage to millions of Moroccans, although implementation and efficiency challenges remain.

Access to health care in Morocco remains unequal, both geographically and socio-economically. Although the country has made progress in health coverage, inequalities between urban and rural areas remain deep. Rural areas, particularly in the south and east of the country, often face a shortage of health infrastructure, a lack of qualified personnel, and long waiting times. Morocco has large cities such as Casablanca, Rabat, and Marrakech, which have modern infrastructure and high-quality health facilities, but these services are often inaccessible to the rural population due to distance, transportation costs, and low incomes.

Morocco's health system also suffers from a strong disparity in the distribution of human resources. According to the World Health Organization (WHO), the country is under-equipped in terms of doctors, paramedical staff and hospital beds, particularly in rural areas. As a result, the quality of care varies considerably from one region to another.

Despite the progress made, the quality of care in the public sector remains a major concern. Public hospitals often suffer from a lack of modern equipment, aging infrastructure and

patient overload. This situation is due, among other things, to the low budget allocated to health in relation to GDP, which limits the government's ability to invest in modern medical equipment, staff training and improvements to hospital infrastructure.

The private sector, although more developed, is often perceived as inaccessible for a large part of the population due to the high costs of care. This creates a duality in the Moroccan health system: on one side, a saturated public system and on the other, a private system reserved for a financial elite.

Morocco has undertaken several reforms to improve its health system and overcome existing challenges. Among these reforms, the generalization of Mandatory Health Insurance (AMO) in 2021 marked a significant step towards universal health coverage, allowing a large part of the population, including self-employed workers and civil servants, to benefit from quality medical care.

In addition, the National Health Strategy 2025 was launched with ambitious goals to improve the efficiency of the health system, modernize infrastructure, strengthen primary health care coverage and improve the management of health facilities. This plan also aims to further decentralize hospital management and promote public health through prevention campaigns, particularly to combat non-communicable diseases such as heart disease, diabetes and cancers.

Despite the progress made, several challenges remain to ensure equitable access to quality care for all citizens. Health system governance remains a key problem: the lack of coordination between the different actors (government, health institutions, health professionals) leads to inefficiencies, particularly in the use of resources and in the implementation of reforms.

Training and distribution of health personnel also remain priorities. The shortage of doctors, especially in rural areas, and the brain drain abroad are recurring problems. Similarly, the management of public hospitals needs to be improved to ensure quality care and better patient care.

In addition, financing the health system remains a major challenge. Although efforts have been made to increase public spending on health, it remains insufficient compared to the growing needs of the population. The Moroccan health system must also cope with increasing demand due to population growth and aging.

In conclusion, the health system in Morocco has made significant progress over the last two decades, particularly with the introduction of RAMED and the establishment of AMO.

However, significant challenges remain in terms of access to care, territorial equity and quality of services. The reforms undertaken and the initiatives underway, such as the National Health Strategy 2025, demonstrate a political will to modernize the sector and ensure more equitable health coverage. Nevertheless, sustained efforts are needed to overcome the remaining obstacles and ensure universal and quality health coverage for all Moroccans.

3. Research methodology

3.1.Construction of the health system governance index:

The Health System Governance Index can be constructed using the Principal Component Analysis (PCA) method, which is a statistical technique for reducing the dimensionality of a data set while retaining the essential information. This can be particularly useful for assessing the governance of a health system, which can be influenced by a large number of complex variables.

a. Definition of the dimensions of health system governance

First, it is necessary to determine the variables or indicators that characterize the governance of the health system. These indicators may include the following aspects:

Painting1: the components of the IGSS

Dimension	Indicators
Human resources in the public sector	- Number of inhabitants per doctor - Number of inhabitants per nurse
Funding	- The share of the investment budget in the MS budget - The share of the Ministry of Health budget in relation to GDP - The share of the Ministry of Health budget in the general state budget - The share of direct household expenditure
Provision of services and healthcare establishments	- Number of inhabitants per bed in public hospitals - Number of inhabitants per basic health care facility - Maternal mortality rate - Infant mortality rate - Average length of stay

Source :Developed by us

b. Data collection

This data comes from the database of the Ministry of Health and Social Protection.

c. Application of the ACP

Principal Component Analysis involves breaking down the variance of the data into several "principal components" that explain the directions of greatest variance in the dataset. Here are the substeps:

- Centering and reducing data: subtract the mean and divide by the standard deviation for each variable.
- Calculation of the covariance or correlation matrix between the variables.
- Principal component extraction: identify the eigenvectors (or "principal components") that explain the maximum variance of the data.
- Choice of the number of components to retain: we select the principal components according to the proportion of variance explained (generally, we retain those which explain more than 70-80% of the total variance).

d. Construction of the index

Once the main components are extracted, we can:

- Calculate an overall score for each country or region based on the weights associated with each principal component (the "coefficients" or "loadings" of the PCA).
- This score represents the overall governance of the health system for each observation (country, region, etc.).
- The index can be a linear combination of the scores of the principal components retained, each component being weighted according to its contribution to the explanation of the total variance.

The choice of SPSS (Statistical Package for the Social Sciences) for the calculation of the Health System Governance Index (HSGI) is based on its advanced capabilities in statistical processing and data management. SPSS is a software recognized for its reliability, ease of use and versatility, making it a preferred tool for complex statistical analyses. It offers a wide range of statistical methods, including factor analysis techniques such as Principal Component Analysis (PCA), which was used for the construction of the HSGI. In addition, SPSS allows for the efficient manipulation of large data sets, the performance of robust statistical tests and the presentation of results in clear visual formats, thus facilitating the interpretation of the results. The user-friendly interface and the wealth of analysis options also allow for better management of the different modeling stages, ensuring accurate and consistent results.

3.2.The period of the study

The choice of the study period 2000-2022 is based on several economic, institutional and

methodological considerations, which guarantee the relevance and robustness of the results obtained.

a. Availability and Reliability of Data

The period 2000-2022 provides access to comprehensive and consistent statistical data on the variables studied, including the Health System Governance Index (HSGI) and the Gross Domestic Product (GDP). Since the 2000s, Moroccan and international institutions (HCP, World Bank, WHO) have strengthened the collection and dissemination of reliable macroeconomic and sectoral data.

b. Structuring Developments in the Health System

The choice of this period is justified by the major transformations that the Moroccan health system has undergone:

• 2005: Launch of the National Initiative for Human Development (INDH), focusing on improving health services.

• 2012: Implementation of the Medical Assistance Scheme (RAMED), a turning point in health coverage for vulnerable populations.

• 2021-2022: Reform of social protection and generalization of Compulsory Health Insurance (AMO).

These reforms have had a significant impact on health sector governance and, potentially, on economic growth.

c. Economic Context and Growth Dynamics

The chosen period covers different economic phases:

• 2000-2008: Sustained growth thanks to economic reforms and the growth of several sectors (agriculture, industry, services).

• 2009-2012: Impact of the global financial crisis, highlighting Morocco's resilience to external shocks.

• 2013-2019: Relative economic stability and implementation of structural reforms.

• 2020-2022: Impact of the COVID-19 pandemic on the economy and the health system, highlighting the importance of effective governance in crisis management.

Including the post-COVID-19 period allows us to assess the ability of the health system to influence economic recovery.

d. Relevance for VAR Model Analysis

A 23-year period is long enough to capture the dynamic relationships between health system governance and economic growth. The use of the VAR model requires a relatively long time

series to ensure the robustness of the estimates and econometric tests.

The period 2000-2022 is therefore a strategic choice allowing us to analyze the impact of health system governance on economic growth, taking into account institutional and economic developments and major events that have marked Morocco.

3.3.VAR model estimation

Estimating the impact of health system governance on economic growth using the Vector Autoregressive Model (VAR) is a powerful econometric approach to analyze dynamic relationships between multiple economic variables over a given period. The VAR model allows to simultaneously study interactions between multiple time series without the need to specify causal relationships a priori, which makes it particularly suitable for analyzing complex phenomena such as the impact of health system governance on economic growth.

The study period extends from 2000 to 2022.

a. Formulation of the VAR model:

To study the effect of health system governance on economic growth, our model is written as follows:

$$\begin{pmatrix} Y_t \\ G_t \end{pmatrix} = A_0 + \sum_{i}^{p} A_i \begin{pmatrix} Y_{t-p} \\ G_{t-1} \end{pmatrix} + e_t$$

Or :

$Y_t$is the economic growth at period t; is the governance of the health system at period t; is a vector of constants; are the coefficient matrices that capture the relationships between the variables at different lags; is the vector of error terms and is the order of the VAR model (the number of lags).$G_t A_0 A_i e_t p$

The VAR model has several advantages that make it a powerful tool for analyzing dynamic economic relationships:

1. Taking into account interactions between variables: Unlike traditional econometric models, VAR allows the study of relationships between several variables without imposing a strict causal structure.

2. Flexibility: It does not impose strong assumptions on the form of relationships and captures interdependencies between variables.

3. Ease of estimation: Each equation is estimated separately by ordinary least squares (OLS), simplifying statistical inference.

4. Good forecasting ability: It is widely used in macroeconomics to anticipate changes in economic variables.

5. Dynamic analysis tools: Shock response functions and variance decomposition help to understand the transmission of shocks and the sources of economic fluctuations.

6. Applicability to various fields: VAR is used not only in economics, but also in finance, public health and economic policy.

Thanks to these assets, the VAR model constitutes a rigorous and relevant framework for evaluating the impact of health system governance on economic growth in Morocco.

b. Choice of variables:

To properly model the impact of health system governance on economic growth, it is crucial to define adequate variables to measure these two concepts:

- Health system governance (G): This variable can be measured by a composite governance index (based on the PCA as explained previously).
- Economic growth (Y): This is typically the growth rate of gross domestic product (GDP) per capita or real GDP.

The following table describes the variables:

Painting2: the source of the variables

Variables	**Source**	**Unit of measurement**	**Rating**
Gross domestic product	World Bank	In Dirhams	GDP
Health System Governance Index	Calculated by the authors	-	IGSS

Source : Developed by us

c. The steps of the VAR model:

VAR modeling follows several rigorous methodological steps to ensure the robustness of the results and the validity of the conclusions.

Before estimating a VAR model, it is crucial to ensure that the time series used are stationary, i.e., their statistical properties (mean, variance, autocorrelation) do not vary over time. For this, we applied the Augmented Dickey-Fuller (ADF) test, which allows to detect the presence of a unit root. The null hypothesis of the ADF test states that the series is non-stationary. If the p-value of the test is less than a critical threshold (usually 5%), we reject this hypothesis and conclude that the series is stationary. If the series are not stationary in level, they are differentiated until reaching stationarity.

Once stationarity is confirmed, we determine the optimal order of the VAR, i.e. the number of

lags () to include in the model. This choice is guided by several information criteria, including:

• Akaike criterion (AIC),

• Schwarz criterion (SC),

• Hannan-Quinn criterion (HQ).

The optimal lag is the one that minimizes these criteria while avoiding overparameterization of the model.

After selecting the optimal lag, we proceed to estimate the VAR model using the ordinary least squares (OLS) method, applied separately to each equation of the system.

A VAR model is stable if its estimates do not produce explosive results. Stability is checked by ensuring that the eigenvalues of the coefficient matrix lie inside the unit circle. That is, all roots of the VAR characteristic polynomial must have a modulus less than 1. If this condition is not met, it may be necessary to change the order of the model or transform the variables to ensure stability.

Once the model is estimated, we subject it to several diagnostic tests to ensure its validity:

• Error autocorrelation test: Use the portomanteau test to check whether the residuals are independent. An error autocorrelation could bias the estimates.

• Heteroscedasticity test: Application of the ARCH test to check whether the variance of the errors is constant. Heteroscedasticity may require a correction of the standard errors.

• Residuals normality test: Use the Jarque-Bera test to ensure that the errors follow a normal distribution. If the p-value is less than 5%, the normality hypothesis is rejected, which can affect statistical inference.

Once the model is validated, we analyze its dynamics in order to better understand the interactions between the variables and the impact of exogenous shocks. This analysis is based on two complementary tools:

a) Shock Response Functions (IRF)

Shock response functions allow us to examine how one variable reacts to a sudden disturbance in another variable in the system. In concrete terms, they show how an exogenous shock applied to one variable influences the other variables over time.

In a VAR, each variable is influenced by its own past values and those of other variables. When a shock is introduced, it propagates through the system. The IRF thus makes it possible to visualize this dynamic transmission.

For example, if we analyze the impact of a positive shock on health system governance

(IGSS), the IRF tells us whether this shock leads to an increase, a decrease or a neutral effect on economic growth (GDP) in the following periods.

The interpretation of IRFs is based on:

• The amplitude of the shock, which measures the intensity of the response of a variable to an initial shock,

• The duration of the effect, which indicates how long the disturbance impacts other variables before fading away,

• The sign of the response, which reveals whether the relationship between the variables is positive or negative,

• Confidence intervals, which allow the significance of the estimated responses to be assessed.

b) Decomposition of the Variance of Forecast Errors

The decomposition of the variance of forecast errors quantifies the share of the variance of a variable that is explained by the shocks applied to the other variables of the system.

In a VAR model, forecast errors can be due to shocks from different sources. Variance decomposition thus makes it possible to identify which variables most influence the fluctuations of another variable over different time horizons.

The variance decomposition analysis shows:

• In the short term, a variable is often mainly influenced by its own shocks,

• In the medium and long term, the impact of other variables becomes more significant.

In our study, this analysis allows us to determine the extent to which GDP fluctuations are explained by variations in the IGSS and vice versa. If a large part of the variance in GDP is explained by the IGSS, this suggests that health system governance plays a key role in economic growth.

For the estimation of the VAR model, EViews 13 was chosen due to its specialization in time series analysis and advanced econometric models. EViews is recognized for its ability to handle multivariate dynamic models, such as the VAR model, and for its powerful features in time series analysis. This software offers an intuitive interface for parameter estimation, optimal lag selection, and diagnostic testing, while ensuring the robustness of the results thanks to its maximum likelihood algorithm. One of the main advantages of EViews 13 is its ability to perform in-depth analysis of shock responses and variance decomposition, two essential elements for this study. In addition, EViews allows simulations and forecasts to be performed from the estimated models, which enriches the dynamic analysis of the economic system and health system governance in Morocco.

4. Results and Discussion

This section presents the empirical results of VAR modeling assessing the impact of the IGSS on economic growth in Morocco (2000-2022). After a descriptive analysis of the variables, we examine the stationarity tests and model diagnostics. Finally, we interpret the impulse-responses and the variance decomposition to assess the dynamics between IGSS and GDP.

Painting3: Descriptive statistics

Variable	IGSS	GDP
Min	50.09	531,510,215,000.00
Average	59.54	888 553 835 973.91
Median	56.47	908 522 708 800.00
Max	81.73	1,192,769,000,000.00
Standard deviation	8.89	213,582,338,360.55

Source :Developed by us from the outputs of EViews 13:

The analysis of the descriptive statistics in Table 3 provides a first overview of the distribution of the two variables studied: the Health System Governance Index (HSGI) and the Gross Domestic Product (GDP). The HSGI has a mean of 59.54, with a slightly lower median (56.47), which could indicate a slight asymmetry in the distribution of values. Its standard deviation of 8.89 shows a moderate dispersion around the mean, which means that the HSGI values do not vary excessively from one observation to another. Regarding the GDP, we observe a high mean of 888,553,835,973.91 Dirhams and a close median (908,522,708,800.0 Dirhams), which suggests a relatively balanced distribution. However, the standard deviation of 213,582,338,360.5 Dirhams shows a high dispersion, indicating that the variation in GDP between observations is significant. This may be the result of structural economic differences or macroeconomic shocks that affect the country's economic performance.

Painting4: The correlation matrix

	IGSS	GDP
IGSS	1	0.7183
GDP	0.7183	1

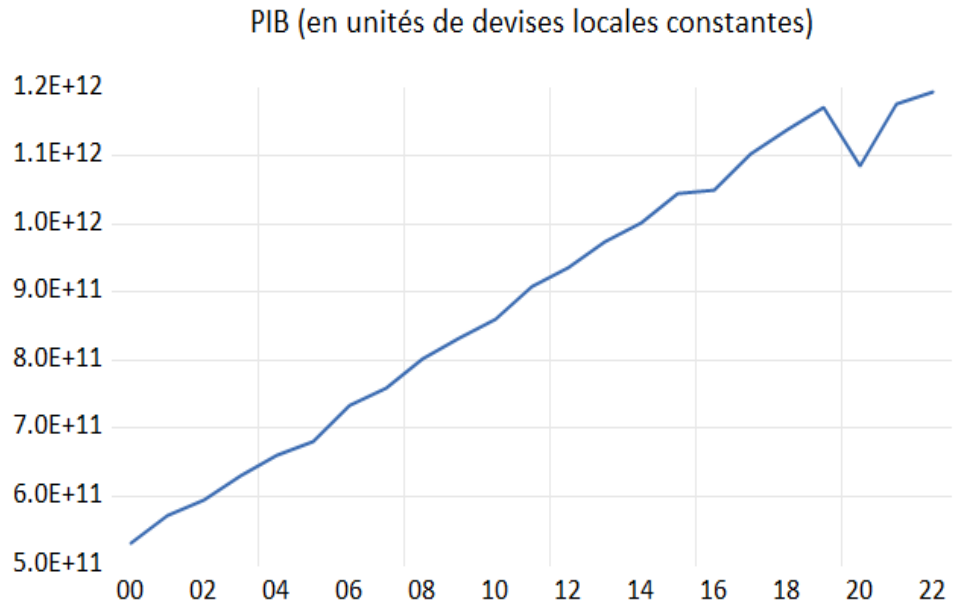
Source :Developed by us from the outputs of EViews 13

Table 4, which presents the correlation matrix between IGSS and GDP, reveals a correlation coefficient of 0.7183. This value indicates a strong positive correlation between these two variables. This means that an improvement in health system governance is generally associated with an increase in GDP. Several interpretations are possible: a better governed

health system can contribute to a healthier population, thereby increasing productivity and economic growth. Conversely, stronger economic growth can allow for better financing of the health system, thereby improving its efficiency and governance.

Furthermore, we describe the evolution of our variables over the period 2000 to 2020.

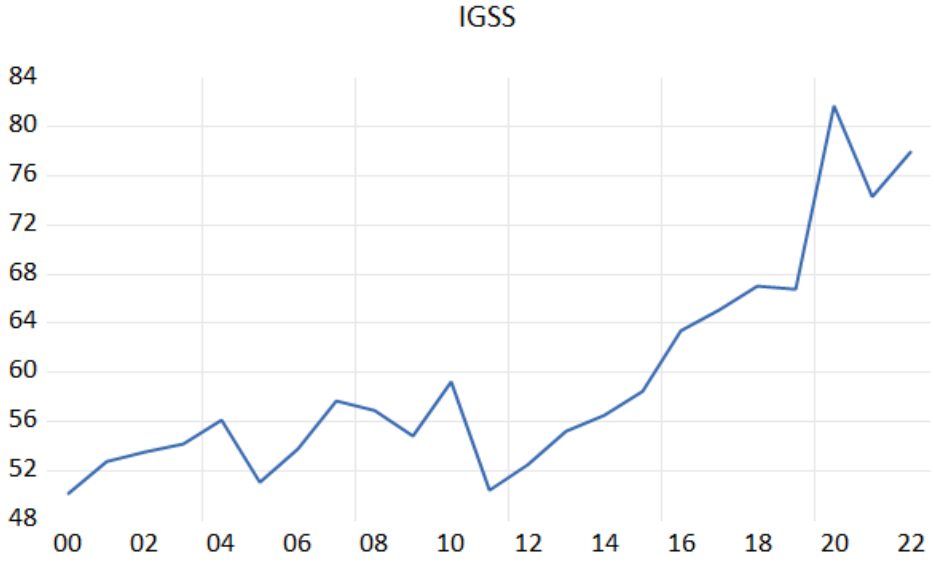
Figure1:The evolution of the gross domestic product in Morocco (2000-2020):



Source :Developed by us from the outputs of EViews 13

The gross domestic product grew during the period 2000-2019. In 2020, the GDP fell due to the repercussions of the Covid-19 health crisis.

Figure2:The evolution of the IGSS in Morocco (2000-2020):



Source :Developed by us from the outputs of EViews 13:

The health system governance index is generally stable between 2000 – 2011, while it has

seen a remarkable improvement since 2011 and which is due to the efforts of the Moroccan government to improve the governance of the health sector.

However, we will proceed to estimate the Vector Autoregressive (VAR) model to evaluate the macroeconomic shocks of our variables in the short term. To study stationarity, we use the Augmented Dickey Fuller test.

Painting5:Unit Root Test

Series	**Order of integration**	**Kind**	**Variable retained**
LPIB	I(1)	DS	D_PIB
LIGSS	I(1)	DS	D_IGSS

Source :Developed by us from the outputs of EViews 13:

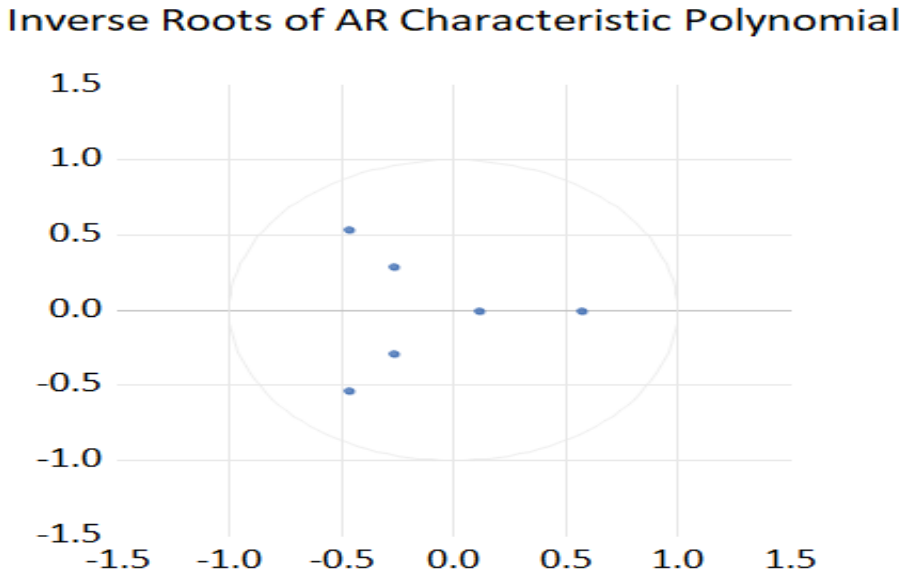
The Augmented Dickey-Fuller (ADF) test is a commonly used method to analyze the stationarity of time series. In this study, the test results show that the Gross Domestic Product (GDP) and the Health System Governance Index (HSGI) are of the DS (Difference Stationary) type and integrated of order 1 (I(1)).

This means that:

• The series are not stationary in level, that is, they exhibit a non-constant trend or variance over time.

• After a first differentiation, the series become stationary, which suggests that they follow a stochastic process where past shocks have a persistent effect but do not grow indefinitely.

Figure3:Stability of a VAR model:



Source :Developed by us from the outputs of EViews 13:

The representation of the inverse of the roots of the characteristic polynomial of the model shows that they are inside the unit circle (less than 1). Hence, the stability of the model is ensured. We validate the model by homoscedasticity tests and autocorrelation of errors.

Painting6:VAR model diagnostic test:

Test	**Objective**	**P-Value**
Arch	Heteroskedasticity	0.65
Coat rack	Autocorrelation	0.56
Jarque Bera	Normality	0.054

Source :Developed by us from the EViews outputs:

Heteroscedasticity means that the variance of errors is not constant, which can affect the reliability of statistical tests and make confidence intervals less precise.

• A p-value of 0.56 is well above the 5% threshold, indicating that we do not reject the null hypothesis of homoscedasticity (i.e., that the variance of the errors is constant).

• This means that the model residuals do not exhibit any significant heteroscedasticity problem, which is a good indicator for the robustness of the model.

• As a result, the estimation results remain reliable and interpretable without requiring specific adjustments to correct for heteroscedasticity.

In this model, the eigenvalues obtained are all less than 1, which means that:

• The VAR is stable and well specified.

• The effects of shocks on variables are transitory and eventually fade away over the long term.

• Simulations and forecasts based on this model are reliable.

The normality test (the Jarque-Bera test) is used to check whether the residuals follow a normal distribution, which is a key assumption in statistical inference of VAR models.

• A p-value of 0.056 is very close to the 5% threshold (0.05), which means that we cannot reject the hypothesis of normality of the residuals at the 5% level, but at the 10% level it could be rejected.

• In practice, this indicates that the residuals are nearly normal, although some distortions may exist.

• A slight deviation from normality is not always a major problem in a VAR model, but if the deviations are large, it may be necessary to apply transformations to the data (such as the logarithmic transformation) or to use robust estimation methods.

Error autocorrelation refers to the correlation between model residuals at different points in time. A good VAR model should have non-autocorrelated residuals to avoid bias in estimates and ensure statistical validity.

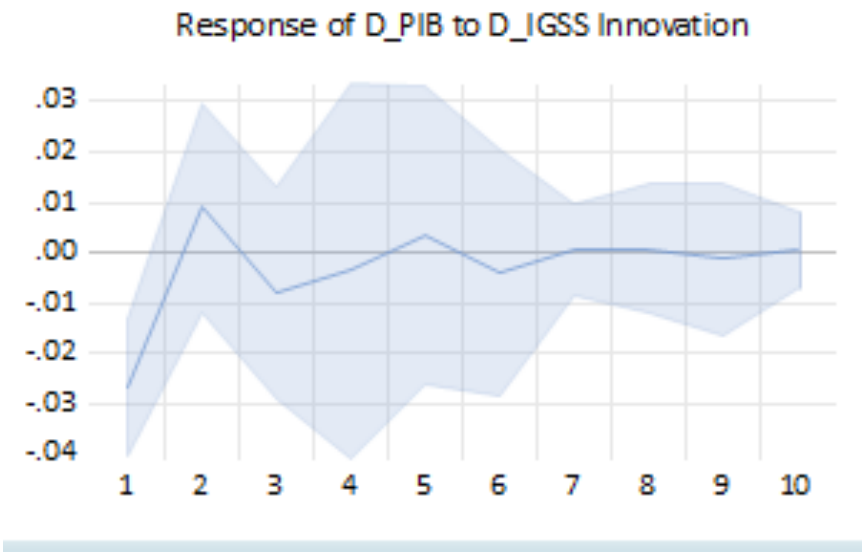
The obtained value of 0.6 represents the p-value associated with the Portmanteau test.

• Since 0.6 is significantly greater than the 5% threshold (0.05), we do not reject the null hypothesis.

• This means that the residuals of the VAR model do not show significant autocorrelation and that the assumption of independence of errors is respected.

• Thus, the model is statistically valid in this aspect, which reinforces the robustness of the estimates and the reliability of the temporal dynamics analyses.

Figure4:The reaction of the GDP following a shock on the IGSS:



Source :Developed by us from the EViews outputs:

From the graph it appears that:

• The horizontal axis represents time periods (from 1 to 10).

• The vertical axis represents the response of D_PIB to a shock from D_IGSS.

• The graph shows the dynamics of the impact over time.

• The initial response (periods 1-2) is slightly negative.

• From period 3, the effect becomes positive and tends to stabilize around 0.00 to 0.01 after a few periods.

Economic interpretation:

• Initial negative impact: a shock on D_IGSS can cause an immediate contraction of D_PIB. This may be due to adjustment effects.

• Positive impact in the medium and long term: after a certain delay, the response of D_PIB becomes positive. This could indicate that the beneficial effects of the shock on D_IGSS take time to materialize, notably via multiplier effects (e.g. public investment (IGSS) stimulating growth).

• Stabilization of the effect: after 6-7 periods, the effect of the shock seems to converge towards a stable value, indicating that its impact is sustainable but limited in time.

Painting7:Decomposition of variance

Period	SE	D_IGSS	D_PIB
1	0.035934	54,89830 (15,3069)	45,10170 (15,3069)
2	0.037531	56,19417 (15,4410)	43,80583 (15,4410)
3	0.038664	57,03274 (16,1727)	42,96726 (16,1727)
4	0.038836	57,39810 (16,3110)	42,60190 (16,3110)
5	0.039003	57,76208 (17,1340)	42,23792 (17,1340)
6	0.039205	58,10678 (17,8389)	41,89322 (17,8389)
7	0.039211	58,10752 (18,2711)	41,89248 (18,2711)
8	0.039218	58,11693 (19,1209)	41,88307 (19,1209)
9	0.039241	58,16366 (19,5558)	41,83634 (19,5558)
10	0.039247	58,17418 (19,8805)	41.82582 (19,8805)

Source :Developed by us from the EViews outputs:

The table shows the decomposition of the variance of D_PIB (variation of GDP) over 10 periods according to the shocks from D_IGSS.

- "Period" column: represents the time horizon (from 1 to 10).
- "SE" column: represents the standard error associated with the estimates.

- Column "D_IGSS": indicates the share of the variance of D_PIB explained by the shocks of D_IGSS (expressed as a percentage).
- Column "D_PIB": shows the share of the variance of D_PIB explained by its own shocks.

In the short term (period 1-3), we notice that:

- The variation in GDP (D_PIB) is mainly explained by its own shocks (45.10% in period 1, 42.96% in period 3).
- The impact of D_IGSS is moderate but increasing (54.89% in period 1, 57.03% in period 3).

In the medium term (periods 4-6), we observe that:

- The influence of D_IGSS on the variance of D_PIB gradually increases (58.10% in period 6), which means that shocks coming from D_IGSS are gaining in importance.
- The share of variance explained by D_PIB decreases slightly (41.89% in period 6).

In the long term (periods 7-10), it appears that:

- The influence of D_IGSS continues to increase (58.17% in period 10), suggesting that its effects are long-lasting and explain a significant portion of the variance in GDP.
- The share of variance explained by D_PIB stabilizes around 41.83%.

Economic interpretation:

- In the short term, GDP fluctuations are mainly influenced by its own internal dynamics, which is classic in economics (e.g. endogenous economic cycles).
- In the medium and long term, shocks on D_IGSS take an increasingly important part, indicating that this variable plays a structuring role in the evolution of GDP.
- D_IGSS represents a public investment factor, this means that these policies have a growing and sustainable impact on economic growth.

Summary of results:

- The variance decomposition shows that D_IGSS plays an increasing and dominant role in the dynamics of D_PIB, especially in the long run.
- The impulse response indicates a delay in adjustment after a shock on D_IGSS, with an initial negative effect followed by a stable positive effect in the medium and long term.

In summary, this econometric analysis confirms the importance of public health policies in GDP dynamics, but also highlights the need for a progressive and well-coordinated approach to maximize their positive effects.

Conclusion

This study analyzes the impact of health system governance on economic growth in Morocco, highlighting the importance of a well-governed health system to stimulate economic development. By adopting an econometric approach based on VAR modeling, the study demonstrated the dynamic relationship between health system governance and Gross Domestic Product (GDP), while taking into account the stationarity of the variables and validating the results through diagnostic tests. The Health System Governance Index (HSGI), constructed by Principal Component Analysis (PCA), was found to be an important determinant of economic growth, particularly in the medium and long term, thus illustrating the crucial role of health in strengthening human capital and stimulating productivity.

The results indicate that in the short run, economic growth is mainly influenced by its own shocks, but that the impact of health system governance becomes dominant in the longer run. Impulse response function analysis highlighted a lagged effect of improved governance on growth, with an initial negative GDP response followed by a positive reversal in the medium run, suggesting that health sector reforms promote sustained economic growth in the long run.

The recommendations from this study highlight the need to adopt a strategic and progressive approach to improve health system governance, focusing on structural reforms such as optimizing public health expenditure, efficient management of health infrastructure and the integration of digital technologies. These actions should help maximize the economic impact of health governance.

However, several limitations should be noted in this study. First, the construction of the IGSS could be improved by integrating more dimensions, such as quality of care and access to health services. In addition, the study is limited to the period 2000-2022, which restricts the analysis of very long-term effects. The use of VAR modeling, although effective for analyzing dynamic relationships, does not allow to precisely explain the causal mechanisms, and more advanced econometric approaches such as structural VAR or the error correction model could refine the results. Finally, some exogenous factors, such as health and macroeconomic crises, were not integrated into the model.

While this study provides relevant insights into the relationship between health system governance and economic growth in Morocco using VAR modeling, it has certain limitations.

First, the VAR approach assumes linear relationships, which may fail to capture complex dynamics or critical thresholds in variable interactions. Second, the quality and availability of Moroccan data (particularly on corruption, public spending efficiency, or healthcare access) may introduce measurement biases, affecting the robustness of the results. Third, the analysis focuses on macroeconomic aggregates, potentially overlooking regional disparities or microeconomic mechanisms (such as the differential impact on low-income households). Finally, although VAR can identify short-term correlations and causalities, isolating the pure effect of governance reforms remains challenging due to external factors (political shocks, pandemics). These limitations call for further research combining mixed methods (qualitative studies, microsimulations) to refine policy recommendations.

To further explore these results, several avenues of research are suggested. It would be relevant to refine the construction of the IGSS by adding new dimensions, to test other econometric methods to more precisely identify causal relationships, and to extend the analysis to other countries to observe the impact of health governance in different contexts. The study of sectoral effects could also enrich the understanding of the impact of health reforms on the productivity of key sectors of the economy, such as industry, agriculture, and services.

In conclusion, this study highlights the significant contribution of health system governance to long-term economic growth, underlining the importance of deep and sustainable reforms in the health sector. However, further research is needed to better understand the underlying mechanisms and to integrate new dimensions of analysis to deepen the understanding of these complex interactions.

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